CHAPTER 1

Operating System Types

Core 2 Objective 1.1: Explain common operating system (OS) types and their purposes.

Computers and mobile devices use different operating systems (OSs). What makes them different? What makes one more suitable for some jobs than others? You need to understand their differences when you are supporting computers and mobile devices. In this chapter, you will learn what you need to know about A+ Certification Core 2 Objective 1.1, including the following topics:

- **Workstation Systems (OSs)**
- **Mobile OSs**
- **Various Filesystem Types**
- **Vendor Life-Cycle Limitations**
- **Compatibility Concerns Between Operating Systems**

WORKSTATION OPERATING SYSTEMS

Workstation OSs run office apps, web browsers, and email clients, and may also be used for graphics, photo editing, and video editing. The choice of a particular OS should take into account the features of the OS, the software available, its compatibility with the

intended hardware, and compatibility with other OSs already in use in the organization. There are four major OS families: Windows, Linux, macOS, and ChromeOS.

Windows

Microsoft Windows is one of the most widely used operating systems for both business and home environments. It is a commercial product that can run on computers from a variety of manufacturers. Windows features a *graphical user interface (GUI)* for interaction via mouse, touchpad, or stylus. It also includes a *command-line interface (CLI)*, which is often used by technicians, system administrators, developers, and other advanced users. Windows provides both a GUI and the command-line Command Prompt interfaces, as shown in Figure 1.1.

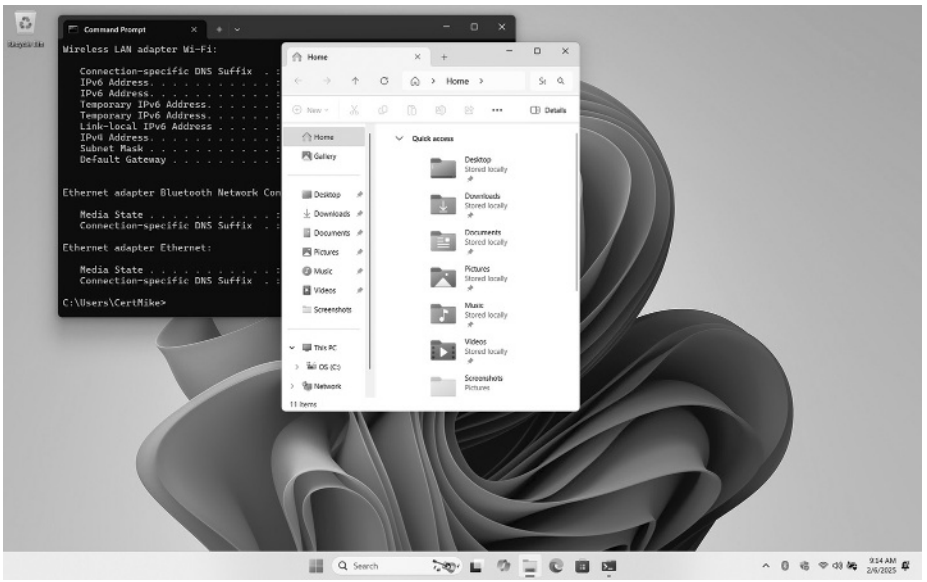

FIGURE 1.1 Windows desktop GUI and Command Prompt interfaces

NOTE

Microsoft recently introduced Windows Terminal, a modern alternative to the classic Command Prompt. It supports multiple tabs, themes, and even Linux shells through Windows Subsystem for Linux (WSL)—all in a sleek, customizable interface.

Windows supports a wide range of processors, including Intel, AMD, and ARM-based processors, making it compatible with various hardware configurations. The Windows 11 operating system is available in several editions, such as Home, Pro, and Enterprise, as well as versions for education, IoT devices, and servers. Windows is known for its extensive software compatibility, including both 32-bit and 64-bit applications, with most modern software designed for 64-bit processors.

While most modern systems are running 64-bit applications, older applications designed for 32-bit processors are still supported for backward compatibility. Windows' ability to run both 32-bit and 64-bit software makes it versatile in mixed environments, where older software may still be in use. Additionally, Windows can run on low-powered devices such as thin clients, where most processing is done by a server, as well as high-performance workstations for tasks like graphics, CAD, and video editing.

For users in mixed OS environments, Windows supports a broad range of device drivers, making it a flexible option for businesses with diverse hardware and peripheral requirements.

