Wolaita Sodo University

School of Informatics

Department of Information Technology

Module Prepared for University Exit Exam

Course Theme: - Computer System

Course Name: - **Computer Maintenance and Technical Support**

Course code: - **ITec3031**

Academic year: - 2023/2015

ECTS/Credits: - 7/4

Status of the course: - Core

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General objective/Competency:

- Identify failures of computer hardware and software and properly apply the procedures of maintenance and repairing of computer system

Specific objectives /learning outcomes

- Students will be able to identify computer components and their cases
- Students will be able to distinguish types of computer cases/problems
- Students will be able to apply procedures to maintain and repair the computer system

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Contents

Basics of Computer Hardware

- **Personal Computer Hardware Components**

Instruction

• Apply all Precautions required before working on computer components

A] Identify the name, function and characteristics of the following Computer Components (with their **usage)**

1. System unit/Cassis (is it Tower case/Desktop/mini-tower)
2. USB port
3. Parallel Port
4. Serial Ports
5. Audio/video ports
6. RJ-45 port/Ethernet
7. PS/2 Port
8. RJ-11
9. Power chord
10. DisplayPort / HDMI / DVI / VGA

B] Identify the following internal components of a computer

1. Motherboard. The motherboard is the computer's main circuit board.
2. CPU/processor, Heat sink & fan
3. RAM (random access memory)
4. Hard drive& its connector
5. CD/DVD Driver & its connector
6. Power supply unit & its connectors (Molex, mini Molex, AT/ATX)
7. Video card
8. Network card
9. Expansion cards
10. CMOS Battery
11. Chipsets
12. RAM Slot
13. PCI Slop

Components of Motherboards

- **Motherboard category**
    - Integrated motherboards
        - Have all essential components integrated?
        - All major functions are handled by a single circuit board
        - The drawback is that if one of the components fails, you might need to replace the entire motherboard
        - And most of the new motherboards fall in this category
    - Non-integrated motherboards
        - Do not have all components integrated on them
        - Components installed as adapter cards on expansion slots
        - If one component fails it is simply replaced (advantage)
        - The inside component of the computer is full of cards (adapters) and wires (disadvantage)
        - And most of the older motherboards fall in this category
- **Motherboard Form factors**
    - **Form factor** refers to the design of the mother board
    - Popular form factors include:
        - AT (Advanced Technology), ATX (Advanced Technology Extended) and BTX (Balanced Technology Extended)

Chipsets

- The chipset of a motherboard refers to the collection of semiconductor chips that provide interfaces for expansion cards, memory, peripherals, and interfaces.
- Chipsets are divided into two main categories—Northbridge and Southbridge:

.1.1. Northbridge:

The Northbridge is a chipset that does not refer to any brand name but is the technique used to **allow communication** among **high-speed peripherals** such as memory, the Peripheral Component Interconnect (PCI) bus, the Accelerated Graphics Port (AGP) bus and the Level 2 processor cache (L2

Cache). The Northbridge communicates with the processor using a ***front side bus (FSB)***. The **actual performance** of the motherboard depends on the **performance** of the **Northbridge** chipset. It also manages communication with the Southbridge chipset.

.1.2. Southbridge

The Southbridge chipset controls all of the computer's onboard Input/Output (I/O) functions such as USB, Firewire, PS/2, parallel, serial, wired, and wireless LAN ports, and IDE, audio, and so on. Southbridge usually consists of a single semiconductor chip.

BIOS/Firmware.

The Basic Input/Output System (BIOS) or firmware of the computer is **low-level software** stored on a semiconductor chip, which is called the **BIOS** chip. BIOS controls how the **processor and chipsets** interact with the installed operating system, and it also helps **detect** the hardware and to **allocate** system resources to it. BIOS is activated as soon as the computer is powered on. The BIOS chip is a dual-line chip with 28 or 32 pins and is usually marked as such. Major manufacturers of BIOS chips include ***AMI*** (American Megatrends Inc.), ***Phoenix/Award***, and ***Winbond***. The complementary metal-oxide semiconductor (CMOS) chip, on the other hand, isa memory chip that stores certain computer settings (such as the date and time) even when the computer is powered off. The CMOS chip gets its power from a small cylindrical battery, called the CMOS battery, installed on the motherboard.

Memory slots.

The primary memory of the computer is the random-access memory (RAM), which is used to temporarily store data during normal operation of the computer. The slots for memory on the motherboard are different for each type of memory and for each type of motherboard design. Most motherboards have slots for dual inline memory modules (DIMMs). DIMMs come in different pin configurations, such as 168-pin, 184-pin, and 240-pin. Some old motherboards use single inline memory modules (SIMMs) that come in 30-pin or 72-pin configurations. It is easy to identify the memory slots on the motherboard, as they are long and located very close to each other. A latch on each side of the slot is used to firmly attach the memory module in place. The pair of memory sockets is also called memory bank.

External cache memory.

Computers use the processor cache memory for improved performance. Each processor comes with a built-in cache memory, which is known as **Level 1 Cache.** Another name for it is internal cache, which runs at the speed of the CPU. To further enhance the performance of the system, motherboards have

external cache memory, which is called Level 2 Cache or External Cache. The External Cache runs at the speed of the system bus.

Processor sockets.

The central processing unit (CPU), or simply the processor, lies at the heart of a computer motherboard. The type, shape, size, and pin configuration of a processor socket depends on the processor itself. Processor sockets or slots are identified by standards written for installing different types of processors on motherboards. Processor sockets are normally flat in shape and have several rows and columns of pins. It is not difficult to identify a processor socket on the motherboard. Most Pentium class processors are installed along with a heat sink and a cooling fan because they generate a lot of heat during normal operation. A processor slot is another way to connect a processor to the motherboard. Slots were used on earlier Pentium II and Pentium III processors. The processor is mounted on a special expansion card and is inserted vertically in the slot. Most of the processor sockets are square in shape, and the processor is usually marked with a dot to correctly align it with the socket. This is done to ensure that the processor pins are not damaged during insertion. Some processors use a special socket called the zero-insertion force (ZIF) socket that makes it easy to insert and remove the processor.

Integrated I/O ports.

Many of the standard I/O controllers for peripherals are integrated in the motherboard. Their connectors are accessible from the rear of the computer case and are used to connect I/O devices.

The most common connectors include the following:

.1.3. The 15-pin SVGA connector

- Used to connect a CRT or LCD monitor.

.1.4. The 6-pin PS/2 connector (mini DIN)

- Used to connect the keyboard and mouse. Old motherboards have a 5-pin
- DIN connector, which is little bigger than the PS/2 connector.

.1.5. The 9-pin serial connector

- Used to connect serial devices such as modems or scanners.

.1.6. The 25-pin parallel connector

- Primarily used to connect printers.

.1.7. The 8-pin RJ-45 connector

- Used to connect network cable.

.1.8. The 4-pin RJ-11 connector

- Used to connect the telephone cable.

.1.9. USB connector

- Used for USB devices.

.1.10. IEEE 1394 connector

- Used to connect devices that support the Firewire interface.

Expansion bus slots.

Expansion bus slots on the motherboard can be easily identified, as they are located close to each other and near the rear end of the case. Each type of expansion bus slot serves a particular function, as summarized in the following paragraphs:

.1.11. Peripheral Component Interconnect (PCI)

- PCI slots are available in most computers these days.
- These slots are used toconnect PCI compatible cards.
- They are usually white and are about threeinches long.

.1.12. Accelerated Graphics Port (AGP)

- AGP slots are used to connect video cards.
- The AGP port allows the video adapter to communicate directly with the processor.
- The AGP slot is usually brown.

.1.13. PCI Express (PCIe)

- PCIe is available on many new motherboards. This slot was designed to replace the PCI and AGP slots. But most motherboards have PCI as well as PCIe slots.

.1.14. Industry Standard Architecture (ISA)

- ISA is the oldest type of expansion slot on motherboards.
- This black-colored slot is long in shape and has two parts: one small and the other long.
- ISA slots are hardly visible in modern motherboards.
- You might find that some old motherboards have both ISA and PCI slots.

Floppy disk and hard disk connectors.

- Most of the motherboards have integrated hard-skinned floppy disk controllers.

- The floppy disk connector is used to connect a floppy disk drive, while the hard disk connector can be used for connecting hard drives or CD/DVD drives.

  Depending on the motherboard, these connectors can be any of the following types:

- **EIDE/PATA**
  - The Enhanced Integrated Drive Electronics (EIDE) interface is the term used to describe the Advanced Technology Attachment (ATA) interface.
  - EID Econnectors are found on most motherboards.
  - These connectors have **40** pins and use a flat ribbon cable.
  - The first pin on the cable is marked with a **red** lining.
  - Since the data is transferred in parallel fashion from motherboard tothe drive, the interface is also called Parallel ATA (PATA).
  - EIDE drives use a4-pin power connector.
- **SATA**
  - The Serial Advanced Technology Attachment (SATA) transfers data betweenthe motherboard and the drive in serial fashion.
  - The connectors for SATAinterfaces have **seven** pins.
  - SATA drives use a **15-pin** power connector.

.1. Power supply connectors

- There is only one main power supply connector on the motherboard.
- There is also a small 4-pin connector for the CPU/fan assembly.
  - It is rectangular in shape and white in color.
- ATX motherboards use a 20-pin power supply connector in which the holes are polarized to prevent incorrect connection.

Power supplies

- The purpose of the power supply is to convert 110-volt or 220-volt AC voltage into DC voltage for different parts of the computer.
- The power supply unit for the computer has its own case.
- These DC voltages include 3.3 volts, +5 volts, –5volts, +12 volts, and –12 volts.
- The rating of the power supply unit is given in watts, which is a measure of power.
- The higher the rating, the more power it can supply to different parts of the computer.
- Most common power supplies come in the range of a **250- to 500-watt rating.**

The+3.3 volts and +5 volts DC supply was first used in ATX motherboards that supported **soft power off** functions.

Power supply connectors

There are several different types of power supply connectors used on computer motherboards and peripherals. Some of the common connector types are listed in the following paragraphs:

- Floppy drive power connector (mini-Molex)
    - This is a small, flat connector with four pins.
    - This connector has 4 wires and supplies 5 volts (red wire) and 12 volts (yellow wire) DC to the floppy drive.
    - The connector is polarized and cannot be connected in wrong orientation.

Molex connectors for peripherals

- Peripherals such as the hard drive and CD/DVD drives use a 4-pin Molex connector.
- This connector is bigger than the floppy drive power connector.
- It has a particular rectangular shape that allows the connection only in correct polarity.
- It uses the same color codes for wires as the floppy drive power connector does.

AT motherboard power connector

- This is a pair of two connectors with six pins each.
- The connectors have small tabs on them so that they can be securely attached to the mother board connector.
- You need to place the connectors side by side with black-colored wires in the center, align the connectors in correct orientation, and then slightly push them together onto the motherboard connector.

ATX power connector

- This is used for supplying power to ATX motherboards. It is also known as ATX System Connector.
- This is a single 20-pin connector that supplies six different types of voltages to the ATX motherboard.
- The connector is rectangular in shape and has a small plastic lock that secures the connector in place. Another variation of the ATX power connector is the ATX12V standard connector, which requires two additional power connectors for the motherboard.
- One of these is a 6-pin connector that supplies additional +5 volts and+3.3 volts. The other is a 4-pin connector that supplies two +12 volt supplies.

SATA power connector

- Serial ATA (SATA) devices use a 15-pin power supply connector.
- This connector supplies three sets of DC power, for +3.3 volts, +5 volts, and +12volts.

Processors

- The processor, or the central processing unit (CPU), is the heart of the computer. It controls and directs all functions inside the computer. The term microprocessor refers to the semiconductor chip on the motherboard that contains millions of transistors. The CPU is the most important component of the computer so far as the computing power is concerned. The size and packing of old CPUs used to be very large compared to the size and shape we see these days. Old CPUs also had limited capabilities and features. The two main manufacturers of microprocessor chips are Intel and AMD.
- Old processors came in a rectangular shape and with Dual inline package (DIP),with two rows of connection pins on each side. New processors come in Pin Grid Array (PGA) packaging, which is a square shape and has connection pins on all four sides. Some processors use a Single Edge Contact Cartridge (SECC) Formfactor. This uses a separate printed circuit board for the same PGA-type processor. Processors are mounted on the motherboard using a special socket or a slot. As the processor technology grows in features and advanced capabilities, the space on the motherboard becomes the main limitation. The Staggered Pin Grid Array (SPGA) packaging solves this problem. SPGA uses arrays of pins, which form a diagonal square.

