Unit 5 : History and Architecture of Windows Operating System

If you lump together all the Windows versions currently in use and count them as a single operating system (OS), Windows is the most widely used PC operating system for home and business. Therefore, technicians should prepare themselves to work with recent versions of the Microsoft Windows desktop operating systems. Like many people, you may have used Windows for much of your life, and you can competently do ordinary tasks, such as navigating folders, saving files, downloading files, and running programs. With such proficiency, you may wonder why you need to study the operating system any further. It's because you need a far different set of skills and knowledge to support Windows than you need to simply use it. Those skills include understanding it enough to competently install, configure, troubleshoot, and maintain it.

On the other hand, you do not need to be a systems programmer who understands the OS's programming code. You only need a base of knowledge, a sharp mind, good powers of observation, and patience.

Lesson 1 : Introduction to Windows Operating Systems

1.1. Learning Objectives

On completion of this lesson you will be able to describe:

- ❖ The brief history of Windows Operating Systems.
- ❖ The family of Windows Operating Systems.

1.2. Windows Operating System

Microsoft Windows is a series of graphical interface operating systems developed, marketed, and sold by Microsoft.

Microsoft Windows Operating System series are one of the most popular operating system among the users. Microsoft Windows is a series of graphical interface operating systems developed, marketed, and sold by Microsoft. Microsoft introduced an operating environment named Windows on November 20, 1985 as a graphical operating system shell for MS-DOS in response to the growing interest in graphical user interfaces (GUI).Microsoft Windows came to dominate the world's personal computer market with over 90% market share, overtaking Mac OS, which had been introduced in 1984.

Windows has been written in Assembly, C and C++ languages and it is simply a graphical user interface (GUI) that manages and maintains the users' computer resources and components.

As of September 2013, the most recent versions of Windows for personal computers, mobile devices, server computers and embedded devices are respectively Windows 8, Windows Phone 8, Windows Server 2012 and Windows Embedded 8.

1.3   Windows 3.X family

1.3.1   Windows 3.1

Microsoft Windows 3.1 was the first member of windows family. It had a graphical user interface (GUI) and was based to run on the DOS (Disk Operating System). Windows 3.1x is a 16-bit operating system that was designed for personal computers.
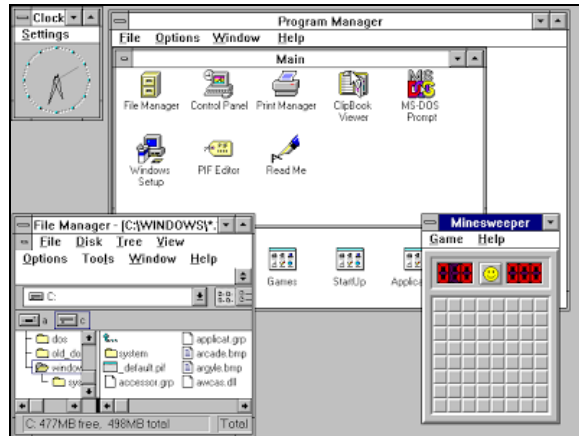

Figure 1.1: Windows 3.1.

1.3.2   Windows for Workgroups 3.11

The main feature of Windows for Workgroup 3.11 was the network support. It supported 32-bit access, full 32-bit network re-directors and ran on the DOS.
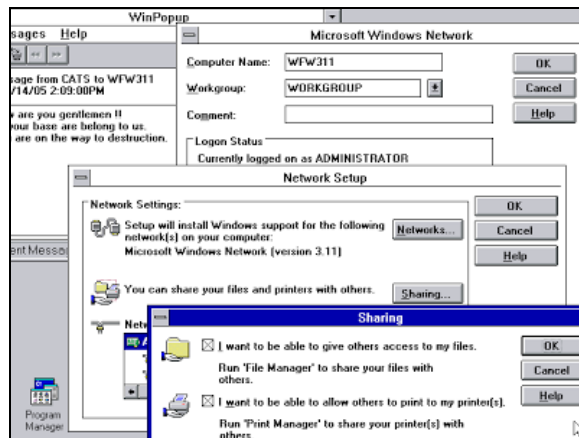

Figure 1.2: Windows 3.11.