Linux

Linux is a family of Unix-like operating systems that run on Intel, AMD, and ARM hardware. There are many different Linux distributions (distros), most of which are free and open source, making them highly customizable. Linux distros vary widely, from those designed to be user-friendly and familiar to Windows users (such as Debian and Ubuntu) to those built for server and enterprise environments (such as SUSE Linux Enterprise Server and Red Hat Enterprise Linux).

As an open source OS, Linux has significant community support, with many developers contributing to its growth and improvement. It's particularly popular for server use due to its reliability, security, and low cost.

Linux started as a command-line-based operating system, and the CLI remains a core part of using Linux effectively. To become proficient, users must be familiar with many commands and their variations. The man (manual) pages are an essential reference tool for all levels of Linux users.

EXAM TIP

All Linux distros include man pages for each command. To access the man page for `apt`, for example, open a Terminal session and type **`man apt`**.

Although many Linux distros now come with GUIs, such as GNOME, KDE Plasma, and XFCE, these GUIs are separate from the core OS. This separation allows users to easily switch between different GUI options, making Linux adaptable to a wide range of use cases and preferences. Figure 1.2 shows the GUI and CLI interface options available with Ubuntu Linux.

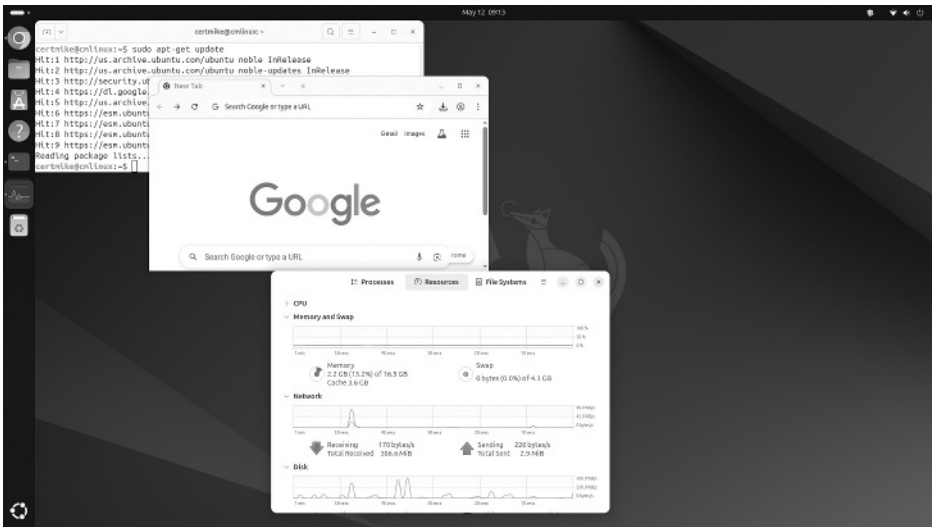

FIGURE 1.2 Ubuntu Linux's desktop GUI and command-line interfaces

Linux is highly scalable, running everything from simple embedded devices to powerful servers in data centers, making it suitable for both personal and enterprise-level computing.

You'll learn more about Linux and its major features in Chapter 9, "Linux."

macOS

macOS is significantly different from both Windows and Linux. Whereas Windows and Linux run on hardware from multiple manufacturers, macOS is designed exclusively for Apple hardware. Apple is the only company authorized to produce computers that run macOS.

Like Linux, macOS has Unix-based roots, specifically from BSD, but it is primarily a graphical operating system with a Terminal command-line interface available for advanced tasks. Figure 1.3 shows the GUI and CLI interfaces of macOS.

macOS currently supports two processor families. Older versions ran on Intel CPUs, but Apple now uses its own M-series Apple Silicon chips, which are not compatible with Intel-based macOS versions or apps.

The macOS software ecosystem is known for its strong focus on creative applications such as graphic design, video editing, and music production, along with productivity tools.

You'll learn more about macOS and its major features in Chapter 8, "macOS."

ChromeOS

ChromeOS is a lightweight operating system developed by Google, designed primarily for web-based computing. Unlike Windows or macOS, which support a wide range of local applications, ChromeOS is built around the Chrome browser and cloud-based apps. It runs on Chromebooks and other certified devices from manufacturers like Acer, HP, and Lenovo,