Characteristics of processors:

Following paragraphs summarize some basic characteristics of processors:

- **Hyper-threading Technology (HTT)**

HTT is the specialized form of simultaneous multi-threading (SMT) used in Intel's Pentium 4 microprocessors. This technology improves the performance of microprocessors by providing useful work to idle execution units and allowing multiple threads to run simultaneously. Processors using the hyper-threading technology appear to the operating system as two processors. If the operating system supports symmetrical multiprocessing (SMP), it can take advantage of this technology by scheduling separate processes on the same HTT-capable microprocessor.

- **Multicore**

A multicore processor integrates two or more processors into a single package. The operating system treats the single multicore processor as two separate processors. The operating system must support symmetrical multiprocessing to take full advantage of a multicore processor. Intel's Dual Core processor

is an implementation of the multicore technology that contains two independent processors in a single chip.

- **Throttling**

CPU throttling is the process of controlling the time spent by the processor on each application. The idea behind throttling is to fairly divide the CPU time among various applications. CPU throttling is mainly used on servers that need to distribute even time to all applications running on it.

- **Microcode and MMX**

Microcode (or microprogram) is the instruction set of a CPU. The CPU uses the microcode to execute various instructions. Microcode consists of a series of microinstructions that control the CPU at its most fundamental level. Microcode is designed for the fastest possible execution of instructions, and it resides in a special high-speed memory of the computer called the control store. MMX refers to Multimedia Extensions, a special microcode developed for Intel's Pentium MMX processors. MMX microcode takes the load off executing multimedia-related instructions from the processor and acts like aco-processor.

- **Overclocking**

Overclocking is used in microprocessors and other computer components to increase their performance. CPU overclocking forces the processor to run at higher clock rates than that for which it was designed. When the CPU is overclocked, arrangements must be made to dissipate the additional heat that it will generate due to increased processing.

- **Cache**

Cache is a high-speed memory that is used to store data and instructions that are most likely to be required by the CPU. The cache located within the CPU is called Level 1 Cache (L1 Cache), and the external cache on the motherboards called Level 2 Cache (L2 Cache). If the cache does not have the necessary data or instructions, a process named cache miss brings the information from RAM and stores it in the cache.

- **Voltage Regulator Module (VRM)**

A VRM is an electronic device that provides the microprocessor with appropriate supply voltage. A VRM allows microprocessors requiring different power supply voltages to be used on the same motherboard. At startup, the microprocessor signals the VRM about the correct voltage supply that it needs. The VRM then supplies a consistent correct voltage to the processor.

- **Speed**

The speed of a microprocessor is represented by its clock frequency, which is measured in Megahertz (MHz) or Gigahertz (GHz). Clock rates or frequencies can be misleading when the speeds of the

microprocessors are compared. This is due to the fact that the amount of work a microprocessor can do in one clock cycle varies from one CPU chip to another.

32-Bit versus 64-Bit Bus

The number of data bits that can be transmitted or processed in parallel is represented by the bus width, which can be 32-bit or 64-bit. The 32-bit bus transmits 32 bits in parallel while the 64-bit bus transmits 64 bits of data in parallel. The width of the data lines that connect the microprocessor to the primary memory of the computer is known as the bus width. The wider the bus, the more data can be processed in a given amount of time. It is important to note that if you are using a 64-bit operating system, you must ensure that the CPU supports 64-bit bus width.

Memory

Random access memory (RAM) is considered the primary or main memory of the computer, and it allows quick data storage and access. This memory is used as temporary storage by the system and by applications during normal operation of the computer. Memory modules, or memory sticks, are small; thin circuit boards that are installed on the motherboard as several rows close to each. In this section, we will look at some basic characteristics and types of memory, as well as memory packaging.

Error checking in memory

There are two main mechanisms used for error checking in computer memory. These are explained in the following paragraphs:

Parity RAM

Parity RAM uses a parity checking mechanism to check the integrity of digital data stored in memory by detecting errors. Memory modules using parity checking are known as parity RAM. These modules are hardly used these days. A parity bit is used as error-detecting code. The parity bit is a binary digit (0 or 1) that indicates whether the total number of bits with a value of 1in a given set is even or odd. Two types of parity bits are used: even parity bit and odd parity bit. The even parity bit is set to 0 when the total count of 1s in the given set is even. If the total count of 1s is odd, the bit is set to 1. On the other hand, the odd parity bit is set to 0 when the total count of 1s in the given set is odd. If the total count of 1s is odd, the bit is set to 0. Parity checking is only a method of checking errors. It does not indicate the cause of the error and does not correct it.

Non-parity RAM

If parity RAM is used, the memory modules need to have more chips for calculation of parity. This not only increases the size of the module but also increases costs. For this reason, non-parity RAM is used on most computers.

Error Checking and Correction RAM (ECC RAM)

ECC RAM automatically detects and corrects errors in memory, without the involvement of the motherboard circuitry. The ECC mechanism generates checksums before storing data in memory. When the data is retrieved from the memory, the checksum is calculated again to determine whether any of the data bits have been corrupted. ECC memory can generally detect 1-bit and 2-bit errors, but can only correct errors that are 1 bit per word.

Types of memory.

Computer memory or RAM is used to temporarily store data. RAM can be dynamic or static. For most common functions, the dynamic random-access memory (DRAM) is used as the main memory of the computer, while the static random-access memory (SRAM) is mostly used for the system cache. The following paragraphs summarize different types of memory:

- **DRAM**

DRAM stands for dynamic random-access memory. The term dynamic refers to the requirement of the memory chip to be periodically refreshed in order to retain its contents—if this fails, the stored contents can be lost. DRAM is much cheaper than other types of memory and is most commonly used to expand the computer memory. Popular variations of DRAM include SDRAM, DDR, DDR2, and RAMBUS.

- **SDRAM**

SDRAM stands for synchronous dynamic random-access memory. SDRAM has a synchronous interface, which means that it waits for a clock signal before it responds to an input. It is synchronized with the computer's processor. The system bus. SDRAM interfaces with the processor in a parallel 8-byte (64-bit)bus and thus, a 100 MHz clock signal produces 800 MBPS throughput. The100 MHz SDRAM modules are commonly identified as PC100 chips.

- **DDR SDRAM**

DDR SDRAM refers to double data rate synchronous dynamic random-access memory. These memory modules can double the data transfer rate by using both rising and falling edges of the clock without actually increasing the frequency of the system bus. This means that a 100 MHz DDR has an effective clock rate of 200 MHz for a 100 MHz clock signal, the effective data rate becomes 1600 MBps (2 × 8 × 100). DDR SDRAM modules are also referred toas PC1600 chips.

- **DDR2 SDRAM**

DDR2 SDRAM refers to double data rate 2 synchronous dynamic random-access memory. This type of memory first doubles the clock rate by using both edges of the clock signal and then further splitting a

single clock into two, thus doubling the number of operations for each clock cycle. DDR2SDRAM uses 1.8 volts (as compared to the 2.5 volts used by DDR SDRAM) to keep the power consumption low. DDR2 modules are referred to asDDR2-400 or PC2-3200 chips.

- **DRDRAM**

DRDRAM stands for Direct Rambus dynamic random access memory, a technology developed by Rambus Corporation. These types of memory modules are no longer really in use. DRDRAM supports the PC800 standard and operates at 400 MHz The effective data transfer rate is 1600 MBps on a 2 byte(16-bit) data bus.

- **SRAM**

SRAM stands for static random access memory. The term static means that the contents of the memory are retained as long as the power is turned on. SRAM is much faster and much more expensive than DRAM. It is mainly used for cache memory.

Memory modules.

Memory modules, or memory sticks, are available in a variety of packaging. The most common of them in use as of date are as follows:

- **SIMM**

SIMM stands for single inline memory module. There are two main types of SIMMs: 30-pin, which has an 8-bit data bus, and 72-pin, which has a 32-bitdata bus. SIMMs do not have a standard pin configuration. SIMM has largely been replaced by DIMM.

- **DIMM**

DIMM stands for dual inline memory module. DIMM is a 64-bit module used for SDRAM, DDR, and DDR2 memory. A standard SDRAM has 84-pins one ach side, making it a 168-pin module. DDR DIMM has 184 pins with 1keying notch, and the DDR2 DIMM has 240 pins with 1 keying notch. TheDDR2 DIMM also has an aluminum cover on both sides that is used as a heatsink to prevent overheating.

- RIMM

RIMM refers to Rambus inline memory module. It is a custom memory module made by Rambus. RIMM modules come in 16-bit single channel width or in 32-bit dual channel bus width. The 16-bit modules have 184 pins, and the 32-bit modules have 232 pins. Sixteen-bit modules need pairs of slots on the motherboard, while the 32-bit modules require only one. RIMM also has an aluminum cover for dissipation of heat.

- **SO-DIMM**

SO-DIMM stands for small outline dual inline memory module. It is mainlyused in laptop computers. The old 32-bit SO-DIMM had 72 pins, while thenew 64-bit modules come in 144-pin and 200-pin configurations.

- **Micro DIMM**

Micro DIMM is the smallest of all DIMM packages (about 50 percent the sizeof SO-DIMM) and is mainly used in laptop computers. These modules have a64-bit bus width and come in 144-pin or 172-pin configurations.

Storage Devices:

As noted earlier in this section, the RAM is called the primary memory of the computer. The hard disk drive remains the main storage device for most personal computers and is called the secondary storage device. Besides hard disk drives, other secondary storage devices are also frequently used for storing data, but most of these are categorized as removable storage devices. These include floppy disks, zip drives, tape drives, USB drives, and CD and DVD drives. This section summarizes the types and characteristics of different styles of storage devices.

1. **Floppy disk drives:**

1.1.A floppy disk, or diskette, consists of a circular piece of thin plastic magnetic sheet encased in a plastic case. These disks are read and written in floppy disk drives (FDD). Earlier floppy disks were 8 inches in size, later reduced to 5.25 inches, and finally reduced to 3.5 inches. The storage capacity of a normal double-sided floppy disk is usually 1.44 MB. Many new computers do not have a floppy disk drive at all due to high storage capacity and falling prices of CD and DVD disks and drives.

1.2.The 5.25-inch floppy disk was known as mini-floppy disk and had a capacity of 360KB for a double-sided double-density disk, and a capacity of 1.2 MB for a double-sided high-density disk. The capacity of 3.5-inch disks, called the microfloppydisk, is 720 KB for a double-sided disk, 1.44 MB for a high-density disk, and 2.88MB for an extended density disk.

2. **Hard disk drives:**

Hard disk drives are the main storage devices for all personal computers and servers. Data is stored on hard disks in the form of files, which is a collection of bytes. A hard disk is usually 3.5 inches wide, and its capacity is measured in gigabytes (GB). It is not uncommon to see hard disks with capacities ranging from 20 GB to even 250 GB. The hard disk drive subsystem of the computer consists of the following three components:

Controller board:

Operates the drive. It is typically located on the hard disk itself and controls different motors, electrical signals, and sensors located inside the disk.

Disk:

Consists of a number of thin disks or platters and read/write heads. The disks are the main medium used to store data. They are placed close to each other inside an enclosure. The disks spin at a speed of 3600 to 7200 (or even10,000) revolutions per minute (rpm). An arm mechanism holds the read/write heads and moves them very precisely at a fast speed. The data is stored on disks in sectors and tracks.

Hard disk adapter:

Typically built in the motherboard. It converts signals from the disk and the controller so that the motherboard can understand it. In old computers, the hard disk adapter was installed on one of the expansion slots.

CD-ROM drives.

A compact disc read-only memory (CD-ROM) is used for long-term storage of data and for distribution of software. The term read-only means that data can be written only once on the CD. Nearly all computers have a CD-ROM drive. The capacity of a typical CD-ROM is about 700 MB. CD-ROM drives are rated in terms of their speed, which is a multiple of 150 Kbps. It is expressed as2X, 4X, 8X, etc., which means that a 2X CD-ROM drive can transfer data at the rate of 300 Kbps. Most new CD-ROM drives are rated between 48X to 52X.

CD burners:

CD burners refer to drives that can write data on CD-Recordable (CD-R)and CD-Rewritable (CD-RW) discs. The main difference between the two is that the CD-R can be used to store data only once while the data on a CD-RW can be erased and the space can be reused any number of times. Some advanced software applications allow you to reuse the CD-R disc until it is full. The speed of CD-R and CD-RW differs when reading the disk, writing data, and rewriting. A rating of 32X-16X-4X means that the drive can read data at 32X speed, write data at 16X speed, and rewrite at 4X speed.

