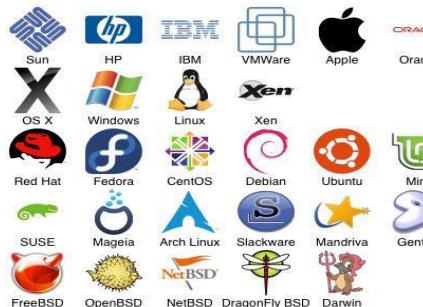
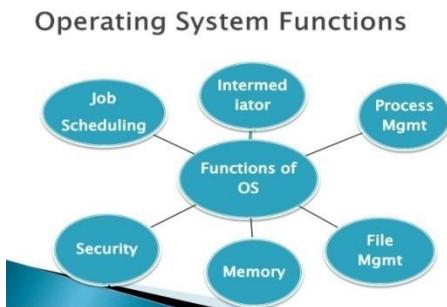
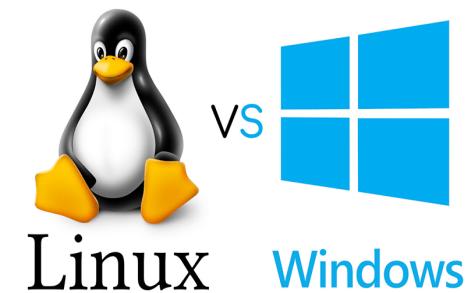
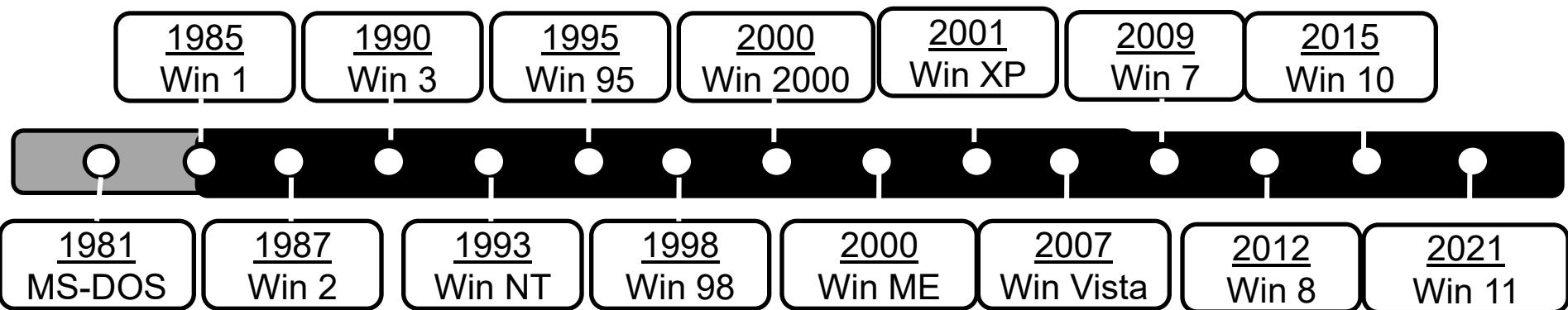


Week3Day1 : Windows Operating Systems: Windows Client OS Enhancements with Windows 11, Windows 11 Architecture, System Components, Server 2022 Features, Licensing, Server Roles



Timeline of Windows



- Microsoft Disk Operating System
- Command-line interface (CLI)

August
1981

Microsoft bought an existing operating system from Seattle Computer Products (86-DOS), for \$75,000 in 1981.

```
Loading CPM.SYS...
CP/M-86 for the IBM PC/XT/AT, Vers. 1.1 (Patched)
Copyright (C) 1983, Digital Research

Hardware Supported :

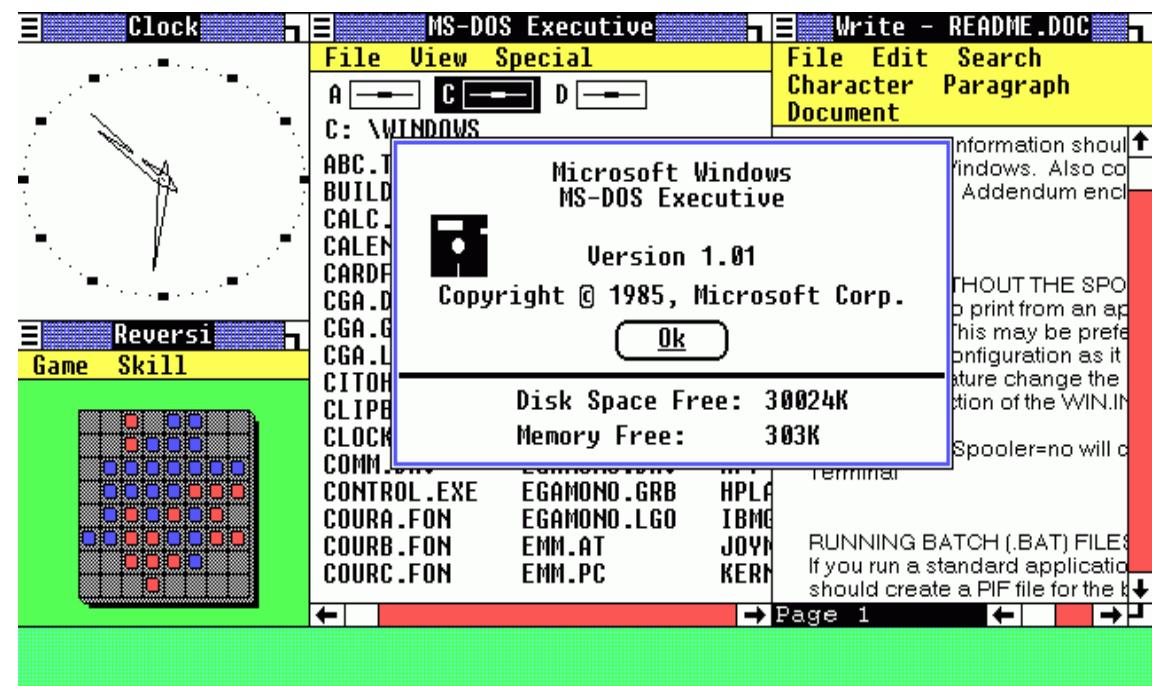
Diskette Drive(s) : 3
Hard Disk Drive(s) : 1
Parallel Printer(s) : 1
Serial Port(s) : 1
Memory (Kb) : 640

D>a:
A>dir
A: PIP      CMD : STAT      CMD : SUBMIT    CMD : ASM86     CMD
A: GENCMD   CMD : DDT86    CMD : TOD       CMD : ED        CMD
A: HELP     CMD : HELP     HLP : SYS       CMD : ASSIGN    CMD
A: FORMAT   CMD : CLDIR    CMD : WRTLDR    CMD : BOOTPCDS  SYS
A: BOOTWIN  SYS : CPM      HB6 : WINSTALL  SUB : PD        CMD
A: WCPM     SYS : DISKUTIL CMD
A>_
User 0          0:00:11           Jan. 1, 2000
```

- 16-bit multi-tasking shell on top of an existing MS-DOS installation
- Limited multi-tasking

20th
November
1985

The development of
Windows began after
Bill Gates saw a
demonstration of
VisiCorp's Visi On.

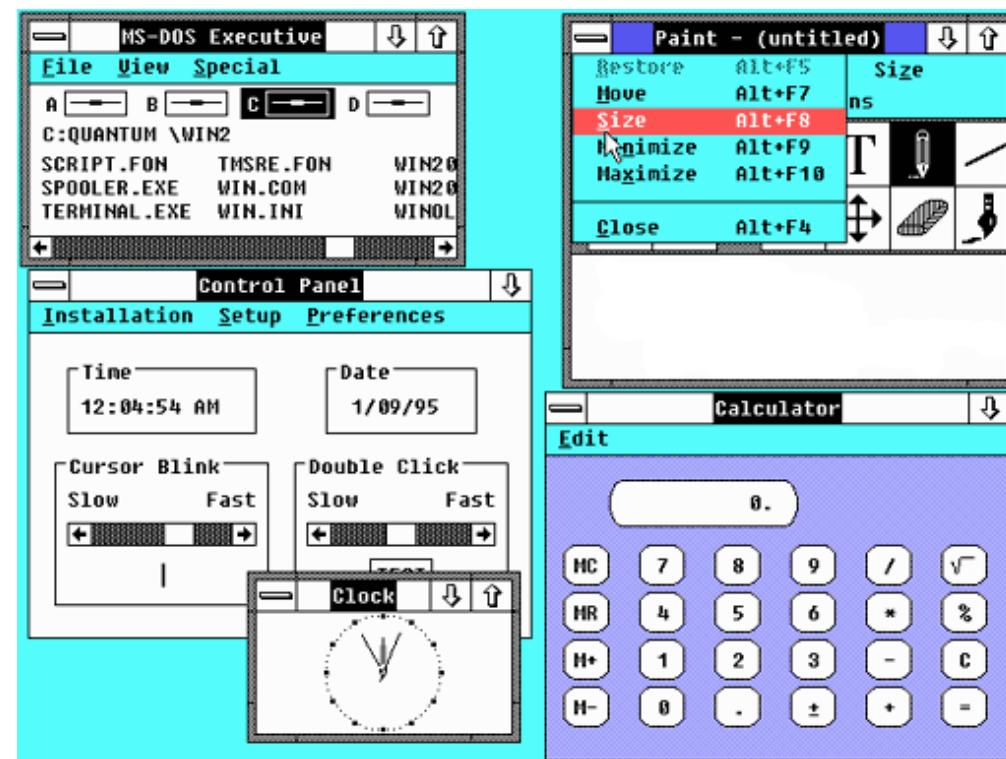


- Allows application windows to overlap
- First version to integrate the control panel

**On March 17, 1988,
Apple filed a lawsuit
against Microsoft and
HP, accusing them of
copying the
Macintosh System.**

Apple lost.