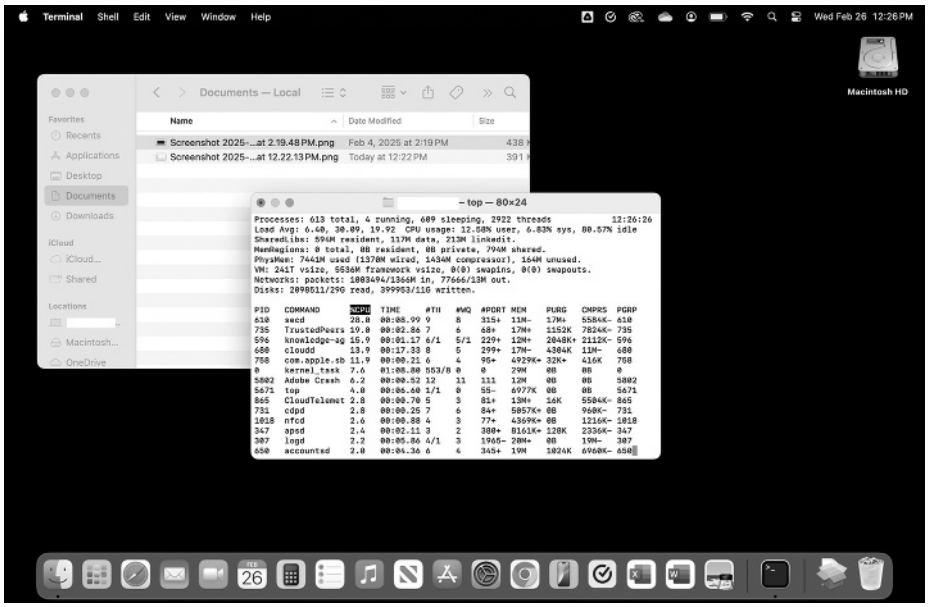

FIGURE 1.3 macOS Monterey's desktop GUI and command-line interfaces

following Google's hardware and security guidelines. Based on a Linux kernel, ChromeOS features a simple, user-friendly graphical interface but also includes a Linux development environment for advanced users who need command-line tools.

Originally focused on web apps and Android apps from the Google Play Store, ChromeOS now also supports Linux applications, making it more flexible for productivity and development tasks. Despite these additions, it remains optimized for cloud computing, with automatic updates, sandboxed applications, and verified boot for security. Because of its simplicity and ease of management, ChromeOS is widely used in education and enterprise settings. Figure 1.4 shows the ChromeOS desktop and interface.

EXAM TIP

Know the common OS types, including Windows, Linux, macOS, and ChromeOS, and be able to explain their purposes.

MOBILE OSs

Apple's iPadOS/iOS and Google's Android are the only players of any importance in mobile OSs. The following sections cover their major features and differences. Keep in mind that these OSs are designed primarily for information viewing and gaming rather than for information creation.

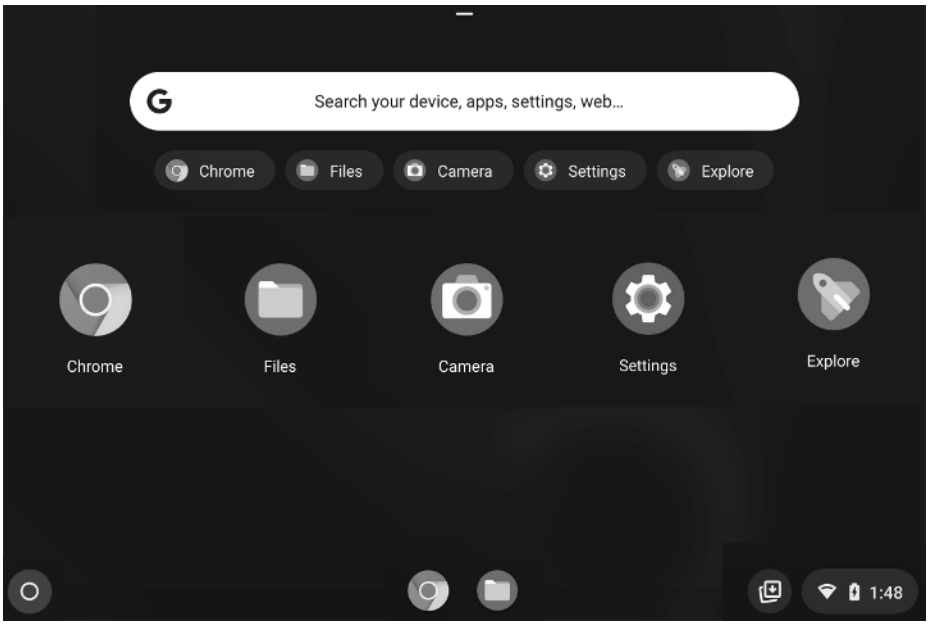

FIGURE 1.4 ChromeOS uses Google web apps

iPadOS

Until recently, Apple, the creator of iPad, iPhone, and iPod devices, used the same operating system (iOS) on their iPhones and iPads. Now iPads have their own OS, known as iPadOS.