1.3.3   Windows 95

The Windows 95 was a significant improvement from the previous Windows versions. It was designed for end-user desktop with better user interface, network support and plug-and-play feature (connect devices to the system without the need of configuration).
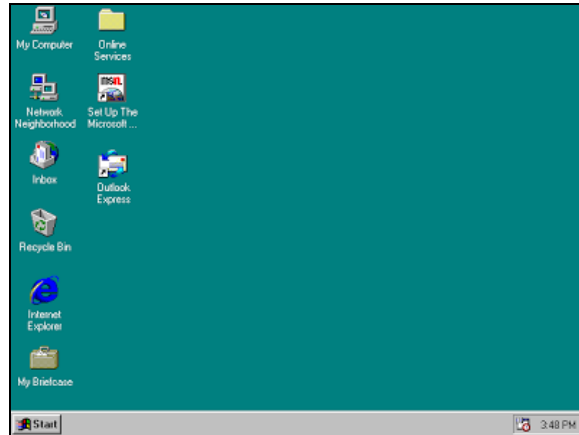
Figure 1.3: Windows 95.

1.3.4   Windows 98

The second major release in the Windows 9x family was the Windows 98. It included new features such as Wizards, Utilities, Tools and resources for better performance. The Windows 98 is a 16-bit/32-bit OS with an MS-DOS based boot stage. This operating system was faster than the Windows 95 and contained enhanced television, video playback, and new hardware support.
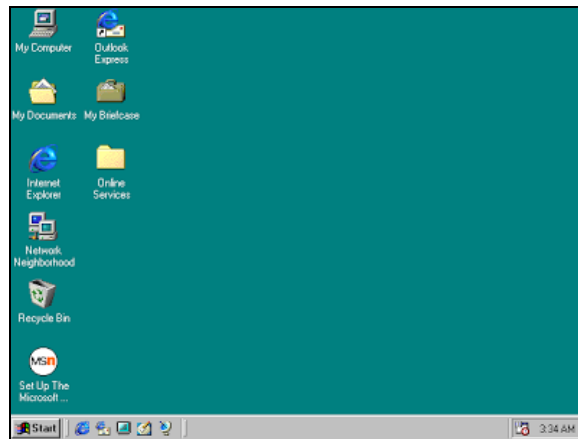

Figure 1.**Error! No text of specified style in document.**.4: Windows 98.

1.3.5   Windows Me

The last operating system released in the Windows 9X series was the Windows Millennium or ME and it was designed by Microsoft for home users. It had the ability to connect users' computers at home to create a local area network with better Internet connectivity, and work with rich multimedia content such as photos, videos, and music.
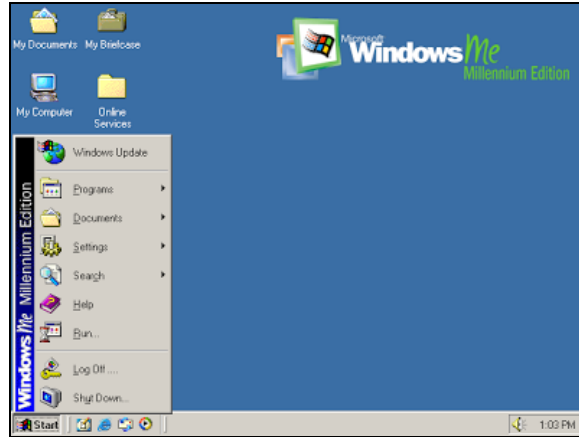
Figure 1.5: Windows Me.