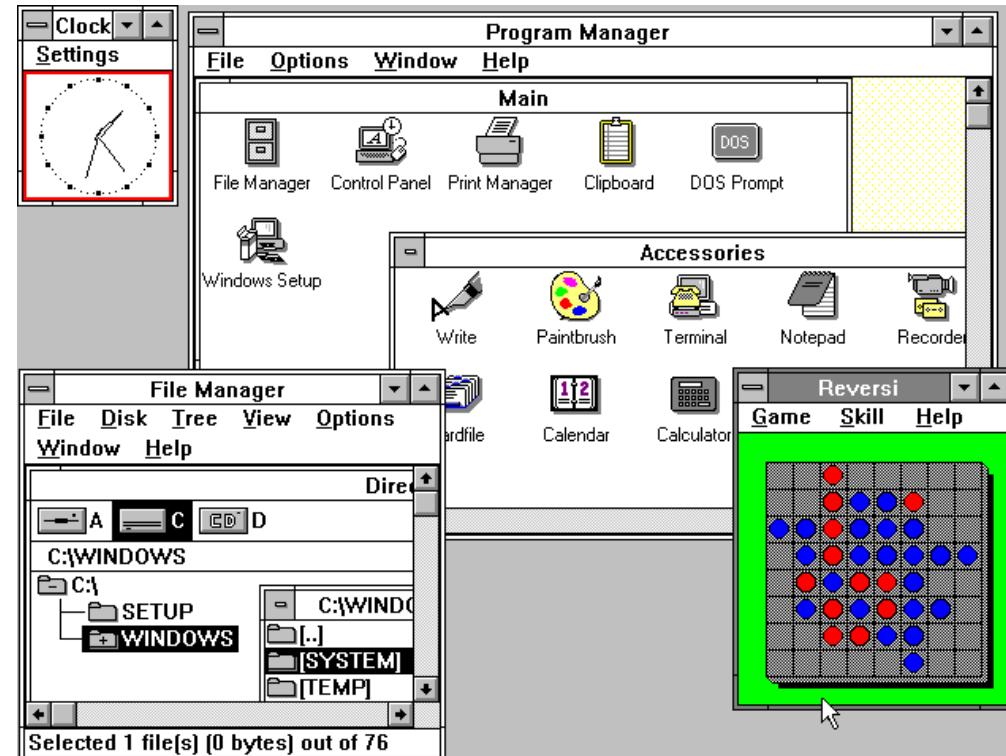
9th
December
1987



- Protected/Enhanced mode to run Windows applications with reduced memory issues
- Better memory management

22nd
May
1990

Developed based on
work by David Weise
and Murray Sargent in
1989.

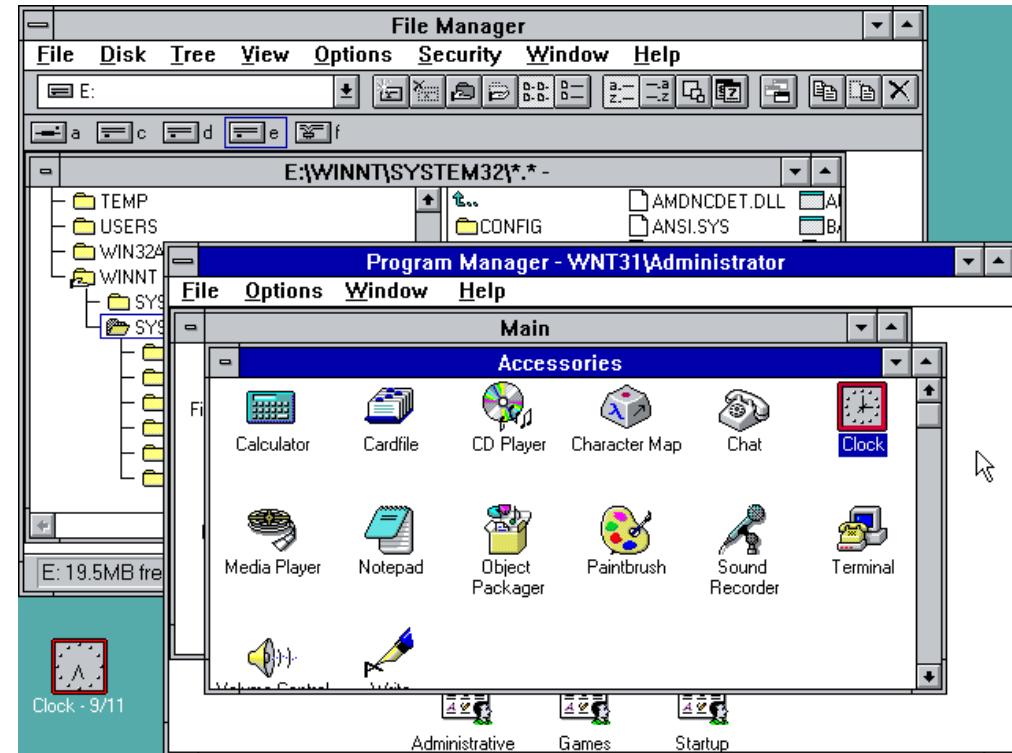


- Portability to multiple processor architectures, as well as higher security and stability
- Designed from scratch (“Unix killer”)

27th
July
1993

Bill Gates hired David Cutler from DEC to design Windows NT.

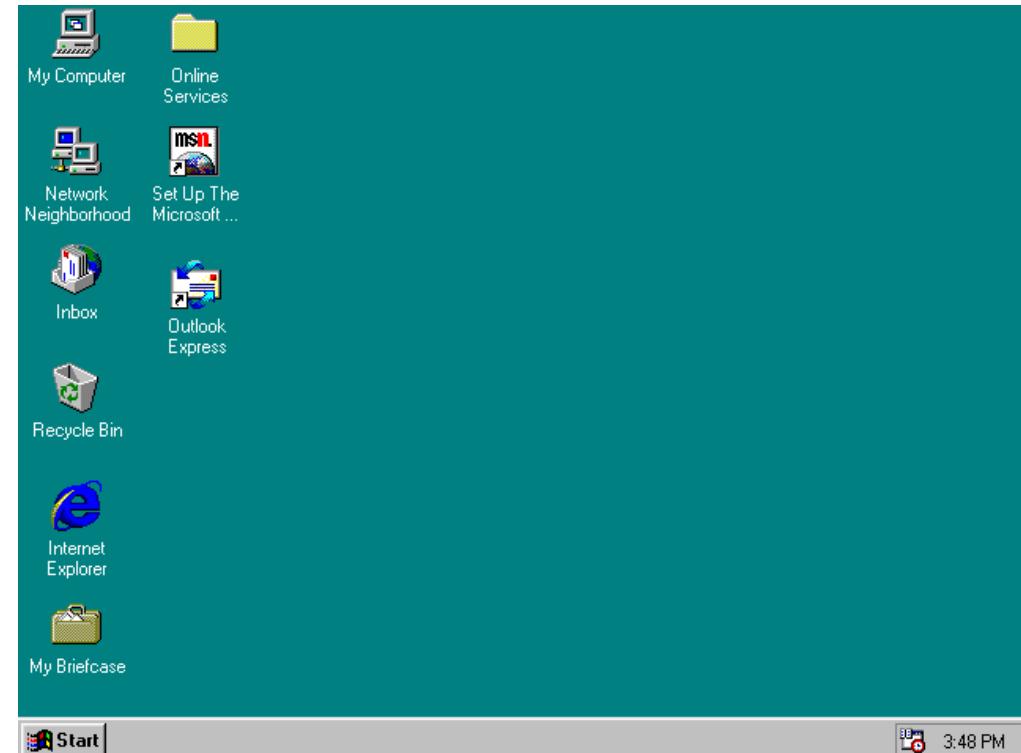
(WNT = VMS)



- Introduced the taskbar, the 'Start' button, and the way the user navigates
- Moved to multitasked 32-bit architecture

24th
August
1995

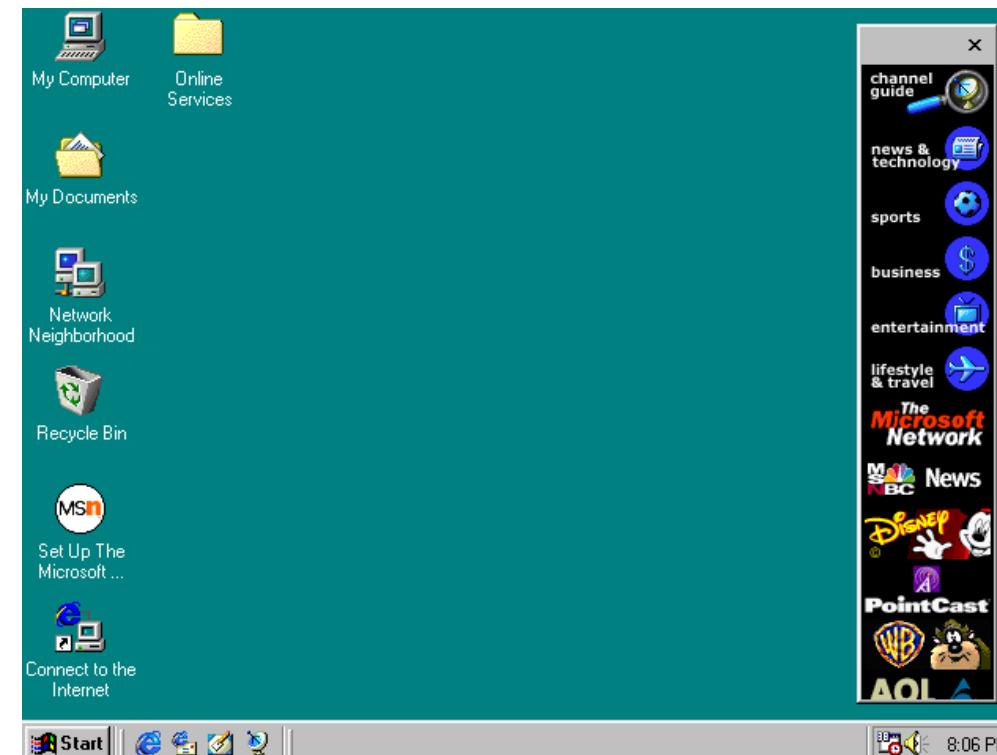
Windows 95 included support for 255-character mixed-case long filenames.