Compared to iOS, iPadOS has several improvements, including support for multiple windows with multitasking (Figure 1.5), Sidecar (enabling some iPad models to work as second monitors for macOS computers), support for Apple Pencil, and an improved Files app for file management.

iOS

Apple's iOS operating system supports its iPhone smartphones. It offers an easy-to-use touchscreen GUI and a large library of apps via the App Store. The iOS operating system is app-oriented, but recent versions have added the Files app for easier access to recent files and support for browsing folders on iCloud. Figure 1.6 shows the Files app running on iOS.

Android

Although Google is the creator of Android, an open source touchscreen smartphone and tablet OS derived from Linux, Google is not the only source for Android devices. Google licenses Android to many other smartphone and tablet vendors and supports modifications to the basic user interface and bundled apps.

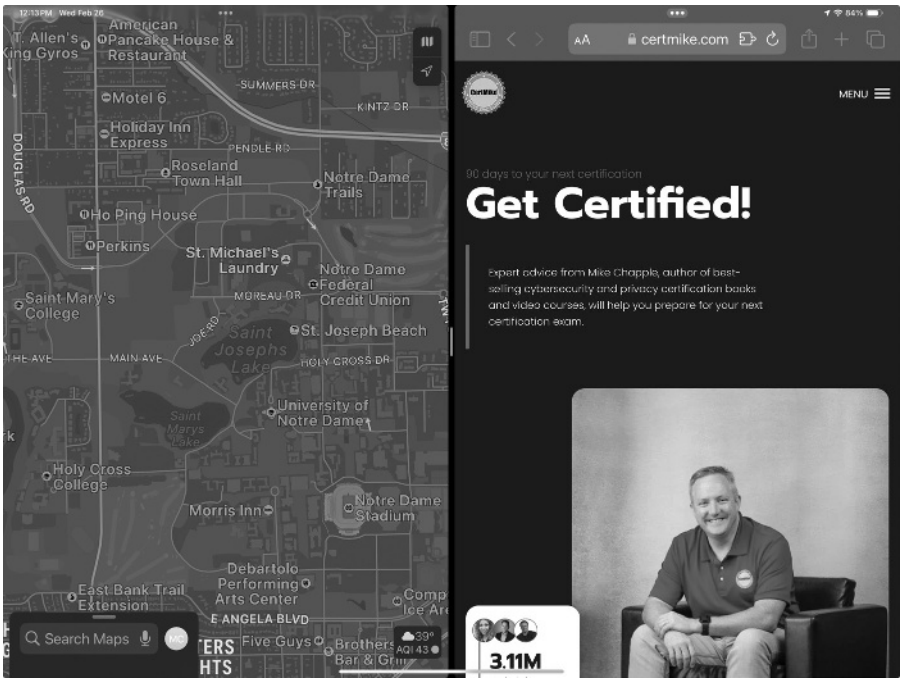

FIGURE 1.5 Using the split-screen multitasking feature of iPadOS

FIGURE 1.6 Browsing files with iOS's Files app

Android is also available in different versions that support older and newer devices. So, don't be surprised to discover differences in Android on devices from Samsung, Google, Lenovo, and other Android smartphone and tablet vendors. Android apps are typically distributed using the *Android Package (APK)* file format at the Google Play Store and third-party app stores such as the Samsung Galaxy Store.

Figure 1.7 shows the home screen for a typical Android smartphone.