1.4   Windows NT family

1.4.1   Windows NT

The first version of Windows NT (New Technology) family was released in 1993. Its design was based on Windows 95 user-interface and was a multiprocessor and multiuser operating system. It was a true 32-bit operating system, which was optimized to work with 32-bit architecture hardware devices. At this stage, Microsoft started to remove the dependencies on DOS and began to fully rely on the NT Kernel.

1.4.2   Windows 2000

Windows 2000 design was built on Windows 98 user-interface and made business user more productive. Windows 2000 introduced many of the new features of Windows 98 and Windows 98SE into the NT family. Windows 2000 made business user more productive. Its integrated Web capabilities and support for mobile computers and hardware devices made Windows 2000 the easy way for business user to connect to the Internet anywhere and anytime.

Windows 2000 design was built on Windows 98 user-interface and made business user more productive.
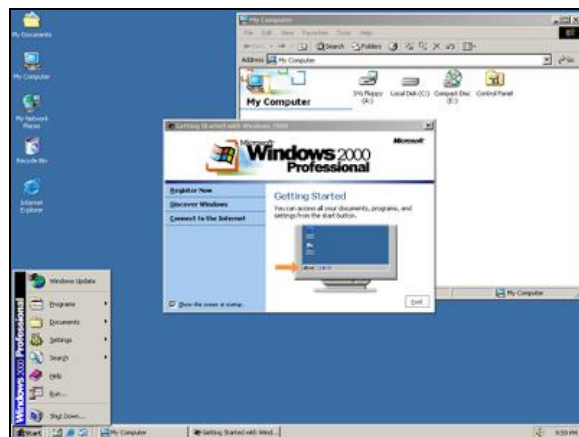

Figure 1.6: Windows 2000.

1.4.3 Windows XP

Microsoft used power of Windows 2000 and business features of Windows 98 and Me and made Windows XP. Windows XP was a smarter OS and introduced several new features to the Windows line, such as GDI+ graphics subsystem and improved image management, Start Menu and Taskbar improvements, Integrated Networking and Multimedia support and many more.

Figure 1.7: Windows XP.

1.4.4 Windows Vista

Microsoft released Windows Vista in 2007. Seen more as an upgrade to the extremely popular Windows XP, it included improvements in how Windows handles graphics, files, and communications. With enhancements to the GUI, Vista is attractive (see Figure 1.8), but it was not widely adopted due to problems with slow speed and high hardware requirements. As a result, Microsoft extended the support lifecycle of Windows XP, allowing sales of new PCs with Windows XP preinstalled until October 22, 2010.
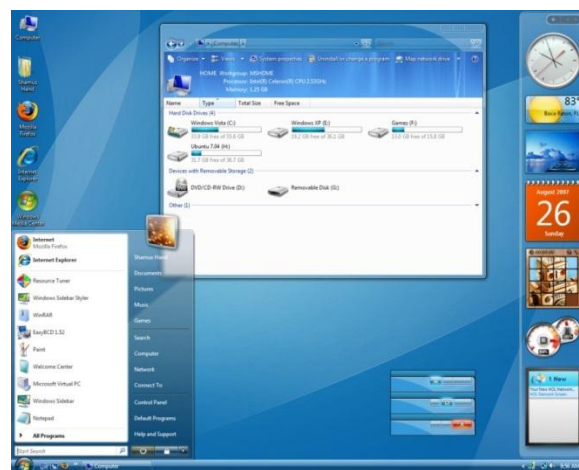

Figure 1.8: Windows Vista.

1.4.5   Windows 7

Released in 2009, Windows 7 includes an enhanced GUI, improved speeds in just about any way you want to measure an OS, and nearly identical hardware requirements as Windows Vista (see Figure 1.9). Given that computers became faster and cheaper (as they do) in the two years between the release of WindowsVista and the introduction of Windows 7, the hardware requirements for Windows 7 are not the burden on the customer that they were for Windows Vista.

Figure 1.9: Windows 7.