- Improved power management, network management, and USB support
- Added *Standby* and *Hibernate* modes

25th
June
1998

Introduced the
*Windows Driver
Model (WDM)* to
manage device
drivers.



- Added NTFS (New Technology File System) 3.0, the Microsoft Management Console (MMC), and the Encrypting File System (EFS)
- Also Active Directory

17th
February
2000

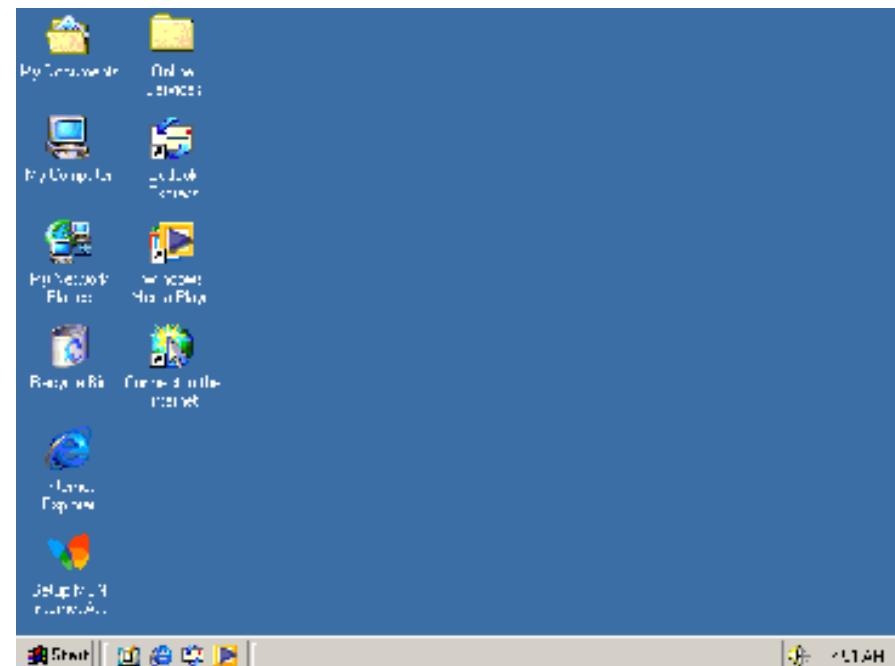
A number of new assistive technologies to support for people with disabilities were introduced.



- Introduced a *System Restore* feature, and improved digital media and networking tools
- Restricted access to real mode MS-DOS

14th
September
2000

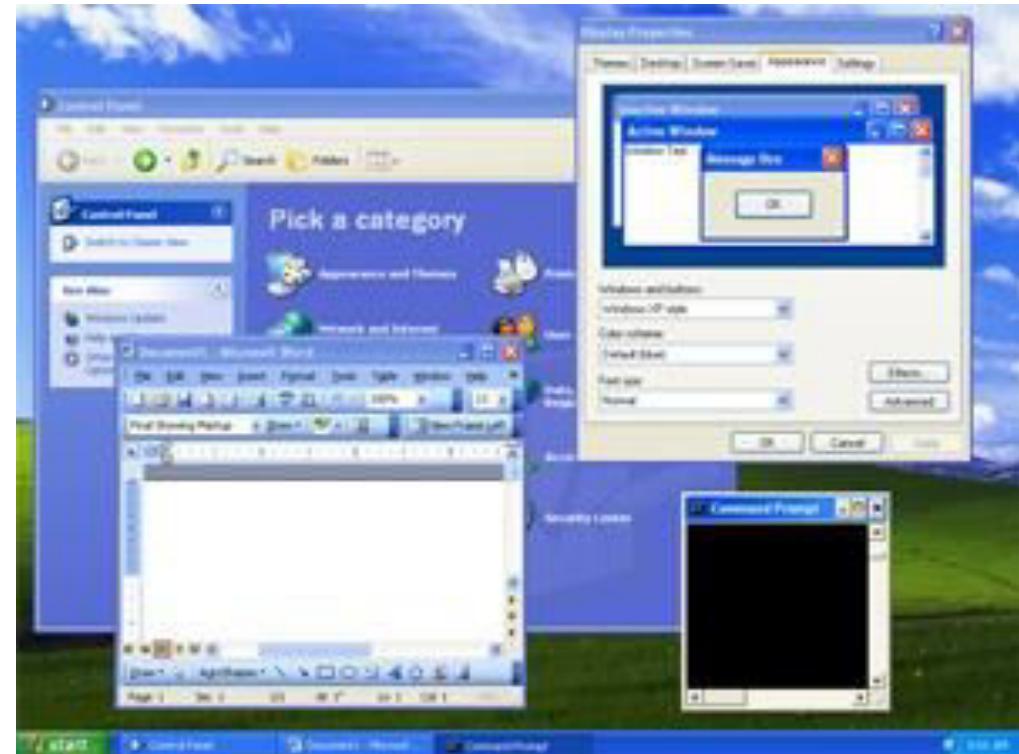
Criticized for speed and stability issues, a *PC World* article dubbed Windows ME the "Mistake Edition" (Very short shelf-life)



- Improved taskbar and ‘Start’ menu, better networking features
- Newly improved user interface

25th
October
2001

The first version of Windows to use product activation in an effort to reduce software piracy.

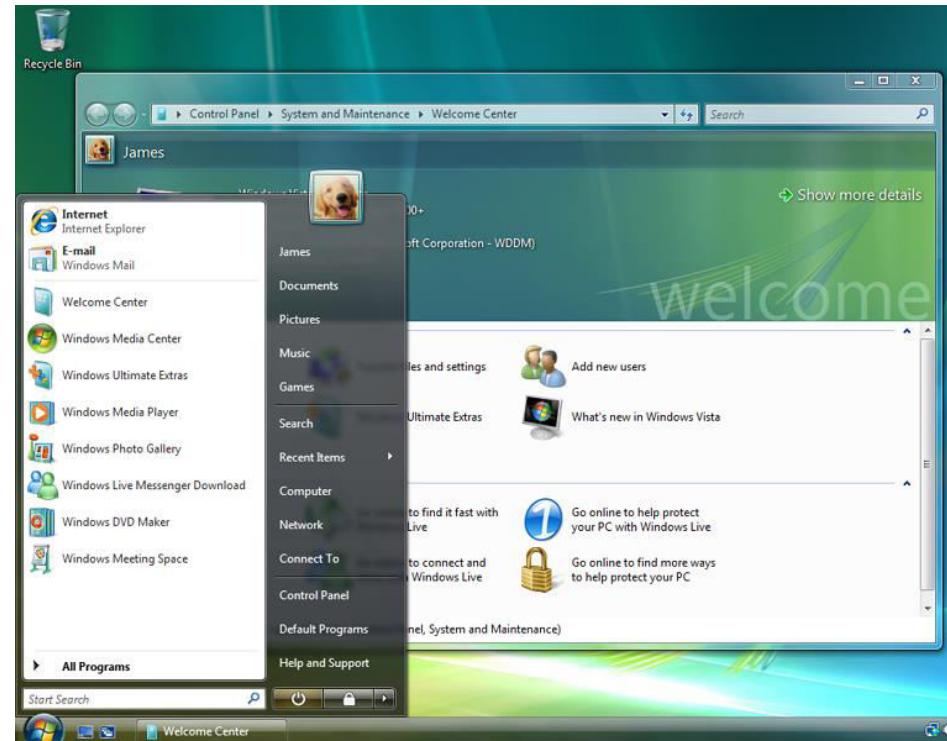


- Introduced Windows Search, Windows Aero, Windows Sidebar, Shadow Copy
- Integrated Speech Recognition

30th
January
2007

Criticisms of Vista

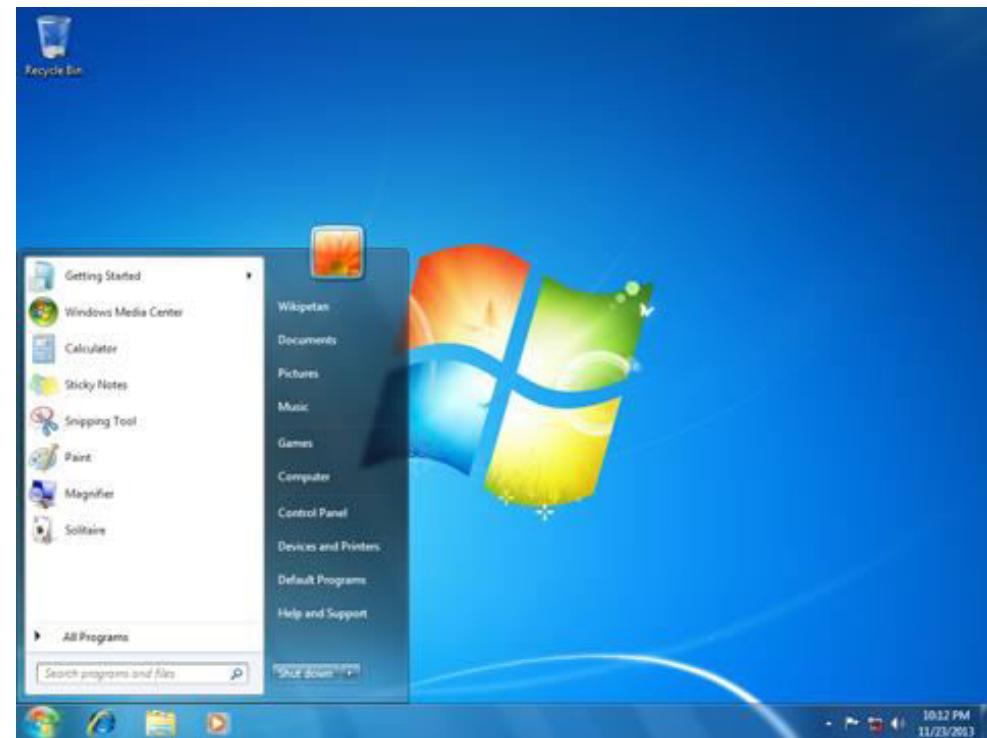
- high system requirements
- more restrictive licensing
- new digital rights management
- lack of compatibility with some pre-Vista hardware and software