DVD-ROM drives:

A digital versatile disc (DVD) has a larger capacity than a CDROM.DVDs can store up to 4.7 GB of data on a single-sided, single-layered disk. Since the DVD-ROM drive is basically the same as the DVD player, you can use it to play DVD movies on your computer. A double-sided, double-layered DVD can store up to 17 GB of data. The DVD drive has the same appearance as the CD drive. The only way to identify it is from the DVD logo on the front panel.

DVD burners:

A DVD burner, or a DVD writer, refers to a DVD drive that can write data on a DVD disc. A single-sided, double-layered DVD disc can store up to 8.5GB of data. DVD burners and writable DVDs have several formats that include DVD-ROM, DVD-R, DVD+R, DVD+RW, and DVD-RAM, depending on the burning technology used. A drive meant for a particular technology may not support burning on other types of DVD discs.

Tape drives:

Tape drives are the traditional type of removable storage media used for taking data backups. Tape drives can be internal or external devices and can be digital or analog. The capacity of tape drives is much more than the hard disks.

Flash memory:

Flash memory, which was at one time used as the main memory for computers, is still used for booting devices such as network routers and switches. For example, Cisco stores its Internetwork Operating System (IOS) in flash memory. It is accessed at the startup time to boot the device. Other forms of flash memory include Secure Digital (SD) cards, USB thumb drives, and PC cards. SDcards are used in mobile phones, digital cameras, and camcorders for additional storage space. It has a write-protect tab that prevents accidental erasure of data. USB thumb drives are very popular for their convenience with transporting data from one computer to another. These drives are considered a good replacement for other types of removable media such as floppy disks, Zip, and Jazz drives. All thumb drives are Plug and Play (PnP)-compatible.

External disk drives:

External disk drives offer additional storage space and are connected to serial, parallel, or USB ports on the computer. Most of the new external disk drives are USB-compatible, which further offer the PnP features. PnP allows the device to be detected and configured automatically. One interesting thing to note is that the external disk drives use the same disk that is used in the computer with additional circuitry to convert the interface to USB.

Display devices:

Computer display devices or monitors fall into two main categories: cathode ray tube (CRT) and liquid crystal display (LCD). Each type of the device is supported by a video display unit (VDU) adapter or integrated video controller on the motherboard. There are several different types of video technologies, each offering different levels of screen resolution and color depth. Resolution refers to the number of

horizontal and vertical pixels that a monitor is able to display. For example, a resolution of 800 × 600 would use 800 horizontal and 600 vertical pixels to draw text or images on the screen. Color depth refers to the number of colors the monitor is able to display.

Video technologies:

A summary of different video technologies is given in them following paragraphs:

Monochrome:

Earlier video technology used monochrome or black and white video displays. The monochrome video had a maximum screen resolution of 720 × 350pixels. Initially, the monochrome technology was unable to display graphics. The Hercules Graphics Card (HGC) was used to display graphics. HGC used two separate modes: text mode for text, and graphics mode for images. Monochrome monitors used a DB-9 D-sub connector that had nine pins arranged in two rows.

Color Graphics Adapter (CGA):

IBM was the first to introduce the CGA video technology. It could use a screen resolution of 640 × 200 pixels with two colors, one of which was black. With four colors, the resolution dropped to 320 × 200 pixels.

Enhanced Graphics Adapter (EGA):

To overcome the limitations of the CGA technology, IBM introduced the EGA video technology. EGA was able to display 16 colors and a screen resolution of 640 × 350 or 320 × 200.

Video Graphics Array (VGA):

The VGA uses 256 KB of on-board video memory and is able to display 16colors with 640 × 480 resolution or 256 colors with 320 × 200 resolution. The main difference between the earlier technologies and the VGA technology is that VGA used analog signals instead of digital signals for the video output. VGA uses an HDB-15 D-sub connector with 15 pins arranged in 3 rows.

Super Video Graphics Array (SVGA):

The Video Electronics Standards Association (VESA) developed the SVGA video technology. SVGA initially supported a screen resolution of 800 × 600pixels with 16 colors. Later, the new developments made the SVGA display1024 × 768 resolution with 256 colors. SVGA also uses an HDB-15 D-sub connector with 15 pins arranged in 3 rows.

Extended Graphics Adapter (XGA):

XGA is another development by IBM that uses the Micro Channel Architecture(MCA) expansion board on the motherboard instead of a standard ISA or EISA adapter. XGA video technology supports a resolution of 1024 × 768 for256 colors and 800 × 600 resolution with 65,536 colors.

Digital Video Interface (DVI):

DVI is a digital video technology that is different from the analog VGA technologies. VI connectors look like the standard D-sub connectors but actually are different in pin configurations. The three main categories of DVI connectors are DVI-A for analog-only signals, DVI-D for digital-only signals, and DVI-I for a combination of analog and digital signals. The DVI-D and DVI-I connectors come in two types: single link and dual link.

High Definition Multimedia Interface (HDMI):

HDMI is an all-digital audio/video interface technology that offers very high resolution graphics and digital audio on the same connector. HDMI provides an interface between any compatible audio/video source—such as a DVD player, a video game system, or an AV receiver—and a digital audio video monitor—such as digital television (DTV). It transfers uncompressed digital audio and video for the highest and crispest image quality.

S-Video

S-video or Separate-video is an analog video signal that carries video signals as two separate signals. It is also known as Y/C video, where Y stands for a luminance (grayscale) signal and C stands for chrominance (color). The basic connector for S-Video is a 4-pin mini-DIN connector that has 1 pin each for Y and C signals, and 2 ground pins. A 7-pin mini-DIN connector is also used in some cases. S-Video is not considered good for high-resolution video due to lack of bandwidth.

Composite Video

Composite Video is a technology in which all components are transmitted on a single cable. This is in contrast with Component Video, which is an analog video technology that splits the video signals into red, green, and blue components. Component video uses three separate RCA cables for each color.

Types of monitors:

Monitors are mainly classified into two categories: CRT and LCD, which are summarized in the following paragraphs.

CRT monitor:

A cathode ray tube (CRT) monitor is the most commonly used display device for desktop computers. It contains an electron gun that fires electrons onto the back of the screen, which is coated with special chemical called phosphors. The screen glows at parts where the electrons strike. The beam of electrons scans the back of the screen from left to right and from top to bottom to create the image. A CRT monitor's image quality is measured by its dot pitch and refresh rate. The dot pitch specifies the shortest distance between two dots of the same color on the screen. Lower dot pitch means better image quality.

Average monitors have a dot pitch of 0.28 mm. There fresh rate, or vertical scan frequency, specifies how many times in one second the scanning beam can create an image on the screen. The refresh rate for most monitors varies from 60 to 85 Hz.

LCD monitor

LCD monitors are used in desktop computers as well as laptops. LCD displays are covered later in the section "Laptops and Portable Devices."

Input devices:

An input device for a computer is used to transfer information from a user or another device to the computer for processing. While a keyboard and a mouse are the basic types of input devices used for user input, some other types of devices (such as a touch screen, multimedia devices, and biometric devices) are also considered input. The computer basically receives input, processes it, and produces results. The following sections cover a brief discussion of some of the commonly used input devices.

Mouse:

A mouse is a pointing device used to interact with the computer. It controls the movement of the cursor on the screen and you can point to an object and click a button on the mouse to select it. The following are the basic types of mice:

Mechanical mouse:

This uses a rubber ball on its bottom side, which can roll in all directions. Mechanical sensors within the mouse detect the direction of the ball and move the screen pointer accordingly.

Opto-mechanical mouse

This is similar to the mechanical mouse but uses optical sensors to detect the motion of the ball.

Optical mouse

This does not have a ball or any other moving parts. It uses light signals to detect the movement of the mouse. This mouse must be used with a special mouse pad that reflects the optical signals. Newer optical mice use laser signals that do not even need an optical pad.

Wireless mouse

Also called a cordless mouse, this has no physical connection with the computer and uses infrared radio signals to communicate with it. A mouse can be connected to the computer by a serial port, a USB port, or a PS/2port, or it can be a wireless mouse using radio signals. You can configure the properties of the mouse in the operating system to change the way a mouse responds to various user actions. For example, the functions of left and right buttons can be interchanged, the speed of a button click can be changed, or the shape of the pointer can be selected from a variety of shapes.

Keyboard.

A keyboard is the most popular and useful of all input devices. A layout of keys on a normal keyboard resembles the keyboard of an old styled QWERTY typewriter. A standard AT keyboard has 84 keys, while newer keyboards normally have 101. In addition to standard alphabetic, numeric, and punctuation keys, computer keyboards have special arrow keys and function keys labeled F1, F2,and so on. A separate number pad allows a user to enter numbers with faster speed. As with the mouse, a keyboard can also be connected to a computer using the serial port, a PS/2 port, or a USB port. In addition, it can be a wireless keyboard using infrared radio signals to communicate with the computer.

Barcode reader:

A barcode reader (or a barcode scanner) is a device that scans the code printed on a surface. Barcode scanners are widely used in retail stores or warehouses as input devices. It consists of an LED or laser-based light source, aset of lenses, and a photoconductor to translate the optical signals into electrical signals. Barcode scanners are connected to the computer using a serial port or a

USB port.

Multimedia devices. Multimedia input devices are mainly classified into two categories: audio and video. A variety of audio and video devices can be connected to the computer to send, receive, or process information. The most common examples of multimedia input devices include web cameras, digital cameras, microphones, and MIDI devices. The connection details of the device depend on the type of device and may vary from one device to another.

Biometric devices

Biometric devices are security devices that are used to control access to a system. A biometric device measures the physical characteristics (fingerprints, eye retina scan, or voice patterns) of a person for the purpose of identification. The information collected by the biometric device is sent to the computer for processing. The computer matches the input from a biometric device and compares it with its database to grant or deny access to the person.

Touch screen

Touch screens are considered a replacement for a standard keyboard and a mouse. A user can simply touch the screen, which translates the user’s actions into electrical signals. The computer receives these signals and processes the user’s request. Touch screens are not only used for computers but also for a variety of other applications, such as retail stores, PDA devices, bank machines, vehicles, and several appliances.

Adapter cards:

Adapter cards, or expansion cards, are used to extend the functionality of a computer. These cards are separate printed circuit boards that are installed on one of the available expansion slots of the computer. Depending on the system bus available in your computer, you must be careful when selecting an adapter card. For example, if you buy a PCI card, the motherboard must have PCI expansion slots. In this section, we will take a look at different types of adapter cards.

Video card:

A video card, or a video adapter, allows you to produce the video output of the computer on a display device such as the CRT or LCD monitor. Most of the new video cards use either the Peripheral Component Interconnect (PCI) bus or the Accelerated Graphics Port (AGP) bus. Some new adapters are PCIe-compatible.

Network card:

The network card, or network interface card (NIC) allows the computer to communicate with other computers on the network. It translates the parallel data stream on the system bus into serial data stream that can be transmitted on the network and vice-versa. Network cards can be PCI-, PCIe-, or ISA compatible. Each network card has at least one RJ-45 socket where the network cable is connected. When you install a network adapter, you must install its device driver and configure network properties of the OS such as the network protocol. Most new motherboards have built-in network functionality.

Sound card

A sound card is used to convert the digital signals into sound and get sound input through a microphone for recording. These cards have audio/video jacks for connection to speakers, headphones, and microphones. Most soundcards support the Musical Instrument Digital Interface (MIDI) functions and have a 5-pin mini-Din connector.

Modem card

A modem card is used when you have a dial-up Internet connection. The term modem stands for modulator demodulator. It converts the digital signals from the computer into analog signals that can travel on ordinary telephone lines and vice versa. Modems have a standard RJ-11 socket where the telephone line is connected. The modem card can be installed on a PCI, ISA, or PCIe expansion slot depending on the type of motherboard and the card. Most new motherboards include an integrated modem.

Types of port connectors:

Standard ports on computers serve as interfaces where you can connect external devices. Each type of port uses a different set of cables, and the device is attached using a different connector. In this section, we will look at some common types of connection ports and connectors. Figure 2-3 shows common ports found on atypical personal computer.

Universal Serial Bus (USB):

To date, the USB is the most common of all computer interfaces. It is used to connect a wide variety of external devices to the computer's 2.0 is the latest version of the USB standard. USB devices are Plug and Play(PnP)–compatible, and you can connect up to 127 devices in star topology on the same USB port using USB hubs. Most computers have two or more USB ports. USB hubs can be used to extend the number of USB ports. There are two types of USB connectors: Type A and Type B. A standard USB cable has a Type A connector on one end and a Type B connector on the other end. The cable end with the Type A connector is always connected to the computer. The Type B side is connected to the USB device. Each USB connector has a polarity and cannot be attached incorrectly.