1.4.6   Windows 8

Windows 8 is a faster and leaner Windows OS with many improvements over previous versions and some surprising new features. The most obvious is the new Metro GUI, an updated version of the Metro user interface found on Microsoft Windows Phone 7.5. The Start screen shown in Figure 1.10 contains one active tile for every installed application, and these tiles show active content, such as news feeds, stock quotes, slideshows, and more, depending on the application.

Figure 1.10: Windows 8.

1.5   Exercise

1.5.1   Multiple choice questions

a.   Microsoft introduced an operating environment named Windows on

   (i)   October 20, 1985
   (ii)   November 20, 1985
   (iii)   November 20, 1984
   (iv)   October 20, 1984

b.   DOS stands for

   (i)   Data Operating System
   (ii)   Disk Operating System
   (iii)   Drive Operating System
   (iv)   Disk Operation System

c.   The first version of Windows NT was based on

   (i)   Windows 98 user-interface
   (ii)   Windows 95 user-interface
   (iii)   Windows 98SE user-interface
   (iv)   Windows ME user-interface

1.5.2   Questions for short answers
   a.   Write the name Windows 3.X family.
   b.   Which Windows are in NT family?
   c.   Give the features of Windows 98.

1.5.3   Analytical Questions
   a.   Describe Windows NT family.
   b.   Describe Windows 3.X family.

Lesson 2 : Windows Version and Edition

2.1. Learning Objectives

On completion of this lesson you will be able to describe:

- ❖ The differences among various editions of three versions of Windows: Windows XP, Windows Vista, and Windows 7.
- ❖ The implications of using the 32-bit or 64-bit versions of each of the above Windows.

2.2 . Windows Versions

Each Microsoft Windows version is a new level of the venerable operating system, with major changes to the core components of the operating system as well as a distinctive and unifying look to the GUI. The Windows versions included Windows XP, Windows Vista, and Windows 7. Here is a portion of the Windows history to help you see where Microsoft has been with the Windows OS.

2.3. Editions

Editions

Microsoft brings out an entirely new group of products for each version of Windows. What distinguishes each of these products, called an *edition*, and from one another is the mix of features in each that is designed for a specific target market. Some Windows editions are available through retail channels as separate boxed or downloadable products, other editions—sometimes referred to *as original equipment manufacturer* (OEM) editions—are only available preinstalled by manufacturers on new computers. Then, there is the Enterprise edition, only available to large organizations that purchase volume licenses from Microsoft.

The list in Table 2.1 contains the Windows editions and versions and their brief description.

2.4. Comparison of Versions and Editions

Table 2.1: Comparison of Windows Versions and Editions.

Windows Version and Edition	Description
Windows XP Home	Designed for home users, it lacked many features included in the Professional edition.
Windows XP Professional	For business or power users, this edition included the ability to join a Windows Server domain, more security features, the ability to be operated by another Windows XP user remotely, and other features required in a

Windows Version and Edition	Description
	business network environment.
Windows XP Media Center	An OEM edition preinstalled on computers with media center capabilities. Not sold separately.
Windows XP 64-bit	The first 64-bit version of Windows, it only ran on systems with the Intel Itanium CPU. They released an updated edition in 2003, but discontinued it in 2005 due to the lack of new Itanium-based computers.
Windows Vista Home Basic	Designed for home users with a limited budget, it lacked many features included in Windows Home Premium.
Windows Vista Business	For business or power users, this edition includes all of the features of Home Basic, except Parental Controls, and it is missing one basic desktop theme. It has the ability to join a Windows Server domain, more security features, the ability for another Windows user to operate remotely, and other features required in a business network environment.
Windows Vista Enterprise	Includes all of the features of the Business edition, but with more features targeted to large enterprises. Only available through Microsoft Software Assurance WA), a software purchasing, volume licensing, and support plan, mainly for large organizations.
Windows Vista Ultimate	Combines the features of both Home Premium and Enterprise editions, as well as a group of optional features bundled as Ultimate Extras that are free through Windows Update.
Windows 7 Starter	Available only as a 32-bit OEM version, preinstalled on low-end computers, such as a *netbook*, which is a minimally configured computer in the ultra-portable category, designed for connecting to the Internet and little else.
Windows 7 Home Premium	Targeted to the home market, this edition includes Windows Media Center, Windows Aero, and multi-touch support on compatible touch screen devices.
Windows 7 Professional	Designed for power users and small-business users, this edition includes all the features of Home Premium, with additional networking and security features, such