- Support for virtual hard disks, better multi-core processors performance, and kernel
- Improved touch and handwriting recognition

22nd
October
2009

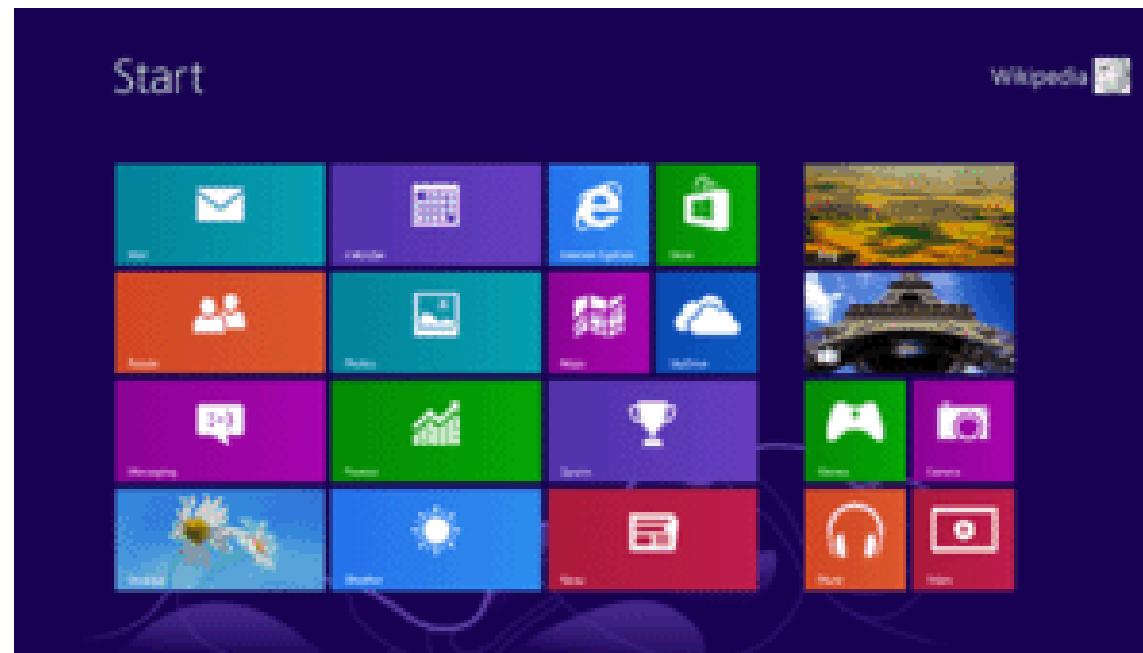
Intended to address criticisms faced by Windows Vista, such as performance improvements



- Heavier integration with online services from Microsoft and others (Skydrive, Xbox)
- Faster startup through UEFI integration

26th
October
2012

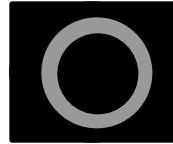
User interface focused on tablets users, including a touch-optimized shell using the "Metro" design language, and a new 'Start' screen (No 'Start button)



- Return of 'Start' button, a virtual desktop system, integration with Windows Phone
- Device dependent interface

29th
July
2015

Incorporates Microsoft's
intelligent personal
assistant Cortana



- 32- and 64-bit preemptive multitasking operating system for Intel microprocessors
- Key goals for the system:
 - portability
 - security
 - POSIX compliance
 - multiprocessor support
 - extensibility
 - international support
 - compatibility with MS-DOS and MS-Windows applications
- Uses a micro-kernel architecture
- Several versions with different prices, for devices/laptops/desktops and servers
- Win 10 has an app store, Windows Desktop Bridge to run older binaries, replacing the old multiple subsystem concept, Hyper-V virtualization, multiuser, distributed services, remote GUI, and other advanced features

Windows 11

- Windows 11 features major changes to the Windows shell influenced by the canceled Windows 10X, including a redesigned Start menu,
- The replacement of its "live tiles" with a separate "Widgets" panel on the taskbar.

October
2021



Windows 11



- Microsoft only officially supports the operating system on devices using an eighth-generation Intel Core CPU or newer (with some minor exceptions), a second-generation AMD Ryzen CPU or newer, or a Qualcomm Snapdragon 850 ARM system-on-chip or newer, with UEFI secure boot and Trusted Platform Module (TPM) 2.0 supported and enabled (although Microsoft may provide exceptions to the TPM 2.0 requirement for OEMs).
- While the OS can be installed on unsupported processors, Microsoft does not guarantee the availability of updates.
- *Windows 11 removed support for 32-bit x86 CPUs and devices that use BIOS firmware.*

Windows 10 vs 11

Feature	Windows 10	Windows 11
New interface Windows 11 is easier on the eyes and easier to use. We took the best elements of Windows 10 and refined them to create a soothing place to work and play.	Not available	□ Available
Wake on approach. Lock on leave. Windows 11 can automatically wake up when you approach and lock when you leave. ³	Not available	□ Available
Smart App Control Exclusive to Windows 11 is Smart App Control. It provides a layer of security by only permitting apps with good reputations to be installed. Only available on the latest version of Windows 11. ⁴	Not available	□ Available
Seamless redocking If you connect your PC to an external display, Windows 11 can remember where you had those windows when you leave, come back, and reconnect. ⁵ This feature is new and exclusive to Windows 11.	Not available	□ Available
Live captions With live captions on Windows 11, speech in incoming audio (such as through a Microsoft Teams call) can be transcribed into captions. ⁶	Not available	□ Available
Natural Narrator To read, or to be read to? Natural Narrator can turn text into spoken words. ⁷	Not available	□ Available

Windows 10 vs 11

Feature	Windows 10	Windows 11
Amazon Appstore Windows 11 can run more choices of apps available from the Amazon Appstore—some of them even originally designed for mobile devices. ¹⁰	Not available	<input type="checkbox"/> Available
Windows Studio Effects Background Blur, Eye Contact, Voice Focus, and Automatic Framing. Better video calling awaits. ¹⁴	Not available	<input type="checkbox"/> Available
Controller bar Jump back into the game you last played or into a new game entirely with the Controller bar. ¹⁹ Only on Windows 11.	Not available	<input type="checkbox"/> Available
Auto HDR Auto HDR increases the range of colors both new and old games can produce. Available only on Windows 11, this new calibration app increases control of color. ¹⁵	Not available	<input type="checkbox"/> Available
Widgets Widgets are new for Windows 11. It's best for staying up to date with all the things you need to keep tabs on: schedules, weather, stocks, sports—even celebrity gossip.	Not available	<input type="checkbox"/> Available
Touchscreen While Windows 10 worked well with touch inputs ¹ , Windows 11 has been designed with them in mind for a true mouse-less or keyboard-less experience.	<input type="checkbox"/> Available	<input type="checkbox"/> Available
Search You can find the Search bar in the Start Menu of Windows 11, and it can find whatever you can't. That's files, apps, or anything you want online. On Windows 11 the Search bar is in a new, easy to find, central location.	<input type="checkbox"/> Available	<input type="checkbox"/> Available

Windows 10 vs 11

Feature	Windows 10	<u>Windows 11</u>
TPM 2.0 A Trusted Platform Module (TPM) helps prevent unwanted tampering. Windows 11 requires TPM 2.0, which provides next-gen security and privacy for you, your apps, and your system's hardware. ²¹	<input type="checkbox"/> Available	<input type="checkbox"/> Available
Microsoft Edge Microsoft Edge is optimized for Windows 11. The browser and OS will work together to bring you the browsing speed and security you need.	<input type="checkbox"/> Available	<input type="checkbox"/> Available
OneDrive backup OneDrive backup is available on both Windows 11 and 10, providing your photos, documents, and other files a second life if, for example, your PC is stolen.	<input type="checkbox"/> Available	<input type="checkbox"/> Available
Windows Security app The Windows Security app serves as the security dashboard and is available on both Windows 10 and Windows 11.	<input type="checkbox"/> Available	<input type="checkbox"/> Available
Snap assist Snap assist makes the most of your screen space by arranging your open windows into perfectly aligned grids. ⁵ And on Windows 11, it's now easier to find and use.	<input type="checkbox"/> Available	<input type="checkbox"/> Available

Client operating systems

Windows 11 is the latest version of Microsoft's client operating system, replacing Windows 10.

There are several editions of Windows 11. Businesses would normally use either **Windows 11 Pro** or **Windows 11 Enterprise**.

Windows 11 Pro is licensed by device. This means that a license must be acquired for each device on or from which the software is used or accessed (locally or remotely over a network).

Windows 11 Enterprise may be licensed by device or user. See the Windows 11 handout in this series for further details on user licensing.