Firewire:

The Firewire (IEEE 1394) ports are used primarily for their speed advantages. Firewire operates at a maximum data transfer speed of 400 Mbps. Firewire800 (IEEE 1394b) supports a maximum throughput of 800 Mbps and a cable distance of 100 meters. Firewire devices are hot-swappable, (can be connected and/or disconnected while the system is powered on) and you can connect up to63 devices. The maximum cable distance between devices can be up to 4.5meters. The Firewire port on the computer has a 6-pin connector, and the devices have a 4-pin connector.

Parallel:

Most parallel ports use a 25-pin D-sub connector. The other end of the parallel cable has either another 25-pin D-sub connector or a 36-pin Centronics connector. Most new printers use the USB port these days.

Serial:

A standard serial port has a 9-pin socket and the connector is 9-pin D-sub. Some other forms of serial interfaces include USB and Firewire. Serial cables are of two types: standard and null modem.

RJ-Series:

Registered Jack (RJ) connectors are used for connecting the computer toa telephone line or to the network. The telephone cables use an RJ-11 connector and sockets. It has two pins for a single line and four pins for two lines. The network port has an RJ-45 socket with eight pins and connects to an Ethernet

cable with a matching RJ-45 connector. A small plastic latch on the connector locks the connector in the socket.

PS/2 (mini-DIN):

PS/2, or mini-DIN, ports are mainly used to connect the keyboard and the mouse to the computer. The connector is round in shape and has six pins. Old computer keyboards used a 5-pin DIN connector that is little bigger than themini-DIN connector. The PS/2 port for the keyboard is purple in color and the mouse connector is green. These ports are usually marked on the computer to prevent incorrect connection. There is a small plastic pin in the center of the connector that also helps in attaching the connector in correct polarity.

Centronics:

A centronics connector is used to connect the parallel printers and SCSI devices. This connector is not located on the computer. The connector has two clips on each side to firmly lock it in place. On the computer side, a 25-pin D-subport is used for connecting a parallel device.

A/V jacks:

Most audio/video (A/V) jacks on computers are of RCA type. These jacks are used for connecting speakers, headphones, or microphones.

Cooling systems:

Computer components produce heat during operation. Some components, such as the CPU, produce so much heat that if some arrangement is not made to dissipate the heat, it can destroy itself. Nearly all computers have cooling systems to keep the internal components cool. These cooling systems also help in maintaining a proper flow of air inside the computer case. Additionally, heat sinks are used with some components to dissipate the heat from their surface. In this section, we will look at different cooling systems inside the computer.

Fans:

- Fans inside the computer are used to maintain the proper flow of air. Thefollowing types of fans are found on most computers:
- Power supply fan:
    - Used to cool the power supply. It is located inside the power supply unit.
- Rear exhaust fan:
    - Used to blow out the hot air inside the computer case.
- Front intake fan:
    - Used to bring fresh cool air from outside the computer case.

- CPU fan:
    - Used to cool the microprocessor. It is located on top of the CPU heat sink.
- Chipset fan:
    - Helps cool the chipset on the motherboard.
- Video card cooling fan:
    - Used on some high-performance video cards to keep the video chipset cool. It is located on the video adapter.

CPU cooling:

Keeping the CPU cool is very critical for the normal operation of the computer. The CPU is one of the PC's greatest heat-producing components. Some motherboards have an on-board CPU heat sensor and a CPU fan sensor. These monitor the temperature and shut down the computer if the heat reaches a level where it can damage the CPU or other critical chips.

The most common method of dissipating the heat generated by the CPU is to install a heat sink right on top of the CPU. A special chemical, called thermal compound is placed between the CPU and the heat sink to improve the thermal transmission between the CPU's surface and the heat sink. Additionally, a small fan is installed on top of the heat sink that blows the hot air away from the CPU surface.

On some CPUs, the heat sinks use heat pipes to take the heat away from the CPU surface. Some other manufacturers use CPU coolers that consist of a heat sink of copper plates and high-performance cooling fans.

In some cases, a liquid cooling system is used to keep the CPU cool. In this method, a water block is used to take the heat away from the CPU and the chipsets. Water is circulated from the water block to the radiator, where it is cooled. The major advantage of liquid cooling is that the cooling parts do not produce noise as do air-cooling systems.

Phase change cooling is another, more extreme cooling technology that takes advantage of the phase change from liquid to gas. The phase change cooler unit contains a small compressor similar to the compressor in a freezer. This unit is located underneath the computer. The compressor squeezes a cool gas and condenses it to liquid form. The liquid is pumped to the processor through a pipe, which heats it, causing its own heat to dissipate.

Installing, Configuring, and Optimizing Personal Computer Components

So far, you have learned about different types of components in a personal computer. As a PC technician, you are expected to be skilled in installing, removing, and upgrading these components. In this section, we will take a look at some basic techniques required when performing these tasks for specific devices such as storage, display, and input devices.

2.1. Installing storage devices

The main storage device for a personal computer is the hard disk. When installing, removing, or upgrading the hard disk, you need to prepare the disk before it is actually installed in the drive bay inside the computer.

Drive preparation. Drive preparation refers to the task of performing some basic jobs before the hard disks actually installed in the computer. In some systems, you may be required to format the disk before installation or configure its jumper settings to make it a Master or Slave drive. Hard drives fall into two main categories: **ATA/IDE** and **SCSI**. The procedure for configuring jumper settings is identical for hard disks as well as for CD/DVD drives when the motherboard has an ATA/IDE interface.

A typical computer motherboard has two IDE connectors, each with two connectors on a single cable. This means that you will be limited to four drives on one computer. When using the SCSI interface, you can connect up to seven drives on a single SCSI cable.

The following steps are completed before installing an IDE drive in the drive bay:

1. Set the Master/Slave jumpers on the drive. The jumpers on the drive can beset to Master, Slave, or Cable Select (marked as M, S, and CS respectively). Look for the jumper settings diagram on top of the drive. Each IDE interface an have only one Master connected to its cable, and the other

drive must beset as Slave. If this is the only drive connected to the interface, it must be set as Master.

2. Remove the drive bay from the computer case, if required.
3. Install the drive in the drive bay.
4. Reinstall the drive bay in case you have removed it.
5. Connect the power supply connector with correct orientation.
6. Select an appropriate connector from the ribbon cable. Identify its first pin(Pin 1) on the ribbon cable, which is usually a red-colored wire on one edge.Pin 1 or the red-colored wire is held close to the power supply connector. Insert the connector carefully.
7. Start the computer. Most drives are PnP-compatible, meaning that they will be identified and configured automatically by the system BIOS. If the computer BIOS does not automatically detect and configure the drive, you may need to enter the BIOS setup program and manually configure the drive.
8. Once the drive is installed, you need to partition and format the hard disk drive. This step is not necessary for CD/DVD drives. For hard disks, you can use the Disk Management utility to partition and format the drive if the computer already has an operating system installed on another hard disk. If this is the first or only drive in the computer, the drive can be partitioned and formatted during the installation of the operating system.

For installing *Small Computer System Interface (SCSI)* disks, the procedure is a little different. An SCSI drive can be an internal or external drive, depending on the hardware configuration of the computer. Also, the SCSI bus can be an 8-bit, 16-bit, or 32-bit bus. The main issues with preparing SCSI drives are as follows:

Cables, connectors, and termination

A typical computer may have an SCSI-1, SCSI-2, or SCSI-3 interface, each with a different number of pins. SCSI-1 has a 50-pin connector, SCSI-2 can have a 25, 50, or 68-pin connector, and the SCSI-3 interface can have a 68-pin or 80-pin connector. If the SCSI devices are internal devices, the single SCSI cable will have several connectors and the first connector is attached to the SCSI adapter. If the SCSI devices are external devices, they can be connected to the SCSI cable in a daisy-chain fashion. Each external SCSI device has two connectors. The first connector is attached to the SCSI cable from the adapter, and the second is attached to the next SCSI device using a similar SCSI cable, and so on. The second connector on the last SCSI device is terminated. Some SCSI devices have a built-in terminator.

Addressing

All SCSI devices must also be assigned a SCSI identification number (SCSIID), which must be unique on the SCSI bus. These ID numbers are from 0 to7 on an 8-bit bus, from 0 to 15 on a 16-bit bus, and from 0 to 31 on a 32-bitbus. A device with a lower SCSI ID always gets higher priority and performs better than devices with higher SCSI IDs. If the SCSI drive you are installing will be a bootable device, you must assign it SCSI ID 0.

Note: The procedure for installing and configuring an SCSI device is much more complex than installing an IDE device. Always refer to the documentation that comes with the device in order to configure it correctly. Remember that each SCSI device must be assigned an SCSI ID, and the SCSI bus must be terminated. If any of these settings are missing or incorrectly configured, the device will not work.

2.2. Installing/upgrading display devices

Installing or upgrading a display device is a common task for helpdesk and support technicians. The task typically involves replacement of an old or nonworking monitor with a new one. It seems to be a simple task, compared to installing other devices such as the hard disk. The following are some important steps that you must take when installing or upgrading monitors:

- Always ensure that the power supply to both the computer and monitor is turned off. Remove the main power supply cables from the wall socket.
- If replacing a monitor, remove the monitor cable from the rear panel of the computer case by removing the DB-15 connector.
- Obtain the driver for the new monitor. It is usually included in the monitor package, or you can download it from the manufacturer's web site.
- Connect the new monitor to the computer and connect to the AC main supply.
- Turn on the computer and look to see whether the computer BIOS and the OS detect the new hardware device.
- If required, install the driver software using an OS utility such as the Device Manager in Windows XP/2000.
- Refer to the user manual of the monitor to adjust brightness, contrast, and color levels. You may also need to adjust the horizontal and/or vertical positioning.

2.3. Installing and removing input/multimedia devices

The procedure for installing or replacing input/multimedia devices depends on the type of device. Installing or replacing a standard keyboard or mouse is fairly simple. These devices are typically connected to either the PS/2 port or the USB port of the computer. Both PS/2 and USB devices are PnP-compatible, meaning that no further manual configuration is required when any of these devices are installed. If you are replacing a PS/2 or USB keyboard or mouse with a wireless keyboard or mouse, you need to refer to the user manual to correctly configure the device settings. Wireless devices need a wireless adapter to be installed on the motherboard.

Troubleshooting Tools and Procedures

Troubleshooting is one of the major tasks that helpdesk and support technicians have to perform. Problems with computers may be a result of a user error, hardware failure, or a software issue. In this section, we will discuss the troubleshooting theory, basic diagnostic procedures, and the identification of problems with different components of the personal computer.

3.1. Basic troubleshooting theory

The basic troubleshooting theory can be summarized as follows:

- ***Back up user data***

If you need to make changes to the system, always back up the system and user data. Although you should not expect this, it is not uncommon that the system may break down because of the changes you make. Backing up datawill ensure that the same can be restored when the system is repaired.

- ***Systematic approach***

Always apply a systematic approach when troubleshooting a problem. More complex problems can be easily broken down into smaller components. These components should then be analyzed individually to correctly identify the source of the problem.

- ***Make no assumptions***

Always give importance to even the smallest cause of the problem. Never assume that a certain problem is always due to a specific reason only. Similar problems on different systems may have different reasons. Verify the identified cause of the problem before you apply a resolution.

- ***Establish priorities***

When faced with several calls, you must establish priorities. You need to decide which problem needs your attention immediately and which problem can wait. For example, if the entire network is down and a single user is complaining that he cannot open a file on his computer, the network problem needs to be resolved first.

- ***Documentation***

Whenever you resolve a problem, make sure that you complete the documentation. The documentation may include the date and time the problem is reported, symptoms of the problem, the actions you took to resolve the problem, and whether the problem was resolved.