Windows Version and Edition	Description
	as the ability to join a Microsoft Windows Server domain, support for Encrypting File System, and Windows XP Mode for running old applications in a virtual machine running Windows XP.
Windows 7 Enterprise	Similar to the Ultimate edition, but with more features targeted to large enterprises. Only available through Microsoft Software Assurance (SA), a software purchasing, volume licensing, and support plan, mainly for large organizations.
Windows 7 Ultimate	Combines the multimedia features of Home Premium with the security, networking, and compatibility features of Professional editions, including Windows XP Mode for running old applications in a virtual machine running Windows XP. It also includes the data encryption features of BitLocker Drive Encryption and BitLocker To Go and support for 35 languages.

2.5. 32-Bit vs. 64-Bit Windows Operating Systems

Operating systems tie closely to the CPUs on which they can run. Therefore, we often use CPU terms to describe an operating system's abilities. For instance, Windows 2000 is a 32-bit operating system. Windows XP, Windows Vista, and Windows 7 come in both 32-bit and 64-bit versions. Most of the Windows XP editions are 32-bit except for a special edition, Windows XP Professional x64 Edition.

The biggest difference between the 32-bit and 64-bit versions of Windows is in the maximum address space used by both systems RAM and other RAM and ROM in your computer (see Table 2.2). Windows 64-bit does not use the maximum theoretical address space of a 64-bit CPU. A 64-bit operating system requires 64-bit applications, although Microsoft has offered ways to support older applications in each upgrade of Windows, described later in this lesson in "Running Old Applications in Windows." To determine if a computer is running 32-bit or 64-bit Windows 7, open Control Panel and click System and Maintenance, and then click System and look at the System Type field, which will say "32-bit Operating System" or "64-bit Operating System."

Table 2.2: Windows Memory Limit.

Edition	RAM Limit in 32-bit Windows	RAM Limit in 64-bit Windows
Windows XP Home	4 GB	N/A
Windows XP Professional	4 GB	N/A
Windows XP Media Center	4 GB	N/A
Windows XP Starter	512 MB	N/A
Windows XP 64-Bit	N/A	128GB
Windows Vista Ultimate/Enterprise/ Business	4 GB	128 GB
Windows Vista Home Premium	4 GB	16GB
Windows Vista Home Basic	4 GB	8 GB
Windows Vista Starter	1 GB	N/A
Windows 7 Ultimate/Enterprise/ Professional	4 GB	192 GB
Windows 7 Home Premium	4 GB	16GB
Windows 7 Home Basic	4 GB	8 GB
Windows 7 Starter	2 GB	N/A

2.6. Updates

Computer hardware technology does not stand still; therefore, operating systems must change to keep up. Each of the major operating systems is modular, so incremental updates can make some changes to the existing OS version. In Microsoft terminology, an update contains one or more software fixes or changes to the operating system. Some updates add abilities to the OS to support new hardware, and some resolve problems discovered with the operating system. This second type of update is often required to fix security problems. A hotfix or patch is a software fix for a single problem. Hotfix seems to be Microsoft's preferred term.

At one time, these updates, whether for functional or security problems, were issued without a predictable timetable. In recent years, Microsoft has assigned the second Tuesday of each month as the release day for updates. This day is widely called "patch Tuesday."