Windows 11

- **Taskbar.**
 - For many people, the biggest difference in Windows 11 is the taskbar. All the icons are now *centered* on the taskbar, instead of lined up from left to right. No longer living in the lower-left corner of the screen, the Start button is now the leftmost icon on the centered taskbar.
- **Start menu.**
 - The Start menu no longer includes live *tiles*: square icons that served as constantly updating marques to display the current news, weather, mail, and other information. Instead, the Start menu shows three rows of icons along its top half, with icons for frequently used apps on the bottom half.
- **Widgets:**
 - To make up for the Start menu's lack of live tiles, Microsoft took the concept and created the Widgets panel: A strip of tiles that update to show the latest news, traffic information, your newest photos, and other information.

The biggest changes that come with Windows 11

- **Teams Chat:**
 - In an effort to cash in on the Zoom video chatting craze from the pandemic, Microsoft built a video chat program into Windows 11. Called *Teams Chat*, it lets you hold video chats and exchange messages with friends, family, and coworkers.
- **Updates:**
 - Microsoft treated Windows 10 as an ongoing service, and it released two big updates to Windows 10 each year. That relentless pace slows with Windows 11, thankfully. Microsoft pledges to update Windows 11 only once a year.
- **Apps:**
 - Microsoft updates some of Windows 11's apps on a daily or weekly basis, adding new features, removing unpopular ones, and fixing problems. The updates arrive automatically through the Microsoft Store app.

- **Stringent hardware requirements:**
 - In a huge break from the past, Windows 11 requires a powerful PC built within the past two or so years. Chances are you won't be able to upgrade your old Windows 10 PC, and certainly not your Windows 7 or Windows 8 PC.
- **Cortana.**
 - Once baked directly into the Windows 10 Start menu and taskbar, Microsoft has completely detached Cortana from Windows 11. If you don't like Cortana, this will be welcome news. If you miss the ol' sport, click the Start button, type "cortana," and the digital assistant will rise to do your bidding.
- **No Tablet mode.**
 - Windows 11 no longer includes a Tablet mode, which made Windows behave differently on touchscreens. Instead, Windows 11 looks and behaves the same on both desktop PCs, laptops, and tablets.

- **Security -**
 - Access control lists (ACLs) – both attribute-based and claim-based
 - Rudimentary capabilities functionally called integrity levels
 - File system and communication encryption
 - Several digital signature facilities
 - Device Guard option for fine grain control over what signers code is allowed on the system

- Extensibility — layered architecture
 - Remote procedure calls (RPCs)
 - Advanced local procedure calls (ALPCs)
- Portability — Windows 10 can be moved from one hardware architecture to another with relatively few changes
 - Written in C and C++
 - Processor-specific portions are written in assembly language for a given processor architecture (small amount of such code).
 - Platform-dependent code is isolated in a dynamic link library (DLL) called the “hardware abstraction layer” (HAL)

Design Principles (Cont.)

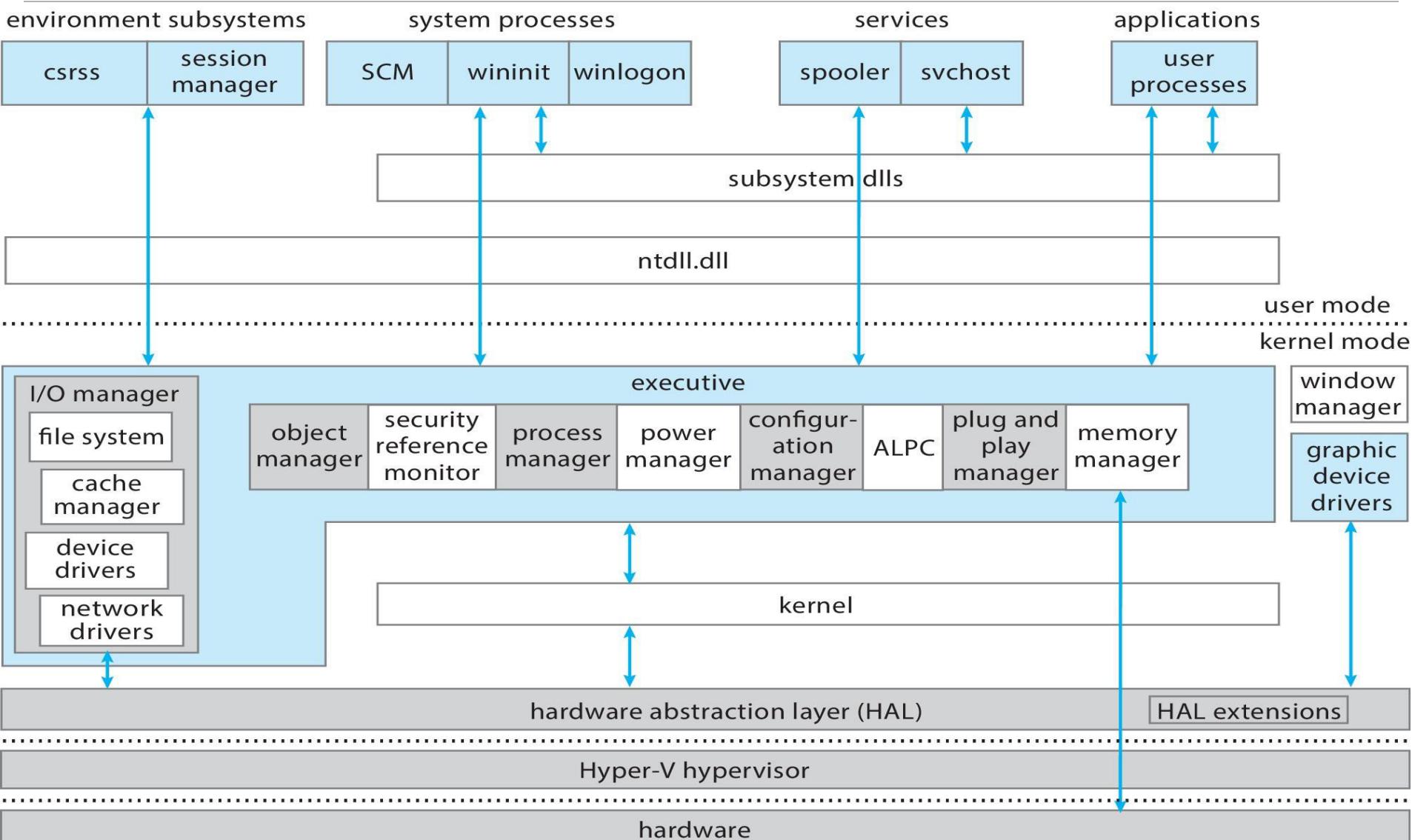
- Reliability — Windows 10 uses hardware protection for virtual memory, and software protection mechanisms for operating system resources
- Compatibility — applications that follow the IEEE 1003.1 (POSIX) standard can be complied to run on 10 without changing the source code
- Performance — Windows 10 subsystems can communicate with one another via high-performance message passing
 - Preemption of low priority threads enables the system to respond quickly to external events
 - Designed for symmetrical multiprocessing
- International support — supports different locales via the national language support (NLS) API
- Energy efficiency – for portable devices, etc, includes dynamic tick feature, process lifetime management, desktop activity monitor, connected standby

Windows 11 Hardware Requirements

- To install or upgrade to Windows 11, devices must meet the following minimum hardware requirements:
- Processor: 1 gigahertz (GHz) or faster with two or more cores on a compatible 64-bit processor or system on a chip (SoC).
- RAM: 4 gigabytes (GB) or greater.
- Storage: 64 GB* or greater available storage is required to install Windows 11.
 - Extra storage space might be required to download updates and enable specific features.
- Graphics card: Compatible with DirectX 12 or later, with a WDDM 2.0 driver.
- System firmware: UEFI, Secure Boot capable.
- TPM: Trusted Platform Module (TPM) version 2.0.
- Display: High definition (720p) display, 9" or greater monitor, 8 bits per color channel.
- Internet connection: Internet connectivity is necessary to perform updates, and to download and use some features.
 - Windows 11 Home edition requires an Internet connection and a Microsoft Account to complete device setup on first use.

- Layered system of module
- Protected mode — hardware abstraction layer (HAL), kernel, executive
- User mode — collection of subsystems
 - Environmental subsystems emulate different operating systems
 - Protection subsystems provide security functions