3.2. Basic diagnostic procedures

Troubleshooting a computer problem requires that you follow some basic diagnostic procedure, which starts from identification of the problem symptoms, isolating the affected area, and so on. Following a logical procedure not only makes troubleshooting easy but also reduces the time it takes to resolve the problem. The following paragraphs summarize these steps:

1. **Define and identify the problem**. The first step in diagnosing a problem is to define and identify it. This ensures that you are applying your diagnostic skills to resolve a correct problem. A problem can be identified only when you have sufficient information. Gather as much information as you can. Check the problem symptoms and question the user. Check whether the user has made any configuration changes to the hardware or the software. Collected information will help in correctly identifying the problem.
2. **Analyze the problem.** You need to make a thorough analysis of the problem to find out whether the problem is due to a user error, a hardware failure, ora software bug. Most often, simply restarting the computer resolves a problem. The best plan is to always check the simple things first. For hardware-related problems, check whether the power is on, check loose connections, and check whether all components are seated properly.
3. **Test and isolate the failed component**. You may also need to isolate the causeof the problem and correctly identify the hardware component that has failed. Once detected, you must test the failed component to make sure that it has actually failed. For OS-related problems, you can use built-in utilities such as the Device Manager, the System Configuration Utility (MSCONFIG),or the Advanced Boot Options.

4. **Consult documentation and other resources**. Replacing a failed hardware component or applying a fix to a software problem may require you to consult vendor documentation. If this is not available, you may need to check other sources of information, such as vendor's web site, online forums, and user groups that use the same or similar products. It is very much possible that someone else has faced a similar problem.
5. **Apply the solution**. Once you have identified the problem, you will need to find out a solution and apply it. Applying the solution requires that you test your solution thoroughly before handing over the computer to the end user.
6. **Document your activities**. When the problem is resolved, you must prepare documentation of your activities. These include the date and time the problem was reported, the details about the computer and the user, symptoms of the problem reported, what you did to identify the problem, and what actions were taken to resolve it. Documentation is very helpful if you face a similar problem again or if someone else needs help resolving a similar problem.

3.3. Basic troubleshooting tools

Troubleshooting tools can be classified into two main categories: hardware and software. These are explained in the following paragraphs:

- ***Hardware tools***

The following tools are categorized as hardware tools:

Screwdrivers

The most common screwdrivers required for installation and repair of computer components are flat blade, Phillips head, and Torx. You may also need a magnetic screwdriver with different types of bits to reach internalparts that you cannot reach with smaller screwdrivers.

Long nose pliers

A long nose pair of pliers is required to hold connectors or to pickup small screws that accidentally fall in the computer case or on the motherboard. Additionally, you should keep a tweezers set.

Flashlight

A flashlight is very helpful in locating parts of the computer where light is not adequate. Keep extra batteries for the flashlight as well.

Soldering iron

A soldering iron is required to make connections using a solder wire. You may hardly need to use a soldering iron on new computers, but it is good to keep it in your toolkit.

Wire strippers

A wire strippers set is used to cut wire and strip off the insulation.

Compressed air can

A small can have compressed air is useful in blowing off dust from internal or external parts of the computer.

Multimeter

A multimeter is used to check resistance (continuity), voltage, and current. You can have an analog multimeter, which shows the readings on a scale, or you can have a digital multimeter, which shows the readings on an LCD panel.

Software tools and utilities

A large number of personal computer problems are caused by software applications, incorrectly configured hardware devices, or user errors.

A variety of software diagnostic tools and utilities can be used to resolve these problems. Some of the software tools include the following:

Bootable disks

Bootable floppy disks are very useful for starting a computer with MS-DOS. You can make a bootable disk and include on it such essential utilities as the FORMAT and EDIT commands. If the computer can start using the bootable disk, you can examine other components such as the RAM, the hard disk, and device drivers, and you can replace any failed component, if required.

Power-On Self-Test

Every computer has a Power-On Self-Test (POST) routine, which is typically stored on the BIOS chip. The POST detects and tests major hardware components installed on the computer. A successful completion of the POST confirms that the basic components of the computer are functioning as expected. Depending on the BIOS software used on the motherboard, certain hardware errors can be identified from the beep codes. You will need to refer to the user manual of the motherboard to understand the correct meaning of these beep codes.

Hard Drive Self-Test

Normally, the POST would indicate whether there is a problem with the hard disk. You can also use the Microsoft Diagnostics (MSD) program to test the integrity of the hard disk. Some hard drive manufacturers include a software utility to do the testing. For example, Hitachi has a software utility named Drive Fitness Test to test hard disks.

Software diagnostic tools

Software diagnostic tools help test the hardware components of a personal computer. Commonly used software diagnostic tools include Microsoft Diagnostics (MSD), Check It Pro, AMIDiag, and QAPlus. Several software utilities are propitiatory to manufacturers and can be used to test their hardware devices.

3.4. Identifying problems

Problems with the components of a personal computer can be resolved only when they are correctly identified. If a problem cannot be identified, it is difficult to solve it. This section covers troubleshooting techniques for common problems with computer components.

- ***Motherboard and CPU problems***

Problems with the motherboard or the CPU typically result in a "dead" computer. If the motherboard or the CPU is not functioning, the computer will not start. Most technicians do not repair a faulty motherboard, and they do not have the resources to do so in an office or at a client location. This means that a defective motherboard must be replaced. A CPU, on the other hand, can be damaged due to overheating if the cooling fan fails or gets jammed due to excessive dust. If a CPU has failed immediately after installation, the most probable cause is that it has not been installed correctly. After installation, make sure that the CPU is inserted properly in its socket and that the cooling fan is working. You may need to remove the CPU to verify that its pins are not bent or broken due to incorrect insertion.

- ***Power supply problems***

If a power supply is malfunctioning, the computer will not respond when it is started. If the power supply fans are jammed or not working,the power supply will suddenly shut down or reset the computer during normal operation. This symptom appears on those power supply units that are built with thermal protection. The first thing to check with a power supply is whether thecooling fan is working. If required, you may open the computer case and measure voltages on different connectors using a **multimeter**. A completely failed power supply unit must be replaced with another power supply unit of the same rating.

- ***Memory problems***

Most problems with memory modules (RAM) can be identified from the slow response of the computer. If one of the memory modules has failed, the computer performance will go down. Applications will take a long time to open, or the computer will take a long time to process requests. On some computers, the Power-On Self-Test indicates whether there is a problem with memory modules. Before you replace a memory module, try to remove and reinstall the original modules. Sometimes, the problem is due to improper seating and/or loose connections.

- ***Problems with display devices***

Display device problems occur due to incorrect configuration, a loose connection of the video adapter, or a failed monitor. There could be either no display at all or a bad video. A monitor can be easily checked by connecting it to another computer. If it works well with another computer, the problem is certainly with the on-board video controller or the video adapter card. If the monitor does not work with another computer, the best way to resolve the problem is to replace it with another working monitor. Make sure that you turnoff power to both the computer and the monitor before disconnecting or connecting the monitor. It is not advisable to repair the monitor yourself at a user's desk or at a client location.

- ***Problems with input devices***

The most common input devices for a computer are the keyboard and the mouse. Many problems with the keyboard are caused due to dust that accumulates on the keys. You can try to fix the problem by cleaning it with a special keyboard cleaning product. If that does not help, you should replace the keyboard. It is meaningless to repair the keyboard because a new keyboard costs much less than the time that you would spend in repairs. Mouse problems are also due to a dirty environment. When you notice that the pointer is jumping around the screen, you may either try to clean the mouse or replace it. First, try connecting the mouse to another computer to verify whether it is working properly. A mouse with a rubber ball has rollers and sensors. Dust accumulated on the ball, on the sensors, and on the rollers causes the erratic behavior of the pointer. If cleaning the mouse ball and rollers does not help, replace the mouse.

- ***Hard disk problems***

A working hard disk generally generates a sound that comes from its spinning. Problems with hard disks can be due to a faulty adapter card, a failed hard disk, or an incorrect/loose connection. If the disk is incorrectly connected or the adapter is loose on the expansion slot, the computer will not go beyond POST. This symptom is fairly easy to identify. Similarly, if the hard disk has completely failed, the POST routine will not be able to identify the bad disk. Sometimes, you can recover a failed disk by

simply reformatting it. This does nothelp in all situations because a reformatted disk is likely to fail again. Due to a failing process of computer components, it is advisable to replace the failed disks instead of trying other solutions such as low-level formatting.

- ***CD/DVD problems***

Most problems with CD and DVD drives are related to media, i.e.,the disc itself. Try replacing the disc with a new disc. If the new disk work s well and old discs do not, you have identified the problem. Problems with newly installed disks are caused by incorrect jumper settings, incorrect connections, or the inability of the system BIOS to recognize the drive. Check your connections, including the power supply connection. Try using a different power supply connector, if one is available.

- ***Adapter card problems***

Most of the new motherboards have built-in interfaces for many functions that were earlier derived from adapter cards. Some of the common adapters include the network card, the modem card, the sound card,and the video card. If any of these are not working, you need to do a visual inspection first. Make sure that the card is seated properly in the expansion slot. For example, if there is a network connectivity problem, check that the network cable is securely attached to the RJ-45 socket on the card and that the LED status indicators are showing normal activity. Similarly, if the modem is not responding ornot able to dial, first check that the telephone cable is properly connected and you have a dial tone.

Preventive Maintenance (PM)

Preventive maintenance helps reduce the chances of computer breakdowns and improves overall system performance. It is essential to perform preventive maintenance at regular intervals. As a computer technician, you are expected to be aware of different forms of preventive maintenance and how these measures can be implemented. In this section, we will brief some essential preventive maintenance tasks for personal computer components.

- ***Scheduling preventive maintenance***

Preventive maintenance should be done for all desktops in an office or at home. It is good to have a written preventive maintenance schedule and to ensure that it is followed. The schedule should outline what PM tasks are to be performed and on which computers. Regular PM tasks include the following:

  - A visual inspection of internal and external components.
  - Updating the operating system and/or device drivers.
  - Cleaning the components.
  - Fragmenting the hard disk and performing a disk cleanup.

- Ensuring that the computer is operating in a healthy environment with acceptable levels of temperature and humidity.

- ***Visual and audio inspection***

Perhaps the first and most important step in performing preventive maintenance on a computer is to do a visual and audio inspection. Visual inspection inside the computer will reveal if any of the components are loose in their respective sockets or if some cooling fans are jammed. Visual indicators such as the hard disk activity, LED, or status indicators on NICs are very helpful in determining whether a component is working. Similarly, beep codes of the system BIOS will usually indicate whether some hardware component is not functioning as expected. Audio inspection also refers to listening to the spinning noise of the hard disk or CD/DVD discs.

- ***Driver and firmware updates***

Due to continuous enhancements in technology, manufacturers of hardware components, software applications, and operating systems keep on making changes to their products. These changes are released to customers as updates. Itis important to check with vendors about the latest driver software for their devices. Software/driver updates also ensure that the devices will work when the operating system is upgraded. Similarly, the BIOS or the firmware must also be kept updated so that it can support new devices built on new technologies.

- ***Heat and temperature***

No matter how many ventilation slots and cooling fans exist within a computer, itis essential that the external cooling factors should also be taken care of. If the computer is located in an area where the temperature is not controlled and no proper ventilation exists, it will eventually heat up after prolonged hours of operation. You must make sure that the computer is operated in a room where adequate air-conditioning and ventilation is available.

- ***Humidity***

Humidity also needs to be mentioned in this section. Computers need to be located in areas with moderate humidity. Dry areas or areas with too much moisture do affect the life and performance of computers. If the air around computers is too dry, it will cause static electricity to build up that may damage expensive computer parts.

- ***PM for display devices***

Display devices, or monitors, produce heat when working and are also exposed to dust around the area where the computer is installed. If not cleaned regularly, dust accumulates on the screen and the case, and also makes its way inside the monitor through the ventilation slots provided for keeping the monitor

cool. Accumulated dust can also block some ventilation slots. Monitors should be regularly cleaned using a lint-free cloth.

PM for power supply

A majority of computer problems are a result of failure of the power supply. Care must be taken to ensure that the computer gets a clean and consistent power supply. Some of the preventive maintenance methods for power supply are as follows:

Uninterruptible Power Supply (UPS)

Should be used to provide a clean and consistent voltage to the computer. UPS systems protect the computer from power spikes, surges, and sags that can cause significant damage to computer parts.

Power strips

Useful for providing extra power slots and are also helpful in protecting the computer from sudden changes in voltage levels such as power spikes and sags.

Surge protector

Used to supply a constant voltage to computers and prevent damage due to power surges. A power surge refers to a sudden change of voltage in the power line.

Regular cleaning of the computer's power supply unit

Helps prevent the power supply unit from heating up during normal preparation (especially cleaning the cooling fan and ventilation).

- ***PM for input devices***

When possible, all input devices, including the keyboard, mouse, scanners, etc., should be kept covered when not in use. Keyboards collect dust from the surrounding areas. As a result, the keys start having intermittent jamming problems. Dust accumulated on the sides of the keys can be blown out using compressed air. You can also use a soft brush to get rid of the dust accumulated around and between key tops.