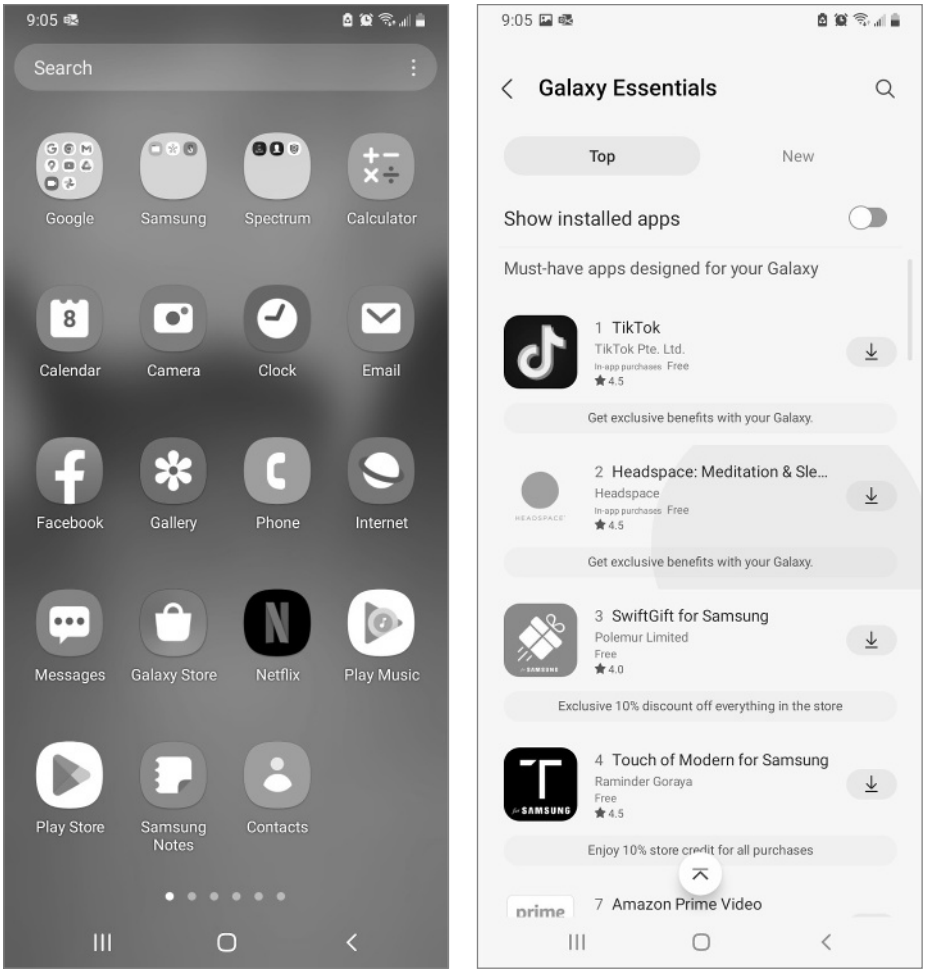

FIGURE 1.7 Two screens from a Samsung smartphone, running a modified version of Android

EXAM TIP

Know the purposes and features of the various mobile OSs.

FILESYSTEMS

A *filesystem* determines how files are stored, named, and retrieved from a storage device. Selecting the right filesystem depends on factors such as operating system compatibility, storage device size, and intended use. This section examines the most commonly used filesystems for Windows, Linux, and macOS, including cross-platform options.

EXAM TIP

Know the purposes and features of the various filesystems and be prepared to answer questions about which one to use in a specific scenario.

New Technology File System

The *New Technology File System (NTFS)* isn't exactly "new" technology anymore—it first came out in 1993! It is designed for reliability, security, and efficiency, making it the preferred choice for modern Windows systems.

Key features of NTFS include a master file table with built-in redundancy, journaling for tracking file changes, access control lists (ACLs) for detailed permission management, and support for file-level encryption through the Encrypting File System (EFS) in most editions of Windows.

NTFS also supports large file sizes, disk quotas, and file compression. While NTFS is primarily used on Windows, macOS and Linux can read NTFS-formatted drives, though write support may require additional software. Figure 1.8 shows the options for compression and encryption in NTFS.

EXAM TIP

To determine what filesystem a Windows drive is using, open its properties sheet and view the General tab.

Resilient File System

The *Resilient File System (ReFS)*, introduced by Microsoft with Windows Server 2012, is designed for high availability, scalability, and data integrity.

Unlike NTFS, which is optimized for general-purpose use, ReFS is built to handle large volumes of data with minimal risk of corruption. It features automatic integrity checking and self-healing capabilities, using checksums to detect and repair data corruption without user intervention.

ReFS also supports larger file and volume sizes than NTFS and is optimized for virtualized workloads, making it ideal for enterprise environments and storage-intensive applications.