Depiction of 11 Architecture

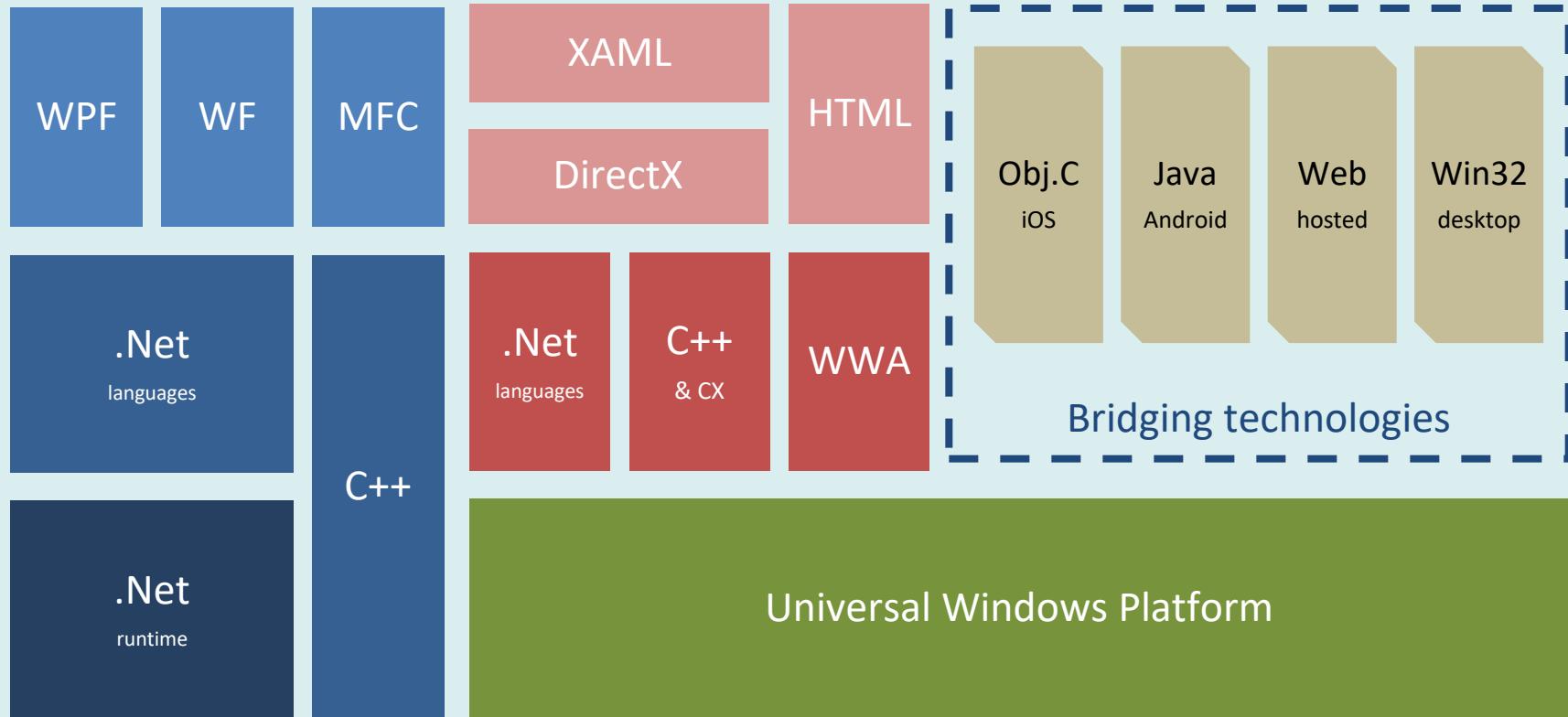


System Components

- Layered system of modules operating at specific privilege layers
- Kernel and user mode of course
- Virtual Trust Levels (VTLs) option implemented by Hyper-V virtualization
 - Enables virtual secure mode
 - Normal World (VTL 0) and Secure World (VTL 1)
 - Within each world are user and kernel modes
 - Secure world has a secure kernel and executive and a collection of trustlets
 - Bottommost layer runs in special processor mode (VMX Root Mode on Intel) including Hyper-V hypervisor, creating hardware-based normal-to-secure-world boundary

System Components — Kernel

- Foundation for the executive and the subsystems
- Never paged out of memory; execution is never preempted
- Four main responsibilities:
 - thread scheduling
 - interrupt and exception handling
 - low-level processor synchronization
 - recovery after a power failure
- Kernel is object-oriented, uses two sets of objects
 - *dispatcher objects* control dispatching and synchronization (events, mutants, mutexes, semaphores, threads and timers)
 - *control objects* (asynchronous procedure calls, interrupts, power notify, power status, process and profile objects)
- VSM (Virtual Secure Mode) Enclaves allow valid signed third-party code to perform crypto calculations



Windows 10/11
operating system

Windows Server Comparison

Use cases	Key features	WS 2019 Standard	WS 2019 Datacenter	WS 2022 Standard	WS 2022 Datacenter	2021 new feature
Hybrid	Storage Migration Service	○	○	○	○	○
	Hotpatch	-	-	-	-	○
	Extended network	-	-	-	-	○
	SMB over QUIC	-	-	-	-	○
Security all-up	Secured-core solutions	-	-	○	○	○
	System Guard for data corruption attacks	-	-	○	○	○
	Trusted Platform Module (TPM) 2.0	○	○	○	○	○
	Secure DNS client over HTTPS (DoH)	-	-	○	○	○
	Secured data at rest and in transit (AES-256 Encryption)	-	-	○	○	○
	Support for TLS 1.3	-	-	○	○	○
Physical machine	Increased memory support (5-level paging support for larger memory servers)	-	-	○	○	-
Virtualization server	Virtualization rights	2 VMs	unlimited	2 VMs	unlimited	○
	Software-defined storage and networking	-	○	-	○	○
	Storage Spaces Direct	-	○	-	○	○
	Storage Replica	-	○	-	○	○
	In-place upgrades from WS 2012 to WS 2022	-	-	○	○	○
Containers	Containers rights	unlimited	unlimited	unlimited	unlimited	○
	Hyper-V containers	limited	○	limited	○	○
	Faster and small images	○	○	○	○	○

Comparison Server 2016/2019/2022

Feature and description	Windows Server 2016	Windows Server 2019	Windows Server 2022
Secured-core server Overview. Secured-core server brings together powerful threat protections for multi-layer security across hardware, firmware, and the operating system. It uses the Trusted Platform Module 2.0 and Windows Defender System Guard to launch Windows Server securely and minimize risk from firmware vulnerabilities. Secured-core server helps secure the foundation of virtualization-based security (VBS) features in the list that follows.			
Hypervisor-protected code integrity (HVCI). Now enabled by default, HVCI is part of Secured-core server and applies hardware-rooted security to prevent advanced malware from tampering with the system.			
Credential Guard. Part of Secured-core server, this feature can be enabled as an option to provide preventative defense for sensitive assets like credentials.			
Secured connectivity Overview. Secured connectivity adds an additional layer of security during transport for advanced protection and includes improvements to hypertext transfer protocol secure (HTTPS), transport layer security (TLS), and SMB Encryption.			
Hypertext transfer protocol secure (HTTPS). HTTP over QUIC (HTTP/3) enables faster and more secure HTTPS connections.			
Transport Layer Security (TLS). Part of secured connectivity, TLS 1.3 is the latest version of the internet's most deployed security protocol and encrypts data to provide a secure communication channel between two endpoints, when used with Windows Server 2022.			

Comparison Server 2016/2019/2022

Feature and description	Windows Server 2016	Windows Server 2019	Windows Server 2022
<p>Server Message Block (SMB) security enhancements. Previously, enabling SMB Encryption on SMB Direct RDMA networks disabled direct data placement and slowed performance; now data is encrypted before placement, reducing performance degradation when using RDMA while adding AES-128 and AES-256 protected packet privacy. Additional improvements include accelerated SMB signing performance with AES-128-GMAC, SMB encryption support for top secret class networks via AES-256-GCM and AES-256-CCM cryptographic suites, and configurable SMB Encryption and signing for internal cluster communications that works alongside existing client-server encryption.</p>			
<p>SMB over QUIC allows on-premises, mobile, and telecommuter users access to file servers at the edge in Azure and on corporate networks—without a VPN. The server certificate creates a TLS 1.3-encrypted tunnel over the internet-friendly UDP port 443 instead of TCP/445 to avoid exposing SMB traffic to the network.</p>			
<p>DNS over HTTPS (DoH) client. Enables the DNS client to protect its domain-name lookups from interference and observation.</p>			

Comparison Server 2016/2019/2022

Feature and description	Windows Server 2016	Windows Server 2019	Windows Server 2022
Other key security features			
Windows Defender Application Control (WDAC) or code integrity. Helps ensure only authorized executables run on the server. Major improvements in WDAC include support for multiple base policies, supplemental policies, and path-based rules.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advanced Threat Protection (ATP). Windows Defender ATP Exploit Guard is a new set of host intrusion prevention capabilities, such as preventative protection, attack detection, and zero-day exploits.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cluster hardening. New clusters running Windows Server will not require NT LAN Manager (NTLM) authentication, which completely removes the requirement of Active Directory for clusters in Windows Server.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SDN encrypted subnet. Virtual network encryption provides the ability for the virtual network traffic to be encrypted between virtual machines that communicate with each other within subnets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Just Enough Administration. Limits administrative privileges to the bare minimum required set of actions (limited in space).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Just-in-Time Administration. Provides privileged access through a workflow that is audited and limited in time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comparison Server 2016/2019/2022

Feature and description	Windows Server 2016	Windows Server 2019	Windows Server 2022
Control Flow Guard. Helps protect against classes of memory corruption attacks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Remote Credential Guard. Works in conjunction with credential guard for Remote Desktop Protocol (RDP) sessions to deliver single sign-on (SSO), eliminating the need to pass credentials to the RDP host.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dynamic Access Control. Enables administrators to apply access-control permissions and restrictions based on well-defined rules.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BitLocker. Uses a hardware or virtual Trusted Platform Module (TPM) chip to provide disk encryption for data and system volumes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comparison Server 2016/2019/2022

Feature and description	Windows Server 2016	Windows Server 2019	Windows Server 2022
<p>Azure Arc. Enables customers to manage, secure, and govern Windows Server on-premises, at the edge, or in multi-cloud environments from a single control plane in Azure. Brings in Azure management capabilities such as Azure Policy, Azure Monitor, and Azure Defender for those servers.</p>			
<p>SMB Compression. SMB compression allows an administrator, user, or application to request on-the-fly compression of files as they transfer over the network. Compressed files will consume less network bandwidth and take less time to transfer.</p>			
<p>Storage Migration Service (SMS). Helps inventory and migrate data, security, and configurations from legacy systems to Windows Server or a cloud virtual machine. Starting with Windows Server 2022, customers can integrate SMS with Azure File Sync and migrate to low-latency private cloud servers or the bottomless cloud storage in Azure while reducing on-premises storage footprint. SMS migrates file servers from Windows Server, Windows clusters, Samba, and starting in Windows Server 2022—NetApp FAS arrays.</p>			

Per Core and CAL licensing

Purchase Core licenses for each physical core in the server with a minimum of 8 Core licenses per processor and 16 Core licenses per server, and then purchase Windows Server 2022 Client Access Licenses (CALs) for either users or devices. A Client Access License (CAL) allows the client to access the services of any licensed server.