- ***PM for storage devices***

There are a number of preventive maintenance methods for storage devices, each suitable for a particular type of device. Even if the computer is located in clean surroundings, cleaning internal parts of computers regularly does help in extending the life of its components. Some of the preventive maintenance procedures for storage devices are as follows:

- Hard disks should be regularly defragmented and cleaned up of unnecessary temporary files. You can use built-in operating system utilities such as Disk Defragmenter (*defrag.exe*) and **DiskCleanup**. You can also **check hard** disks regularly using standard procedures such as defragmentation and regular clean up. Additionally, you can check for and fix bad sectors in disks using the Check Disk (*chkdsk.exe*) utility.
- CD and DVD drives rely on laser beams and an optical lens to read and write data. Dust accumulates on the lens surface that causes intermittent disk read/write problems. You should regularly clean CD and DVD drives using appropriate lens cleaners.
- Tape drives should be cleaned using tape drive head cleaners.
- Floppy disk drives should be cleaned using a floppy disk drive head cleaner.

- ***PM for motherboards, memory, and adapters***

Motherboards, memory modules, and add-on cards (adapters) are all thermally sensitive devices. Ensuring that the computer is used in an area where temperature, humidity, and dust are controlled helps enhance their performance, extend their life, and reduce breakdowns. Make sure that all the cooling fans are working properly, that dust has not accumulated around them, and that the ventilation slots of the computer case are not blocked. To ensure that problems are minimized, regularly blow out dust from tops of motherboards, CPU fans, memory modules, and adapter cards. Cooling fans usually get jammed due to accumulation of dust around blades and walls.

Part Two

2. Operating System

Computer hardware, such as the motherboard, CPU, adapter cards, display devices, and I/O devices, are only a part of the entire computer system. To make this hardware work, we need software that acts as an interface between human beings and the hardware. Software can be classified into three major categories as follows:

- ***Operating systems***

The operating system interacts directly with the computer hardware and provides a platform for applications and device drivers. It manages computer memory, input, output, disks, and filesystems.

- ***Device drivers***

Device drivers act as an interface between the operating system and the specific devices for which the driver software is written.

- ***Applications***

An application is the software program that takes commands from the user for a specific task, executes them, and produces the results.

The operating system is the primary software that makes the computer hardware usable. In this section, we will discuss some of the fundamentals of using operating systems, their installation and upgrade methods, troubleshooting techniques, and preventive maintenance procedures.

2.1. Overview of Operating Systems

Once we start discussing various operating systems, we certainly need to know about their revision levels. In this section, we will cover some basics of Microsoft Windows, Apple MAC, and Linux.

- ***Windows***

Microsoft Windows is no doubt the largest used operating system to date. This operating system evolved from *Microsoft Disk Operating System (MS-DOS)*, which had a command-line interface. In contrast to the MS-DOS operating systems, Windows uses a *Graphical User Interface (GUI)*. Windows has gone through various revisions since its introduction. A summary of Windows versions is given in the following sections.

Windows 1

Windows 1 was the graphical version of Microsoft's DOS operating system with added support for mouse, menus, and tiling windows. It supported running multiple applications simultaneously, a feature known as *co-operative multitasking*. This version of Windows did not have the icons that we see and use in modern versions of Windows.

Windows 2

This version of Windows included support for *Program Information Files (PIFs)* and had icons to launch applications.

Windows 3.x

The main attraction of Windows 3.0 was the operating system's ability to effectively manage memory. When used in enhanced mode, the OS could use a part of hard diskspace for supplementing memory. This feature is still used in modern Windows versions and is known as *virtual memory* or *paging file*. This version had support for networking Windows and included additional features such as the Program Manager and the File Manager.

Windows 3.1

Windows 3.1 supported multimedia devices, had an improved GUI, and included error protection for system and applications through *Object Linking and Embedding (OLE)*.

Windows 3.11

Windows could support only 16-bit applications until version 3.11.

Windows 3.11, also known as Windows for Workgroups, added support for both16-bit and 32-bit applications.

Windows 95

As is evident from the name, this version of Windows was released in1995. It supported both 16- and 32-bit applications, and had the ability to network computers. The major advancement in this version was the support for Plug and Play (PnP) devices. For the PnP feature to work properly, the system motherboard (and the BIOS), the OS, and the device, all had to be PnP-compatible. Once all three conditions were met, the PnP devices could be automatically detected and configured by the OS. At the time of this writing, most devices, operating systems and applications still support the PnP functionality.

Windows 98, Windows ME, and Windows NT

Windows 98 was released in 1998, followed by Windows ME (Millennium Edition), and Windows NT (New Technology).Windows NT was a major upgrade for the Windows platform and was much more powerful than Windows 98 and Windows ME. Windows NT Work station and Windows NT Server had versions named Windows NT 3.5x and WindowsNT 4.0.

Windows 2000

Windows 2000 Professional and Windows Server 2000 operating systems were released in the year 2000. These operating systems were meant as desktop (client) and server operating systems respectively. With Windows NT,Microsoft introduced the concept of *domains*, which are meant to effectively manage users, computers, resources, and security in the network.

Windows XP

Windows XP followed after the release of Windows 2000. This operating system is mainly used as a standalone OS for home computers or as an alternative to Windows 2000 Professional as a client operating system in a networked environment. Most of the discussion in this section is related to Windows 2000 Professional and Windows XP operating systems. Windows XP has different versions, each addressing the needs of specific applications, as follows:

- ✓ *Windows XP Professional*

  This is designed as a client operating system in networked environments.

- ✓ *Windows XP Home*

  This is designed for standalone home computers.
- ✓ *Windows XP Media Center*

  This is designed to be used in situations where multimedia capabilities are more important than other features.

Windows Server 2003

The most current server operating system in use today is

Windows Server 2003. This includes several enhancements to earlier server operating systems such as Windows NT Server 4.0 and Windows 2000 Server. ThisOS is basically designed to overcome many drawbacks of previous server versions of Windows and to compete with its peer operating systems such as Unix, MACOS, NetWare, and Linux. Different editions of Windows Server are as follows:

- ✓ Web Edition
- ✓ Standard Edition
- ✓ Enterprise Edition
- ✓ Datacenter Edition

Windows Small Business Server 2003 is also a popular network operating system targeted for small businesses. Windows Server 2003 has a new version named *Windows Server 2003 R2*.There is a long list of features supported in Windows Server 2003, some of which are as follows:

- ✓ It supports both 32- and 64-bit microprocessors.
- ✓ It supports large amounts of physical memory (RAM) and efficiently manages it.
- ✓ It supports centralized management for applications, users, data storage, and security through a centralized database called *Active Directory*.
- ✓ It has strong support for client/server-based applications and services such as SQL Server, Internet Information Server (IIS), Terminal Server, DomainName System (DNS) server, and Dynamic Host Configuration Protocol(DHCP) server.
- ✓ It supports server clusters for providing fault tolerance and network-load-balancing for improved performance.

Windows Vista

Windows Vista is the latest desktop operating system. This OS is meant to replace Windows XP. The list that follows describes different editions of Windows Vista.

- ✓ Home Basic

- ✓ Home Premium
- ✓ Business Edition
- ✓ Ultimate
- ✓ Enterprise Edition

One of the most attractive features of Windows Vista is Windows Aero, which is a 3-D graphical interface. Windows Vista also includes Internet Explorer 7 (the new version of Microsoft's web browser application), and it supports speech and handwriting recognition. This OS will be more secure than Windows XP and Widows 2000 Professional.

2.2. Working with Windows interfaces

Microsoft Windows includes several GUIs that are used to manage the operating systems and run applications. For most of the versions of Windows, such as Windows Me, Windows NT, and Windows 2000, these GUIs look similar, but the functionality of each is a little different when you start using them. This section provides a brief discussion of some of the main interfaces.

Windows desktop

The Windows desktop is the screen that appears as soon as you start Windows and successfully log on. This is the place where you find most of the icons (shortcuts) for most of the system utilities and application programs. Itincludes the Start menu, the Taskbar, and other icons placed as shortcuts to application programs. You can change the way your desktop looks by right-clicking anempty area on the desktop and selecting one of the choices from the context menu. You can rearrange the icons or change the display settings by selecting Properties.

Taskbar

The bottommost part on the Windows desktop is known as the Taskbar. It contains the Start menu and the System Tray (systray). The System Tray includes the Quick-Launch area on the left-hand side and the Notification Area on the right-hand side. The Start menu is used to run programs as well as to configuresystem settings. In the middle of the Taskbar, Windows displays buttons for programs that are currently running. When you right-click an empty area on the Taskbar, a menu appears from where you can configure the following settings:

- ✓ Change the Properties of the Start Menu and the Taskbar
- ✓ Launch the Task Manager utility
- ✓ Automatically hide the Taskbar when not in use

- ✓ Cascade Windows or tile them horizontally or vertically
- ✓ Lock the Taskbar at its position

Start menu

When you click the Start button located on the left-hand bottom corner of the Windows screen, the Start menu appears, which displays the name of the user who is currently logged on to the computer. The Start menu includes shortcuts to installed programs, the Control Panel, a Settings button, and folders suchas My Documents, My Recent Documents, My Pictures, My Music, My Computer, My Network Places, and so on. The appearance of the Start menu can be changed to classic style from the Start menu tab of the Taskbar Properties. Some of the common menu items are listed in the following paragraphs:

- ***Shut Down***

  Depending on whether you are using Windows 2000 or Windows XP, the Shut Down button gives several options, such as log off the current user, switch user, shut down the computer, activate the Standby mode, or restart the computer.

- ***Programs/All Programs***

  Installed application programs can be launched from the Programs/All Program icon on the Start menu. When you see an arrow pointing towards the right-hand side, this means that the selected menu contains submenus.

- ***Help (Windows 2000)/Help and Support (Windows XP)***

  The Help window is displayed in Windows 2000 when you select the Help option in the Start menu. In Windows XP, the Help and Support shortcut in the Start menu launches the Help and Support Center which is very helpful for getting help with using, configuring, and troubleshooting the operating system. The Help and Support center in Windows XP also includes online help options from Microsoft support. You can also use the Remote Assistant to get help from an expert when connected to the network.

- ***Search***

  The Search option opens a search window where you can find files or folders stored on the hard disk.

- ***Run***

The Run option opens the Run dialog box where you can enter a commander the name of an executable file to launch the program. You must use the correct path of the executable file when using the Run option.

Desktop icons

Some standard icons are available on both Windows 2000 and

Windows XP. Some of the icons have been removed from the desktop in Windows XP and placed inside the Start menu. The following is a summary of these icons:

- ***My Computer***

  The My Computer icon is used to explore the computer (including the disk drives) and view their contents. These drives include floppy drives, hard disk drives and their partitions, and CD and DVD drives. You can double-click any drive to view its contents. You can configure your computer by right clicking this icon and selecting Manage from the context menu. The Manage option opens the Computer Management console.

- ***My Network Places (Windows XP)/Network Neighborhood (Windows 2000)***

  This icon is used to browse the Windows network. You can view or connect to any computer on the network where you have appropriate permissions. In Windows XP, the My Network Places icon is available in the Start menu. The Properties pages allow you to configure your network, wireless, or dial-up connections.

- ***Recycle Bin***

  The purpose of the Recycle Bin is to collect all files or folders that you delete from the computer. It is actually a separate folder on the hard disk that stores the deleted objects. The main advantage of the Recycle Bin is that you can restore a file or folder that you might have accidentally deleted. When you no longer need a deleted file or are running out of diskspace, you can right-click the Recycle Bin icon and select the Empty Recycle Bin option to permanently delete the objects.

Control Panel

The Control Panel in Windows is the utility that you can use for most of the configuration tasks related to the operating system itself as well as to the devices and drives. To access it, click Start and select Control Panel. In Windows XP, you will first see a list of categories, while in Windows 2000, you will go directly to the Control Panel folder. The Control Panel further contains icons for various utilities.

The System Control Panel

The *System* utility in the Control Panel is used to configure most of the system settings such as computer name/identification, virtual memory, startup and recovery options, remote desktop/remote assistance, hardware devices, user profiles, and network options. Different tabs included in the System Properties page are General, Computer Name/Network Identification, Hardware, Advanced, System Restore (XP), Remote (XP), Automatic Updates, etc.

The General tab displays information about the computer, installed operating system, system memory, and registration information. The configuration options in other tabs are summarized in the following discussion.