2.7. Service Packs

A service pack is a bundle of patches or updates released periodically by a software publisher. Windows service packs are major milestones in the life of a Windows version. For that reason, some devices and applications will require not simply a certain version of Windows, but also a certain service pack.

2.8. Hands on Practice

2.8.1 Viewing the Windows Version, Edition, and Service Pack Information

Here is an easy way to determine the version, edition, and service pack level for Windows 7:

1. Open the Start menu and right-click Computer in the column on the right.
2. Select Properties.
3. Look for the version, edition, and service pack information near the top of the window, as shown in Figure 2.1.
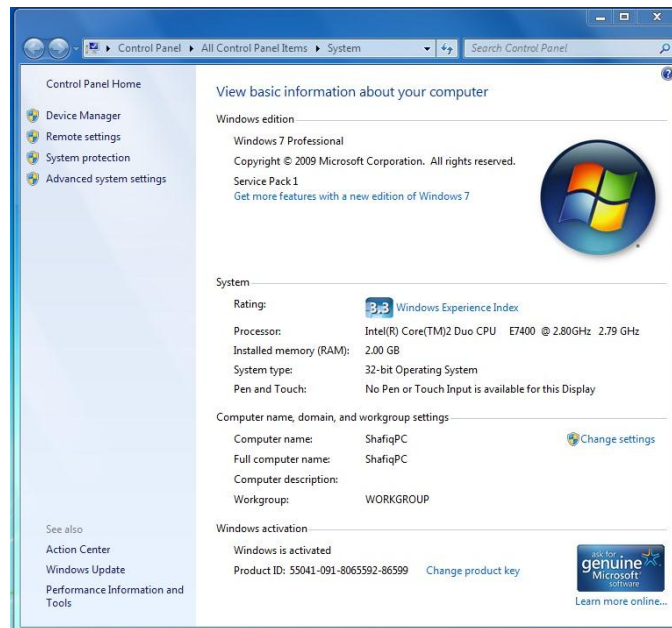

Figure 2.11: This System dialog box shows that the version is Windows 7 Professional, and it includes Service Pack 1.

2.9.   Exercise

2.9.1.   Multiple choice questions

a.   Windows 7 Starter is
   (i)   available only as a 32-bit OEM version
   (ii)   available only as a 64-bit OEM version
   (iii)   available both as a 32-bit and 64-bit OEM version
   (iv)   none of the above

b.   RAM limit for Windows XP 64-bit is
   (i)   512 MB
   (ii)   4GB
   (iii)   8 GB
   (iv)   128 GB

c.   A hotfix or patch is a software fix for
   (i)   a single problem.
   (ii)   multiple problems.
   (iii)   two problems.
   (iv)   none of the above

2.9.2.   Questions for short answers

a.   Why did the update edition of Windows XP 64-bit discontinue?
b.   What is a Service Pack?
c.   What is meant by "patch Tuesday"?

2.9.3.   Analytical Questions

a.   Differentiate among different editions and versions of Windows XP.
b.   Compare among the versions of Windows 7.
c.   Describe the difference between 32-bit Windows and 64-bit Windows.

Lesson 3: Windows Operating System Architecture

3.1 Learning Objectives

On completion of this lesson you will be able to describe:

❖ The kernel of Windows Operating System.
❖ Different layers of Windows Operating System.

3.2 Windows 2000 Architecture

Windows 2000 Architecture

Windows 2000 architecture is the latest architecture of Windows operating system and the newer versions of the Windows OS have the same structure as Windows 2000. This structure is a modular structure, composed of several simple modules.