A Device CAL is assigned to the device and allows multiple users to use that device



A User CAL is assigned to the user and allows that user to use multiple devices

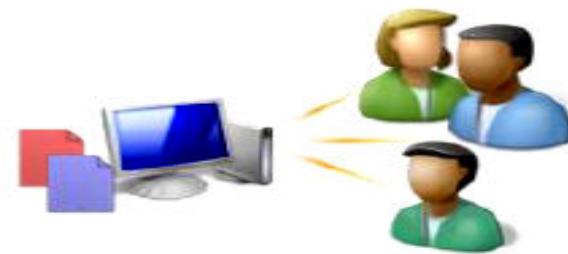
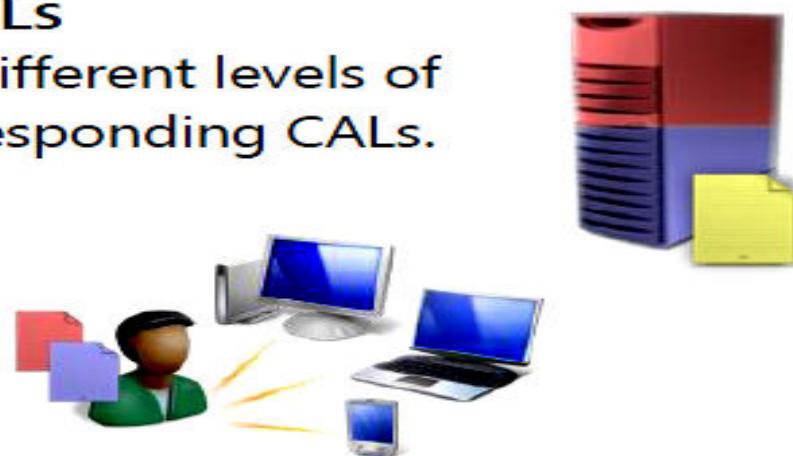
Standard and Enterprise CALs

Some server applications offer different levels of functionality, and there are corresponding CALs.

The core functionality
(depicted by the blue shading)
is linked to a Standard CAL
(depicted by the blue license)
assigned to a user or device.

If the extended functionality
(depicted by the red shading) is
utilized, then the purchase of an
Enterprise CAL is required
(depicted by the red license)
in addition to the Standard CAL.

Note that Skype for Business Server 2019 also has a Plus CAL available which must be purchased in addition to the Standard CAL.



Virtualized Server Solution

Licensing virtualized server solutions

IT professionals often implement virtualized server solutions to ease management and to reduce hardware costs. Windows Server 2022 Standard and Windows Server 2022 Datacenter include Hyper-V to allow server virtualization. Note that virtualizing is not a way of reducing licenses purchased, and different versions and different editions of different products may have different virtualization rights. For example:

Windows Server 2022 Standard

When licensing a server completely with Windows Server 2022 Standard Core licenses, 2 virtual machines are allowed



Windows Server 2022 Datacenter

When licensing a server completely with Windows Server 2022 Datacenter Core licenses, unlimited virtual machines are allowed



Microsoft Skype for Business Server 2019

In conjunction with the client application Skype for Business, Skype for Business Server provides: secure instant messaging; integrated presence; audio, video and web conferencing; and enterprise voice capabilities.

Skype for Business Server 2019 is licensed through the Server and CAL licensing model (see above right). Standard, Enterprise and Plus CALs are available depending on the functionality required by the users.



Skype for Business

Microsoft System Center

Microsoft® System Center is a comprehensive management platform that enables IT Professionals to more easily and efficiently manage IT environments, including the server infrastructure and client devices.



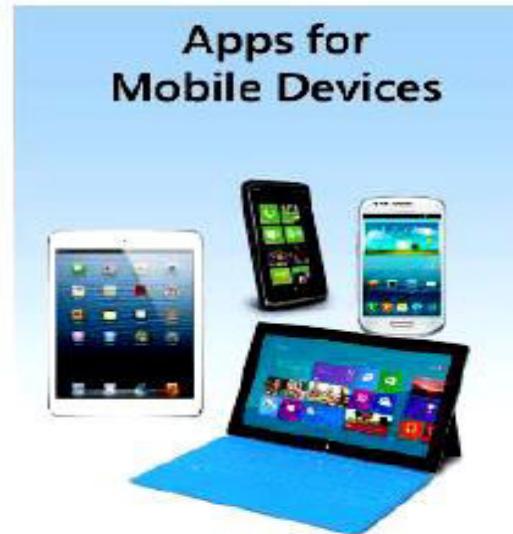
System Center 2019 is licensed by purchasing a Management License (ML) for each endpoint being managed. Managed clients need **Client MLs** and managed servers need **Server MLs**. Server MLs are licensed with the Per Core model: assign one Core ML for each physical core, with a minimum of 8 Core MLs per processor and 16 Core MLs per server.

SQL Server 2019 is a relational database including services such as Microsoft® SQL Server® Analysis Services for analysis and Microsoft® SQL Server® Reporting Services for reporting. SQL Server is at the heart of Microsoft's Business Intelligence solution and is required in solutions containing Microsoft SharePoint Server, Microsoft Skype for Business Server and the Microsoft System Center products.

Some editions of SQL Server 2019 are licensed through the Server and CAL licensing model and some editions are licensed through a model which counts processor cores. See the SQL Server handout in this series for further details on licensing SQL Server 2019.



There are a variety of ways for users to access their mailbox:



Exchange Server

Exchange Server 2019 is licensed through the Server and CAL licensing model (see right). Standard and Enterprise CALs are available depending on the functionality required by the users.

- **Datacenter:** Ideal for companies of all sizes that have demanding IT workloads, require advanced storage, virtualization, and application deployment
- **Standard:** For businesses that need advanced features, support for distributed office locations, and require a flexible way to virtualize their environment
- **Essentials:** For small companies with basic IT needs purchasing a first server; likely small or no dedicated IT department. Essentials is also a good option for customers who have previously used Windows Server Foundation edition, which has been phased out in the Windows Server 2016 generation.

- **Modernized Server Infrastructure**
 - Microsoft Windows Server 2022 features containers that allow for packaging apps with their dependencies and using operating system-level virtualization to provide fast, fully isolated environments on a single system.
 - The Containers extension in Windows Admin Center enables the containerization of apps, as well as troubleshooting for containers running on a host, such as opening a console connection to a container, checking logs, or monitoring resource consumption.
 - Microsoft drastically decreased the size of the Windows Server core container base image by reducing duplicate payloads and removing unused optional components.
 - Performance and scalability increased with support for up to 48TB memory and 2048 logical processors

- **Features include:**
 - **Server Manager**
 - **Security**
 - **Clustering**
 - **Enhanced Web services**
 - **Windows Server Core and Nano Server**
 - **Windows PowerShell**
 - **Virtualization**
 - **Reliability**
 - **Multitasking and multithreading**
 - **Physical and logical processors**
 - **Containers**

- **Server Manager**
 - Enables the server administrator to manage critical configuration features from inside one tool
- **Server Manager is used to:**
 - Configure a server from the beginning
 - View computer configuration information.
 - Change server roles and system properties
 - Configure networking
 - Configure Remote Desktop
 - Configure security, including the firewall
 - Add and remove features
 - Run diagnostics
 - Manage storage and backups
 - Manage multiple servers from one place

- When you install Windows Server 2016/2019/2022, add a feature, or install a Windows component
 - An essential level of security is automatically implemented
- Other security features include:
 - File and folder permissions
 - Security policies
 - Encryption of data
 - Event auditing
 - Various authentication methods
 - Server management and monitoring tools

- Windows Server 2016/2019/2022 offers tools to:
 - Test a cluster to ensure it is set up to accomplish the tasks for which it is intended
 - Migrate configuration settings from one cluster to another
 - Quickly configure a cluster and troubleshoot problems
 - Set up storage used in a cluster
 - Create better cluster storage performance and reliability
 - Secure a cluster and enable it to use new network capabilities

- **Microsoft Internet Information Services (IIS)**
 - Transforms Windows Server into a versatile Web server
- **IIS has been designed to:**
 - Include over 40 modules
 - Intended to enable IIS to have a lower attack surface
 - Provide easier application of IIS patches
 - Make it easier for network programmers to write network applications and configure applications for the Web

- **Windows Server Core**
 - A minimum server configuration
 - Designed to function in a fashion similar to traditional UNIX and Linux servers
 - Does not provide the following:
 - A graphical interface, just a command line
 - Graphical tools to configure the server
 - Extra services that you do not need
- **Windows Nano Server**
 - A new installation option in Windows Server
 - Smaller footprint than Server Core
 - Provides a basic foundation for server computing
 - Intended to be faster and need less maintenance

- **Windows PowerShell**
 - A command-line interface that offers a shell
 - A customized environment for executing commands and scripts
 - Scripts are files that contain commands to be run by a computer OS
 - Offers over 130 command-line tools, also called cmdlets
- **Can perform the following tasks with PowerShell:**
 - Manage disk storage
 - Manage network tasks
 - Set up local and network printing options
 - Install, list, and remove software applications
 - View information about the local computer, including user accounts
 - Manage services and processes
 - Manage IIS Web services

- **Hyper-V provides the ability to run two or more operating systems on a single computer**
- **The Hyper-V capabilities include the following:**
 - Compatible with clustering
 - Can be used with Windows and Linux operating systems
 - Compatible with different types of disk storage methods
 - Enables fast migration from one computer to another
 - Can house 64-bit and 32-bit operating systems