- ✓ *Computer Name (Windows XP)/Network Identification (Windows 2000)*

  This tab allows you to change the name of the computer and whether the computer is a part of a workgroup or an Active Directory domain.
- ✓ *Hardware*

  This page includes several tools to manage hardware devices and drivers installed on the system. The Device Manager Button opens the Device Manager snap-in where you can view and manage all hardware devices. The Driver Signing option allows you to configure system behavior when unsigned device drivers are installed. The Hardware Profiles button allows you to enable/disable devices for specific hardware profiles. You can add, delete, copy, or change user profiles. In Windows XP, the User Profiles button is available in the Advanced tab.
- ✓ *Advanced*

  This tab includes buttons to fine-tune system performance, system startup, and recovery options and environment variables. The Settings button in the Performance section provides options to configure virtual memory settings. The Settings button in the User Profiles section (Windows XP) provides options to add, delete, copy, or change user profiles. The Settings button in the Startup and Recovery section provides options to configure system startup and recovery options. You can change the default operating system toload for a multiboot system. You can also edit the *BOOT.INI* file.
- ✓ ***System Restore (Windows XP)***

  This utility is new to Windows XP and can be used to configure system restore points that are used to restore the operating system to a working condition in case it becomes unstable.

- ✓ ***Remote (Windows XP)***

  This tab includes buttons to enable or disable Remote Desktop and Remote Assistance. You can select users that will be allowed to make remote connections with the computer. These features are not available in Windows 2000Professional.

- ✓ ***Automatic Updates (Windows XP)***

  This tab is used to enable or disable Automatic Updates for the operating system. You can choose how the updates are downloaded and whether they are installed automatically or require user action.

Windows Registry

Windows Registry is a collection of system configuration settings stored in a hierarchical data file. This data includes the operating system settings, user specific settings, application data, hardware components, and installed device drivers. The hierarchy is organized into keys and sub-keys, each of which can have one or more values. The value can be a text identifier, string, binary, word, a multiple string, or an expandable string. There are five main sub-trees in the Registry hierarchy and are as follows:

- ✓ *HKEY_CLASSES_ROOT*

  This subtree mainly stores Object Linking and Embedding (OLE) data and file associations. File associations link files to the programs used to run them.

- ✓ *HKEY_CURRENT_USER*

  This subtree contains data about the currently logged-on user that is taken from her user profile.

- ✓ *HKEY_LOCAL_MACHINE*

  This subtree contains all the hardware-specific configuration data for the machine that essentially includes OS and hardware configuration.

- ✓ *HKEY_USERS*

  This subtree contains a default set of settings as well as data for each user profile.

- ✓ *HKEY_CURRENT_CONFIG*

This subtree contains data about the currently loaded hardware profile.

- ✓ **Registry Editor.**

Under extreme circumstances, if you require changes to the Registry, you should first make a backup copy of the existing Registry files. The Registry Editor (*REGEDIT.EXE or REGEDT32.EXE)* program

is located in the *SystemRoot%\System* folder. It can either be run from the command prompt or from the Run option in the Start menu.

Note:

With most of the systems settings and configurations made easy using the Windows Wizards, you will hardly need to edit the Registry directly. Unless you do not have another way to configure your system, you should not edit the Registry to change any configuration values. Improperly editing the Registry may render your system unable to boot or generate unexpected errors.

You must have advanced level knowledge of the Windows OS and Registry keys in order to configure the registry correctly. If you are unsure of your actions, do not attempt to edit the Registry. Otherwise, you may damage the operating system and may have to reinstall it.

Virtual memory

Virtual memory is a part of the hard disk that the operating system uses as temporary storage. This memory is also known as *swap file* or *paging file*. Windows treats this hard disk space as RAM and uses it as and when the system runs out of RAM. The operating system automatically configures the size of the paging file during installation.

Windows system files

Several files are critical for the Windows 2000 or Windows XP operating system to start successfully. By default, all of these files are marked as system files and are hidden. You will need to change folder options to view these files. These files are protected so that a user won't delete them accidentally. While some of these files are stored in the root of the system partition, others are located in the System32 subfolder in the drive where you installed the operating system.

Managing disks

Hard disks are the primary data storage devices used in computers. Hard disks are treated as fixed storage devices and are connected to IDE or SCSI interfaces. USB disks, CD-ROMS, and DVDs are called removable storage media. Windows OS supports two types of hard disks for data storage: Basic disks and Dynamic disks.

Basic disks

Basic disks are the traditional type of disks used in computer systems. Windows OS treats all disks as Basic unless they are converted to Dynamic using the Disk Management utility. The disks are divided into one or more *partitions*, each of which can be a logical storage unit accessible by a drive letter. Windows XP Professional stores partition information in a partition table that is not a part of the operating system and can be accessed from any operating system besides Windows. Partitions in Basic disks can be Primary or Extended.

- ***Primary Partition***

  Each Basic diskcan have up to four primary partitions, or three primary and one extended partition. One of the primary partitions is marked as the *Active Partition* and is used to boot the system. There can be only one active partition on a computer. The primary partition is formatted using one of the filesystems: FAT, FAT32, or NTFS.

- ***Extended Partition***

  An Extended Partition is created on unallocated space on the hard disk. You then create logical drives on this partition and assign them drive letters. Extended Partitions cannot be formatted with any filesystem, and they cannot be assigned drive letters.

- ***Logical Partition***

  Logical Partitions are created inside the Extended Partitions. Logical drives cannot be marked as active and cannot be used to boot the system. These partitions are used to organize files and folders on the hard disk.

Dynamic disks

Dynamic disks are the disks that are specifically converted from Basic disks using the Disk Management utility. Dynamic disks treat the entire diskas a single partition and you can create volumes on the diskto organize your filesand folders. Dynamic volumes can be extended on single or multiple Dynamicdisks and offer fault tolerance features. You can create the following types ofvolumes on Dynamic disks:

- ***Simple volume***

  A Simple volume contains space from all or part of a single Dynamic disk.They are similar to a partition on a Basic disk.

- ***Spanned volume***

A Spanned volume contains space from a single or multiple Dynamic disks.You can add unallocated space from 2 to 32 Dynamic disks to create a largeSpanned volume. Each disk can be of any size.

- ***Striped volume***

A Striped volume combines space from 2 to 32 Dynamic disks to make a single Dynamic volume. Data is stored on Spanned volumes in stripes (chunks of 64 KB) on each disk in turns so that each disk has an equal amount of disk space. Striped volumes cannot be extended and are not fault tolerant. If one of the disks in a Striped volume fails, all data is lost.

Disk drives are managed using the Disk Management utility found within the Computer Management console. Right-click the My Computer icon and select Manage to open the Computer Management console. The Disk Management tool is located under the Storage folder.

Creating partitions

To create a partition, right-click a disk and click Create Partition.

The New Partition Wizard guides you through the process of creating a primary, an extended, or a logical drive. Once you have created a partition, you can format it with FAT, FAT32, or NTFS filesystem. Right-click the partition and select Format. Existing volumes can also be formatted from Windows Explorer. This action destroys all data on the partition. The Format option also allows youto assign a volume label and drive letter to the partition.

Converting from Basic disk to Dynamic disk

To convert a Basic disk to Dynamic, you must have at least 1 MB of free space at the end of the disk, and the sector size must not be larger than 512 bytes. Right-click the disband select Convert to Dynamic Disk. This action does not cause any loss of data.

Note:

If the Convert to Dynamic option is not available for a particular disk, the disk is either already a Dynamic disk or you are trying to convert the disk on a portable computer. Remember that Dynamic disks are not supported on portable computers. This option is also not available on removable disks such as CD-ROMS, floppy drives, and Zip drives.

Converting from Dynamic disk to Basic disk

Converting a disk from Basic to Dynamic is a one-way process. Conversion from Dynamic disk back to a Basic disk destroys all data on the disk. You must first back up all the data on the disk before attempting to perform this conversion. To convert a disk back to Basic, right-click the disk in Disk Management and select Convert To Basic Disk.

Filesystems

Filesystems refer to the method operating systems use to manage disk partitions and data storage. Filesystems help the OS keep track of files and folders on the disk. You will need to decide on a filesystem when partitioning and formatting a disk. The following are the main filesystems used in Windows operating systems:

FAT

The File Allocation Table (FAT) was implemented in DOS operating systems.Its main characteristics include:

- ✓ Supports only 8-character filenames with a 3-character extension, knownas 8.3 file format.
- ✓ No spaces are allowed in filenames.
- ✓ The maximum partition size is 2 GB in Windows 95, Windows 98, and Windows ME. In Windows NT 4.0, Windows 2000, and Windows XP, the maximum supported FAT partition size is 4 GB.

FAT32

FAT32 is an improved version of FAT and is supported in Windows 95(OSR2) and later operating systems. Windows XP, Windows ME, and Windows 95 OSR2 also support the FAT32 filesystem. Main characteristics of FAT32 include:

- More reliable storage than FAT.
- Not compatible with FAT.
- Uses smaller disk cluster sizes to prevent wasting disk space.
- Support for long filenames of up to 255 characters.
- Extended disk partition size of up to 2 TB (Terabytes) or 2048 GB.

NTFS

NTFS is the preferred filesystem for Windows XP Professional, Windows Server 2003, Windows 2000, and Windows NT operating systems. Some of the benefits of using NTFS are as follows:

- It supports long file names of up to 255 characters.
- It supports disk sizes of up to 16 EB (Exabytes).
- It supports file- and folder-level security.
- NTFS Encrypting File System (EFS) secures files and folders from un authorized access.
- It supports Disk Quotas to limit the use of disk space on a per-user basis.
- It supports files larger than 4 GB in size.

- It provides file compression to save disk space.
- It supports Dynamic disks to efficiently use and manage disks and partitions.
  - *CDFS*

    CDFS stands for Compact Disk File System, which is used on compact disks(CDs).
  - *UDF*

    UDF stands for Universal Disk Format, which is used on digital versatile disks (DVDs).

Managing files and folders

Files and folders are managed using Windows Explorer in both Windows XP and Windows 2000. The Windows Explorer utility is located in the Accessories folder in Programs/All Programs in the Start menu. The following tasks can be completed using this utility:

- Viewing and navigating files and folders.
- Copying and moving files and folders from one location to another.
- Creating new folders and subfolders.
- Deleting files or folders.
- Viewing or changing file or folder attributes.
- Executing (running) program files.
- Searching for a particular file or folder.
- Sharing folders and setting permissions.
- Formatting a disk.

A simple way to perform any of the given file or folder tasks to right-click it and select the desired action such as copy, cut (and paste at another location), delete, rename, etc. You can select the Properties from the context menu to open the Properties window to view or change permissions, sharing, and file/folder attributes.

File extensions

Each file is associated with an extension. Windows operating systems use file associations to open files with specific extensions. Common file extensions are as follows:

.EXE

Executable files

.DLL

Dynamic link library files

.SYS

System files

.LOG

Log files

TXT

Text files

DOC

Document files

.HTM and .HTML

Web page files

.AVI, .MPG, .MP3

Audio video files

.BMP, .TIF, and .JPG

Picture files

File attributes

File and folder attributes determine the type of actions a user can perform on them. For example, if a file attribute is set as read-only, a user cannot delete the file or make changes to it. You can use the Properties page of a file or folder in Windows Explorer to view or change attributes. The types of attributes supported in Windows XP and Windows 2000 are described next.

- ***Read-only***

  A file or folder with the Read-only attribute cannot be deleted or its contents cannot be changed.

- ***Hidden***

  A file or folder with the Hidden attribute is not visible when navigating in the Windows Explorer. It cannot be deleted or copied.

- ***System***

  A file or folder with the System attribute is used by the operating system. It is marked as both Hidden and Read-only. When you click the Advanced button, the following attributes can be viewed or changed:

- ***Archiving***

  The file or folder has been changed after the last backup. The Windows Backup utility uses this archive to select files and folders for backing up data.

- ***Indexing***

A file or folder marked with the Index attribute is used by Windows Indexing Service for a faster search. This attribute is available on NTFS volumes only.

- ***Compression***

The Compression attribute is used for compressed files and folders to save disk space. This attribute is available on NTFS volumes only.

Encryption

The Encryption attribute is used to store files and folders in encrypted format for security purposes. This attribute is available on NTFS volumes only.

File permissions

File permissions are used to control access to files. Permissions determine which users are allowed to access files. Windows XP and Windows2000 support two types of permissions: NTFS file permissions and share permissions. The share permissions can be configured on NTFS as well as FAT volumes, while the NTFS permissions are supported only on disk partitions formatted with NTFS filesystem. File and folder permissions can be assigned to individual users as well as user groups. The following is a list of standard NTFS permissions:

- ***Full Control***

  The Full Control permission grants the user all rights on the resource.