These modules are:

❖ Hardware Abstraction layer
❖ Kernel
❖ Executive Services
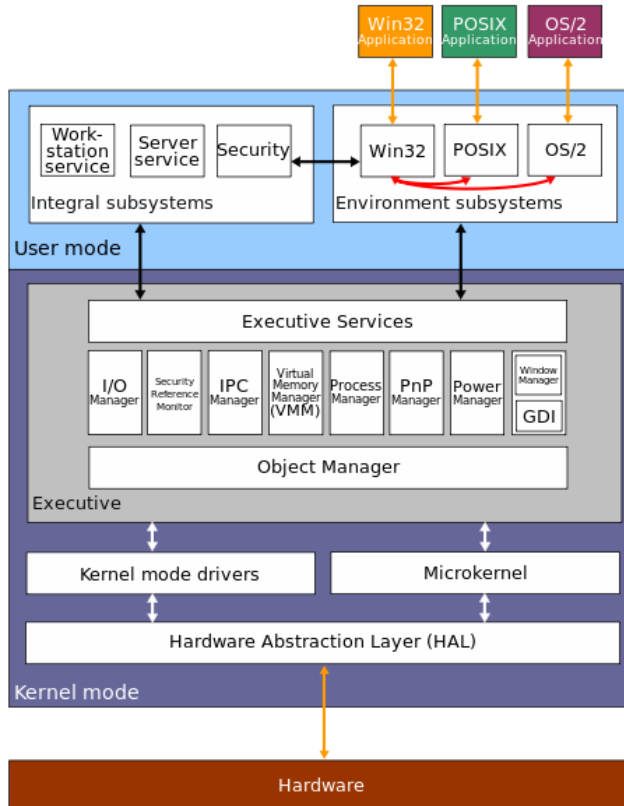❖ Integral Subsystems
❖ Environment Subsystems

Figure 3.1: Windows 2000 Architecture.

3.3 Hardware Abstraction Layer

Hardware Abstractions is a set of routines that give a program direct access to the hardware resources. The Hardware Abstraction Layer (HAL) makes the hardware dependencies transparent to the rest of the operating system. This allows Windows to be portable from one hardware platform to another.

3.4 Kernel

The Kernel works very closely with the HAL and is the heart of the operating system. It schedules the activities to be performed by the CPU. On a computer that has multiple processors, the kernel synchronizes activity among processors to optimize performance. For example, if you open more than one application, such as, MSWord, MS Excel, and PowerPoint, the kernel schedules the processor's time within all applications.

3.5 Executive Services

The Executive Services, which includes the kernel and the HAL, provides a set of common services that the user can use. This section interacts with Input/output devices, object management, process management and the system security. The Object Manager of executive service first allocates an empty object and then reserves the required resources. After that Ob inserts the object and makes it accessible through its name or a handle (cookie). A Handle is an identifier that points to a certain Kernel resource. The Security Reference Monitor (SRM) in executive service is responsible for enforcing the access validation and audit-generation policy defined by the local security subsystem.

3.6 Integral Subsystem

The integral subsystems are services that provide the APIs that Win32 applications call to perform important operating system functions, such as creating windows and opening files.

3.7 Environment Subsystems

Windows 2000 allows many different types of applications to run on the same graphical desktop. It runs applications for operating systems such as MS-DOS, OS/2, Windows and POSIX. Windows 2000 support a variety of applications through the use of Environment Subsystems, which are Windows 2000 processes that emulate different operating system environments. For example, through command prompt of Windows 2000, you can get the CUI environment of DOS.

1.3.1 Exercise

3.8.1 Multiple choice questions

1. Which part of the architecture allows Windows to be portable from one hardware platform to another?

(i) Hardware Abstraction layer
(ii) Kernel
(iii) Executive Services
(iv) Environment

a. What is a Handle that points to a certain Kernel resource?
(i) A process
(ii) An identifier
(iii) A manager
(iv) A monitor

b. Which is responsible for enforcing the access validation and audit-generation policy?
(i) Device Manager
(ii) Security Reference Monitor
(iii) Virtual Memory Manager
(iv) Cache Manager

3.8.2 Questions for short answers
a. What is a Kernel?
b. Name the layers of Windows architecture.

3.8.3 Analytical Questions
a. Describe the functions of the Hardware abstraction layer.