- The operating system kernel runs in privileged mode
 - Protects it from problems created by a malfunctioning program or process
- The kernel consists of the core programs and the computer code of the operating system
- Privileged mode gives the operating system kernel an extra level of security from intruders
 - Prevents system crashes due to poorly written applications
- Process
 - A computer program or portion of a program that is currently running
- Protected process
 - One for which outside influences are restricted

- **Multitasking**
 - The ability to run two or more programs at the same time
- **Multithreading**
 - The capability of programs written to run several program code blocks, or “threads,” at the same time
- **Preemptive multitasking**
 - Each program runs in an area of memory separate from areas used by other programs
 - Reduces the risk of one program interfering with the smooth running of another program

- **Physical processor**
 - Is plugged into a processor socket on the motherboard of the computer
 - Windows Server 2016/2019 can support up to 64 sockets for physical processors
- **Logical processor**
 - A core than can run its own executable threads
 - One physical processor can house several logical processors
- **Virtual processor**
 - A logical processor or one or more of its cores that function for the use of a specific VM
- **With Hyper-V in use**
 - Windows Server 2016/2019 supports up to 320 logical processors

- **Network**
 - A communications system enabling computer users to share computer equipment, application software, and data, voice, and video transmissions
 - Contains computers joined by communications cabling or sometimes by wireless devices
- **Workstation or client network operating system**
 - Enables individual computer to access a network, and in some cases to share resources
- **Peer-to-peer networking**
 - Focuses on spreading network resource administration among server and nonserver members of a network
- **Server-based networking**
 - Centralizes the network administration on one or more servers

- **Uses workstations to share resources such as files and printers and to connect to resources on other computers**
 - No special computer is needed to enable workstations to communicate and share resources
- **Can be effective for very small networks**
- **Disadvantages**
 - Management of network resources is decentralized
 - As the network increases in size, administration becomes more difficult
 - Lack of security of resources

- **Server**
 - A single computer that provides extensive multiuser access to network resources
 - Can handle hundreds of users at once
 - Fast response when delivering the shared resource
 - Less network congestion when multiple workstations access that resource
- **Advantages**
 - Users only need to log on once to gain access to network resources
 - Security is stronger
 - Computer resource sharing can be arranged to reflect the work patterns of groups within an organization
 - The server administrator can save time when installing software upgrades

- **Automatic Private IP Addressing (APIPA)**
 - Used to automatically configure the TCP/IP settings for a computer without using a DHCP server
 - Computer automatically assigns itself an IP address from the reserved range of 169.254.0.1 to 169.254.255.254 and a subnet mask of 255.255.0.0
 - Appropriate for small organizations that have only one network segment and do not need to access another network or the Internet
- **Automatic configuration can be disabled through the Windows Server Registry**
 - Registry is a database used to store information about the configuration, program setup, devices, drivers, and other data important to the setup of Windows OSs

- **Dynamic Addressing Through a DHCP Server**
 - Common for medium-sized and large networks
 - You must first install and configure a DHCP server on the network
 - In addition to assigning the IP address, the DHCP server can also assign the subnet mask, default gateway, DNS server, and other IP settings
 - Using a DHCP server can save you a great deal of administrative effort

- **New Technology File System (NTFS)**
 - The native Windows Server file system
- **NTFS features include:**
 - Local security through file and folder permissions
 - Compression
 - Disk quotas
 - Encryption
 - Indexing
 - Journaling
 - Large volume capacity
 - Self-healing

- **Resilient File System (ReFS)**
 - Microsoft targets ReFS v2 primarily for use with data stores and storage spaces in Hyper-V
 - At this writing, there are still questions about performance
 - ReFS can be faster than NTFS in read and write activities, but it is not consistent in different circumstances and types of loads
 - Disk errors and file system corruption that occur in ReFS can be repaired more quickly than NTFS
 - ReFS provides more versatility than NTFS

Determining Domain or Workgroup Membership

- Determine the type of network access for which your computer will be configured
- You can specify a domain or workgroup through the Server Manager window
- Requirements for adding the computer to a domain:
 - Provide the DNS name of the domain you want to join
 - You must have an authorized user account in the domain you want to join
 - One domain controller and a DNS server must be online before you can join the domain

Choosing a Computer Name

- The installation process assigns a randomly generated name for the server computer
- Some organizations have a predetermined naming scheme for computers on their network
- Microsoft's recommendations for creating a computer name include the following:
 - The maximum length is 63 characters
 - Use shorter names up to 15 characters for easier typing
 - The computer should have a name that is different from any other computer name on the local network or in the domain
 - If no DNS server exists on the network, use only standard Internet characters
 - If a DNS server is present on the network, use standard Internet characters plus additional characters such as \$, %, &,* , and others

Determining What Server to Install ?

- **Some scenarios for a Nano Server or Server Core installation:**
 - Your organization is medium or large in size and wants to dedicate one server to operate as a DHCP or combined DHCP and DNS server
 - Your organization offers many shared folders to users for their work and the organization wants to centralize all of the shared folders on one computer
 - The server contains only centralized databases accessed by users
 - The server is dedicated to one narrow task
 - The server is a dedicated web server and you want to give it a small attack surface
 - The server is used to offer private cloud-based applications to users

Determining What Server to Install ?

- **Sample scenarios for installing the full GUI version are:**
 - Your organization is a small or medium-size business and does not plan to dedicate a server for a specific function, such as for DHCP
 - You prefer to work in a GUI environment
 - Your organization needs to have GUI-based software on the server
 - The server administrator is relatively new to Windows Server and wants to use wizards for guidance
 - The server is used by small business in which the server administrator and the administrator's backup person are relatively novice at managing a server

- **Active Directory Certificates Services Role**
 - Offers the ability to establish digital certificates for enhanced security
 - A digital certificate is a set of unique identification information that is typically put at the end of a file or that is associated with a computer communication
 - Four services are incorporated into the Active Directory Certificate Services role.

- **Active Directory Domain Services Role**
 - Central to implementing Active Directory and creating one or more domains
 - Offers two central services:
 - Active Directory Domain Controller
 - Identity Management for UNIX
 - Can use Microsoft Passport
 - A new authentication technique that replaces the use of passwords with a two-step authentication process
- **Active Directory Federation Services Role**
 - Used to manage security tokens and security services on a Windows Server Web-based network

Identifying Server Roles

- **Active Directory Lightweight Directory Services Role**
 - Intended for servers that primarily manage applications for users
- **Active Directory Rights Management Services Role**
 - Uses security capabilities such as encryption, user authentication, and security certificates to help safeguard information
- **Device Health Attestation Service Role**
 - Enables the server to assure that each server client meets a predetermined level of security before that client can gain access to server-managed resources
- **DHCP Server Role**
 - Role in which the server leases IP addresses to network clients

- **DNS Server Role**
 - DNS maintains tables from which this service translates domain and computer names into IP addresses and vice versa
- **Fax Server Role**
 - Through the Fax Server role, you can manage all fax resources on a network
- **File and Storage Services Role**
 - Enables users to access and share files through one or more servers
 - Distribute File System (DFS) – enables folders shared from multiple computers to appear as though they exist in one centralized hierarchy of folders
- **Host Guardian Service Role**
 - Ensures the “shielding” of VMs, particularly in the cloud
- **Hyper-V Role**
 - Enables Windows Server to function as a virtual server

- **Multipoint Services Role**
 - Enables multiple users to share one computer through connecting a keyboard, mouse, and monitor into a USB hub and connecting the USB hub to a USB port on a server
- **Network Controller Role**
 - Turns a NIC in the server into a central device that can mine the network for information to be used by one or more network management applications
 - Medium and large organizations will find the Network Controller role valuable to enable centralized management of their networks through automation software

- **Network Policy and Access Services Role**
 - A network is kept secure and healthy by having policies governing who can access it
 - This role offers services to:
 - Set up and manage network policy by creating and using a Network Policy Server (NPS)
 - Configure network policy from a single location rather than having to configure network policy on each network access server
 - Enable the use of secure wired and wireless authentication protocols so that unauthorized clients cannot access a network or receive an IP address via DHCP
 - Validate client health certificates to be sure all network client workstations are current on their security patches and other security conditions

- **Print and Document Services Role**
 - Includes a service to make a Windows Server a formal Print Server that manages print jobs and network printers from one place
 - Another service manages Internet printing, including sharing web-based printers
 - Line Printer Daemon (LPD) service manages printing activities for UNIX and Linux computers

Identifying Server Roles

- **Remote Access Role**
 - Enables clients to access network and server resources from anywhere the Internet is available
- **Remote Desktop Services Role**
 - Terminal Services were renamed Remote Desktop Services beginning with Windows Server 2022 R2
 - Clients can use VM and session-based desktops to access and run applications on a server
- **Volume Activation Services Role**
 - Can be used by business, government, and other organizations that purchase software in bulk for many clients

- **Web Server (IIS) Role**
 - Enables Windows Server to provide an ever-expanding range of Web services
 - Turns Windows Server into a full-featured web server
- **Windows Deployment Service Role**
 - Enables an organization to purchase multiple computers without operating systems and then install Windows Server on all of the computers
- **Windows Server Essentials Experience Role**
 - Offers automated features that Standard and Datacenter Edition server administrators may want to use
- **Windows Server Update Services Role**
 - Provides a way to automate updating one, some, or all Windows servers and Windows clients on your network

Making Immediate Preparations

- **Immediate preparations include:**
 - If you are upgrading, back up the files before starting
 - Ensure that all important hardware are preinstalled
 - Disconnect or remove removable storage devices
 - Disconnect any connection for communications with an (UPS)
 - Have on hand USB thumb drives or DVDs or other media with drivers for new peripherals
 - Use the test software disc or USB thumb drive that comes with the server to verify that the CPU, memory, and disk drives are working properly
 - If you are installing Windows Server into a VM, ensure there is adequate memory and disk storage on the parent virtual server hardware to support the installation