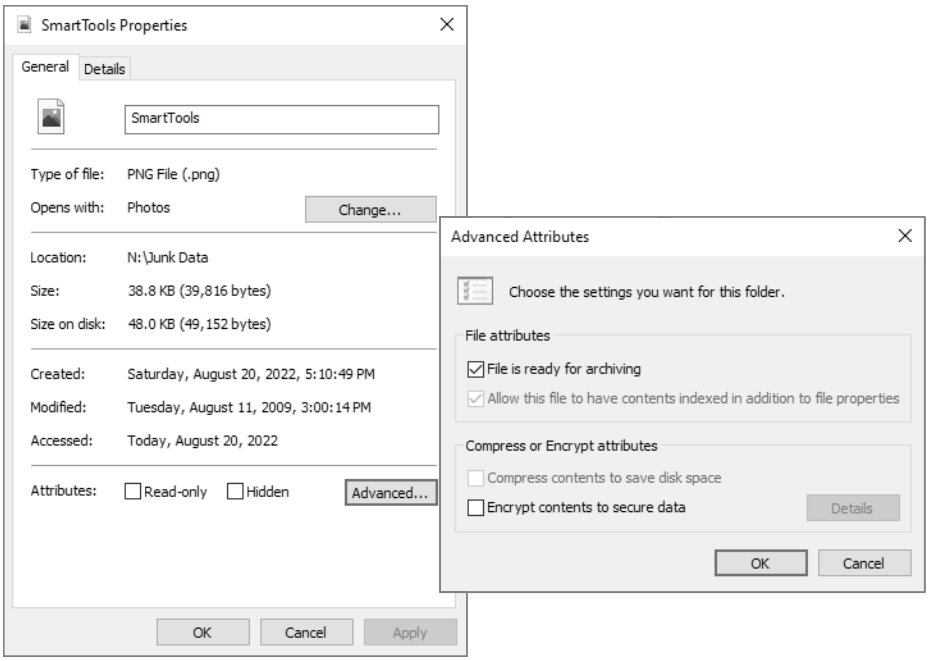

FIGURE 1.8 Click Advanced on the file's properties sheet to see the options for compression or encryption with EFS

ReFS does lack some NTFS features, such as file compression, Encrypting File System (EFS), and support for removable drives.

Although it was originally intended to replace NTFS, ReFS is currently limited to specific Windows editions, primarily in server and enterprise settings.

File Allocation Table 32

The *File Allocation Table 32 (FAT32)* filesystem is a widely compatible filesystem that has been in use since the mid-1990s. It is supported by nearly all operating systems, including Windows, macOS, Linux, and even gaming consoles and embedded devices, making it a common choice for USB drives and external storage.

FAT32 does have some significant limitations, including a maximum file size of 4 GB and a volume size limit of 2 TB, which can be restrictive for modern storage needs. FAT32 lacks built-in security features such as ACLs and encryption, making it less suitable for sensitive data.

Despite these drawbacks, its universal compatibility keeps it relevant for situations where cross-platform access is essential. Figure 1.9 shows the format options for FAT32 in Windows.

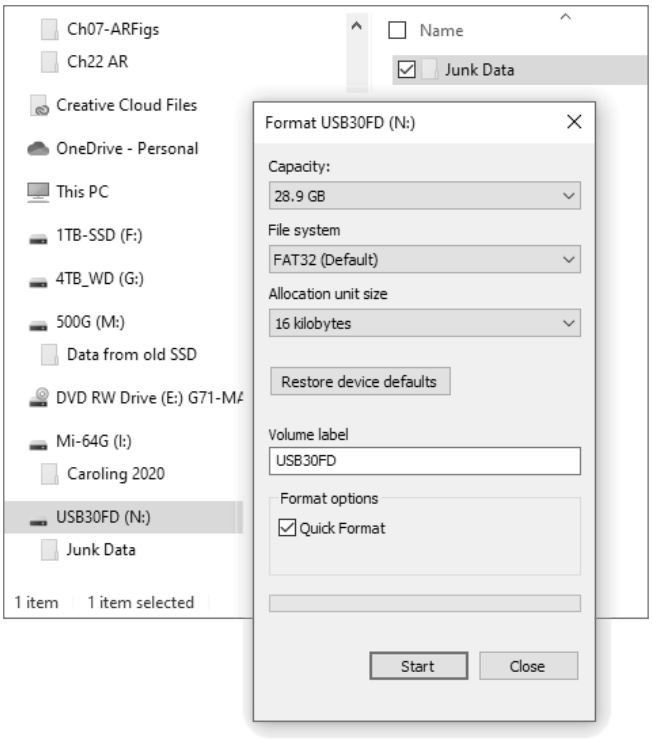

FIGURE 1.9 Formatting a 32 GB USB flash drive with FAT32

Fourth Extended Filesystem

The *Fourth Extended filesystem (ext4)* is the default filesystem for many Linux distributions, offering a balance of performance, reliability, and scalability. It improves upon its predecessor, ext3, with support for larger file and volume sizes, reduced fragmentation, and journaling for faster recovery after crashes. ext4 also features delayed allocation, which optimizes disk writes to improve performance, and extents, which help manage large files more efficiently.

While primarily used in Linux, ext4 can be accessed on Windows and macOS using third-party software.

EXAM TIP

To determine what filesystem a Linux volume is using, open a Terminal session, change to a folder on the volume, and use the command `findmnt`.

Extended File System

The *Extended File System (XFS)* is a high-performance journaling filesystem designed for handling large files and high-throughput workloads. XFS is optimized for scalability, making it well suited for enterprise servers and storage-heavy applications. It supports extremely large file and volume sizes, fast recovery from system crashes through metadata journaling, and efficient allocation techniques that reduce fragmentation.

XFS performs particularly well with workloads that involve sequential and parallel data access, such as databases and multimedia processing. However, unlike ext4, XFS does not support file shrinking, and while it offers ACLs, it lacks built-in encryption. Despite these limitations, XFS is widely used in enterprise Linux environments where speed and reliability are critical.

Apple File System

The *Apple File System (APFS)* is the default filesystem for macOS, iOS, iPadOS, and other Apple devices, designed to improve speed, reliability, and security. Introduced in 2017 with macOS High Sierra, APFS replaces the older HFS+ filesystem, offering features such as snapshot support for fast backups, space sharing to optimize storage usage, and strong encryption for data security.

APFS is optimized for flash and SSD storage, providing faster file operations compared to HFS+. APFS also includes crash protection through a copy-on-write mechanism, which ensures data integrity by writing changes to a new location before updating the original file. However, APFS has limited compatibility outside the Apple ecosystem—Windows and many Linux distributions cannot natively read or write to APFS-formatted drives. Despite this, APFS remains the preferred choice for modern Apple devices due to its performance and advanced security features.

Extensible File Allocation Table

The *Extensible File Allocation Table (exFAT)* was developed by Microsoft and later made available to other vendors. The exFAT filesystem is designed to support large drives, including flash drives over 32 GB in size and USB hard drives, supporting files up to 16 EiB and drives up to 128 petabytes (PiB), and over 2.7 million files per folder. However, it lacks journaling and other security features of NTFS.

Microsoft Windows, Linux, macOS, Android, ChromeOS, and many smart TVs and digital cameras support exFAT devices, so exFAT is a good filesystem to use for cross-platform file transfers. Figure 1.10 illustrates formatting a 64 GB flash drive with exFAT.

EXAM TIP

Know the various filesystem types well. You are sure to be tested on them!

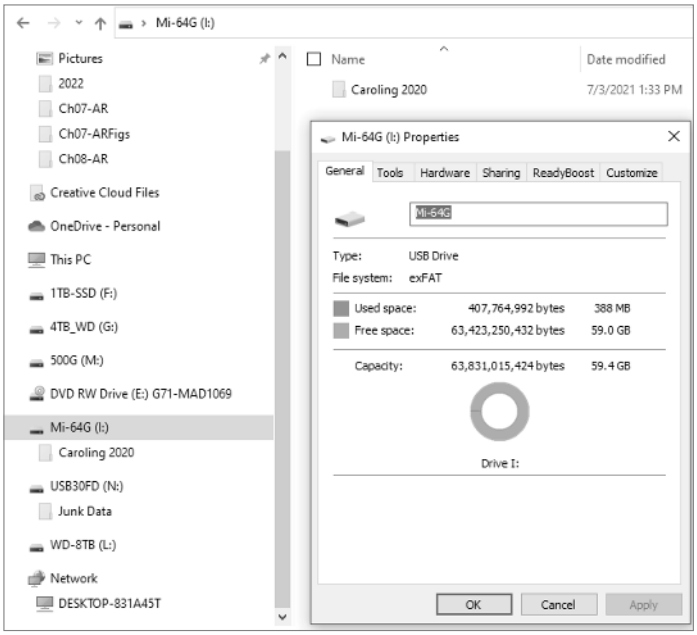

FIGURE 1.10 Formatting a 64 GB flash drive with the exFAT filesystem

VENDOR LIFE-CYCLE LIMITATIONS

No operating system lasts forever. Windows 7 and Windows 8 are now outdated, and Windows 10 is on the road to retirement in October 2025. There are two reasons why operating systems become obsolete: end-of-life and update limitations.

End-of-life (EOL) refers to the point when an operating system or software is no longer produced, supported, or updated by its developer. For hardware, this means replacement parts like motherboards, graphics cards, and storage devices become harder to find and more expensive over time. Organizations that continue using outdated hardware may struggle to maintain systems as components wear out.

With software, the biggest concern is security and compatibility due to *update limitations*. Once an OS reaches EOL, it no longer receives security patches, leaving it vulnerable to cyberattacks. It may also lack support for newer hardware, applications, and features, making it increasingly difficult to use in modern environments.

EXAM TIP

Even though Windows 10 is nearing retirement, CompTIA specifically included it in the Core 2 220-1202 exam objectives. Be sure you're familiar with both Windows 10 and 11 when you take the exam!

COMPATIBILITY CONCERNS

Operating systems handle software, filesystems, networking, and hardware differently, which can create compatibility challenges in environments where multiple OS types are used. Software designed for one OS may not run on another without additional tools. For example, Windows applications do not work natively on macOS or Linux. Some software vendors offer cross-platform versions, and web-based applications are a common solution for bridging OS differences.

Filesystems can also cause compatibility issues when sharing data across operating systems. Windows primarily uses NTFS, which macOS and Linux can read but not write to without extra software. macOS uses APFS, which is not supported by Windows or Linux, while Linux commonly uses ext4, which is not natively recognized by Windows or macOS. For external drives and file transfers, exFAT is widely supported across all major operating systems. Networking protocols can also vary, requiring adjustments to enable file sharing between Windows, macOS, and Linux.

Hardware and peripherals present another challenge, as drivers are often OS-specific. Windows generally has the broadest driver support, while macOS is limited to Apple-approved hardware. Linux has improved in this area but may still require manual driver installation for some devices. Printers, external storage, and other peripherals may require additional configuration or firmware updates to function across multiple operating systems. Understanding these compatibility concerns is essential when managing mixed-OS environments.

CERTMIKE EXAM ESSENTIALS

- Workstation operating systems include Windows, Linux, macOS, and ChromeOS, each offering different compatibility, performance, and security features. Windows is widely used for business and home computing, Linux is favored for its flexibility and security, macOS is exclusive to Apple hardware, and ChromeOS is optimized for web-based applications.
- Mobile operating systems, including iOS/iPadOS and Android, are designed for touch-screen devices and prioritize app-based functionality. iOS and iPadOS are exclusive to Apple devices, while Android is open source and used by multiple manufacturers, leading to variations in user experience.
- Filesystems dictate how an OS stores and retrieves data, with NTFS, FAT32, exFAT, ext4, APFS, XFS, and ReFS common options. NTFS is standard for Windows, ext4 for Linux, APFS for macOS, and exFAT is widely used for cross-platform file sharing.
- Vendor life-cycle limitations mean that operating systems eventually reach an EOL stage, losing security updates and compatibility with new hardware. Organizations must plan for OS migrations to avoid security risks and software obsolescence.

Practice Question 1

You are preparing a group of external 4 TB portable drives that will be used for file copying by Linux, macOS, and Windows users. Currently, these drives are formatted with the NTFS filesystem. Which of the following would be the *best* way to use these drives with all three types of operating systems?

A. Install NTFS drivers for Linux and macOS.
B. Reformat the drives using ext4.
C. Reformat the drives using FAT32.
D. Reformat the drives using exFAT.

Practice Question 2

A technician is supporting a business that primarily uses Windows workstations but also has a few macOS computers. The company needs to ensure file compatibility between the two operating systems while maintaining security features such as encryption and access controls. Which of the following solutions would BEST meet these needs?

A. Install third-party software on macOS to run Windows applications.
B. Use a cloud-based file storage solution for cross-platform access.
C. Configure a virtual machine to run Windows on macOS devices.
D. Reformat the macOS computers to run Windows natively.

Practice Question 1 Explanation

Reformatting the drives using exFAT is the best option because exFAT is natively supported by Windows, macOS, and Linux (with additional drivers if needed), and it supports large file sizes and partitions, making it ideal for external storage.

Installing NTFS drivers for Linux and macOS would allow those systems to read and write to NTFS, but this requires extra configuration and may not work seamlessly. Reformatting with ext4 would make the drives incompatible with Windows and macOS without additional software. FAT32 is widely compatible but has a 4 GB file size limit, which can be restrictive for large file transfers.

Correct Answer: D. Reformat the drives using exFAT.

Practice Question 2 Explanation

Using a cloud-based file storage solution for cross-platform access is the best option because it allows seamless file sharing between Windows and macOS while maintaining security features like encryption and access controls.

Installing third-party software to run Windows applications on macOS does not directly address file compatibility. Configuring a virtual machine to run Windows on macOS devices would enable Windows applications but is unnecessary for simple file sharing. Reformatting macOS computers to run Windows natively would eliminate macOS functionality, which is not a practical solution for a mixed-OS environment.

Correct Answer: B. Use a cloud-based file storage solution for cross-platform access.