- ***Modify***

  The Modify permission allows a user to change the contents of the file.

- ***Read and Execute***

  The Read and Execute permission allows a user to read the file and execute(run) it.

- ***List Folder Contents***

  The List Folder Contents permission allows the user to list the files and subfolders inside a folder.

- ***Read***

The Read permission allows a user to read a file.

- ***Write***

  The Write permission allows a user to write files to a folder.

Note:

When both NTFS and share permissions are assigned for a user or for a group, the more restrictive of the two becomes effective.

To assign share permissions on a folder, open Windows Explorer and navigate to the folder. Right-click the folder and select the Sharing and Security option. This opens the Sharing tab of the folder properties. You can share the folder and click the Permissions button to assign share permissions.

To assign NTFS permissions, open Windows Explorer and navigate to the file or folder. Right-click it and select the Sharing and Security option. Click the Security tab, which opens the NTFS permissions page as shown in Figure 2-9. Click the Add button to select a user or a group. Select the user or group in the upper Group or user names box. Click the appropriate checkbox in the Permissions box to assign the desired permission.

2.3. Installing and Configuring Operating Systems

Computers are useless without the operating system or software applications. As a PC technician, you must have good hands-on knowledge of installing operating systems. Since Windows XP and Windows 2000 are the most widely used operating systems, in this section, we will take a look at a variety of tasks involved in installing and configuring the Windows operating system.

Installing the operating system

Before you start installing the operating system or upgrading an existing one, you will be required to make some preparations that include checking the minimum hardware requirements, verifying compatibility of components, deciding on disk partitions, selecting the filesystem, and determining whether the computer will join a workgroup or a domain. Next, you will decide on an installation method, which can be CD-based or from the network, and whether the installation will be attended or unattended. In this section, we will take a look at various installation and upgrade scenarios.

- ***Minimum hardware requirements***

  Before starting the actual installation process, you will need to ensure that your computer meets the minimum hardware requirements. Although many new computers will surpass these requirements, older computers will need to be checked against these minimum requirements.

- ***Hardware compatibility***

  The components of the computer should be compatible with the operating system you have selected to install. You can check the compatibility with Windows 2000 Professional from the *Hardware Compatibility List (HCL)*, which contains a list of hardware tested with the OS. With the release of

Windows XP, Microsoft changed the name of this list to *Windows Catalog*, which includes software applications as well.

Installation methods

You can choose from a variety of installation methods for installing or upgrading the operating system. Unlike Windows 98 and older versions, which were available on floppy disks, Windows XP and Windows 2000are distributed on bootable CD-ROMs. If you want to start the installation process from the CD-ROM, you must first change the BIOS settings to make the CD drive as the first boot drive. The following is a summary of installation methods:

- ***Attended installation***

  When you install Windows XP/2000 from a CD-ROM and are physically present to answer the questions prompted by the setup program, the installationis known as attended. This installation can be started from the setup CDROMor from a shared network folder where all setup files are already copied.

- ***Unattended installation***

In the unattended installation method, an *answer file* provides answers to most of the questions that are prompted during the installation. The answer file contains answers to most common parameters required by the setup program. You must first create an answer file using Notepad or the Setup Manager utility. The answer file is usually named *unattend.txt*.

- *SysPrep installation*

  The System Preparation (*SysPrep*) utility is actually a disk duplication method. It is used to prepare a master image of an existing Windows XP/ 2000 Professional installation. This image can then be copied to other computers with identical hardware. The Sysprep utility removes the computer-specific information from the image. This method can only be used for clean installations. The computer used for this purpose is known as the master or reference computer and can have any number of applications installed besides the OS. After running SysPrep, you must use a third-party utility to create the actual image of the disk.

- *Remote Installation Service (RIS)*

  You can use the RIS for unattended large-scale deployments of Windows XP and Windows 2000 Professional. RIS requires that the computer must be connected to a Windows domain; a domain controller running Active Directory service, and a DNS server, and that a DHCP server is available during installation.

Installation options

The Windows setup program gives you several options for the installation. These include the installation method, a choice of the file system for the disk partition, network configuration, and provision for multi-booting the computer (installing two or more operating systems on the same computer).

- ***Installation type***

You can choose from typical, full, minimal, or custom. The typical installation installs most common components while the full installation installs all mandatory as well as optional components. If you are experienced in installations, you can customize the installation using the custom installation option.

- ***Network configuration***

Installing the network components is optional at the time of initial setup. You can install these components later. Even when you have selected to include the networking components, you can initially let the setup join the computer to a workgroup and later change it to a domain membership.

- ***Multiple-boot system***

You can install Windows XP or Windows XP Professional with any other Windows OS and keep the system as a multi-boot system. At the time of installation, you are given the option of whether you want to delete the existing OS, upgrade it, or keep the system as dual or multi-boot.

Disk partition

One of the most important decisions when installing the operating system is about disk partitions. A *partition* is a logical section of the hard disk where the system can store data. When you start installing the operating system, the setup program lets you install the operating system on an existing hard disk partition, or you can create a new partition. If you decide on using the existing partition to create a new one, all previously stored data on that partition will be lost.

Microsoft recommends that you should create only one partition during installation that is to be used for installing the operating system and that you make other partitions after the installation is complete. When you partition the disk, you must also format it using the FAT or NTFS file system. In case you are dual-booting the system with Windows XP/2000 Professional and another operating system, you should install each operating system in a separate disk partition. It is recommended that you use the NTFS file system for all disk partitions due to its efficiency and advanced security features. In case you are dual-booting Windows XP/2000 with an old operating system such as Windows 95 or Windows Me, which do not recognize NTFS partitions, you must keep the boot partition as FAT.

Installing Windows XP Professional

Windows XP Professional comes on a single CD-ROM with a product key that will be used during the installation. If your computer BIOS supports booting from the CD-ROM, simply insert the Windows XP Professional CD in the CD-ROM drive and start the computer. The setup process starts with *text mode*, during which the hard disk is prepared and necessary installation files are copied to the hard disk. Setup then enters the *GUI phase*, when the user is prompted for information about the computer, username, and password, etc. This phase includes the network phase where the setup program detects the network adapter and collects information about networking components. The installation completes when the setup program copies final files to the hard disk, creates Start menu items, registers components, removes temporary setup files, and restarts the computer.

- *Text mode.*

The text mode phase copies the initial setup files to the computer, creates hard disk partitions, and then copies setup files to the hard disk. The following steps are completed:

1. If the computer BIOS supports booting from the CD-ROM, you can start the text mode by inserting the Windows XP Professional CD-ROM into the CDROM drive. Restart the computer, and the text mode of installation begins.
2. If you are already running an operating system, simply insert the CD-ROM and choose whether you want to upgrade the previous operating system or perform a clean installation from the Welcome screen.
3. If you wish to install any third-party device drivers, such as a SATA disk controller, press F6.
4. Installation continues with copying initial setup files into memory. A Welcome screen appears. Press Enter to continue.
5. Press the F8 key to accept the Licensing Agreement.
6. In the Disk Partitioning section, select the disk partition you wish to use for Windows XP Professional. Press C to create a new partition or press D to delete an existing partition.
7. The setup program checks the selected partition for errors and formats the partition with the selected filesystem. Setup then copies necessary files to the hard disk partition.
8. The computer restarts and enters the GUI phase, as explained in the next section.

- ***GUI mode***

After the computer restarts, the setup wizard starts. This is known as the *GUI phase* or *GUI mode*. The following steps explain the procedure:

1. Press Enter to continue installation. During this time, setup detects and installs various devices and drivers. This takes several minutes before the next screen is displayed.

2. The Regional and Language Options screen appears. Make your selections appropriately and click Next.
3. In the Personalize Your Software page, fill in the correct information and click Next. Enter the correct 25-digit Product Key and click Next.
4. In the Computer Name and Administrator Password screen, enter a name for the computer and enter the password that you wish to assign to the computer's local administrator. Click Next.
5. In the Date and Time screen, check and, if required, correct the date, time, and time zone settings and click Next.
6. The setup now enters the *Network Phase*. Networking components are detected and installed. Choose Typical if you wish to proceed with automatic configuration; otherwise, choose Custom. Typical networking components include Client for Microsoft Networks, File and Print Sharing for Microsoft Networks, and TCP/IP protocol with automatic IP addressing. Click Next.
7. The Workgroup or Computer Domain name screen appears next. If you select a domain name, you will be asked about the domain administrator's username and password. Enter the correct information and click Next. Setup copies several files to the hard disk.
8. Setup completes the installation by installing the Start menu items, registers various components you selected, saves your configuration to the registry, removes temporary installation files, and restarts the computer.

When the computer restarts, the Welcome screen appears if you selected to join a workgroup. If you selected to join a domain during installation, the Logon to Windows screen appears instead.

- ***Installing over the network***

When installing Windows XP Professional over the network, the installation files are stored on a network file server known as the *distribution server*. The setup process is started using either the *winnt.exe* or*winnt32.exe* command, depending on the operating system currently in use.

- If you are using MS-DOS or Windows 3.x versions, run *winnt.exe* to start the installation process.
- If you are currently using Windows 95, Windows 98, Windows Me, Windows NT 4.0, or Windows 2000 Professional operating systems, run the*winnt32.exe* to start the installation.

The following are some essential steps that you must take before starting theinstallation:

1. Locate the distribution server and the correct path to connect to the sharedfolder.

2. Create a FAT partition on the computer where you want to install Windows XP Professional.
3. Install necessary network client software in order to enable the computer to connect to the distribution software. If the computer does not have any operating system, you can use a boot floppy disk that contains network client software to communicate on the network.
4. Start the computer either using the currently installed operating system or from the network client boot disk.
5. Connect to the shared folder (*/i386*) on the distribution server.
6. Start the installation by running the *winnt.exe* or *winnt32.exe* from the command prompt.

Completing post-installation tasks

After the installation is complete, you must perform a number of tasks such as product activation (Windows XP), updating device drivers, copying user data files, and verifying the installation. These tasks are explained in the following paragraphs:

- ***Product activation (Windows XP)***

The retail and evaluation copies of Windows XP Professional must be activated within 30 days of installation. Activation is not required if the copy of Windows XP Professional is a part of volume licensing plan. After 30 days, the Windows XP Professional ceases to work and does not allow you to logon to the system.

- ***Update OS and device drivers***

Once the basic installation is complete, you might need to update the drivers for certain devices such as the network adapter or a printer. Some vendors might have updated their drivers after the release of the operating system. You must also check whether Microsoft itself has updated the OS. For Windows 2000 Professional, you need to install Service Pack4. In the case of Windows XP Professional, you need Service Pack2 if it is not included on the setup CD-ROM.

- ***Copy user data files***

After the installation is complete, you will need to install application software and restore data files for the user who works on the computer. You will also need to restore his desktop settings as well. You can use the File and Settings Transfer Wizard in Windows XP to copy user settings and files from another computer. This wizard is located in the System Tools subfolder in the Accessories folder in the Start Menu. This wizard can copy application settings and user data files as well as

several other settings such as Internet Explorer settings, Outlook settings, desktop settings, folder options, etc.

- ***Verifying installation***

  After the installation is complete, you must verify that the OS and the applications work as expected. Reboot the computer and examine the functionality of different devices. Make sure that it is able to connect to the network and printers. Run a couple of applications and verify that they do not produce unexpected errors.

Upgrading an operating system

In some situations, you might be required to upgrade a previously installed version of Windows to Windows XP or Windows 2000 Professional. You will need to make certain checks to perform a successful upgrade installation. These checks include verifying that an upgrade path exists, the new OS supports the computer hardware and the applications are compatible. When you decide to perform the upgrade, you will also be required to back up the existing data files. In the discussion that follows, we will take a look at these aspects.

- ***Available upgrade paths***

Not all previous versions of Windows can be directly upgraded to Windows XP or Windows 2000 Professional. Table 2-10 lists the options available for performing an upgrade installation for both of these operating systems.

Note:

Memorize the details given in Table 2-10 because questions on upgrading OS generally make their way into the A+ exams. Also make it a point to figure out a tricky question where you would be asked to upgrade a previous server operating system (Windows NT 4.0 Server to Windows 2000 Professional or a Windows 2000 Server to Windows XP Professional). Remember that only client operating systems can be upgraded to new client operating systems.

- ***Checking hardware compatibility***

Both Windows XP and Windows 2000 Professional setup programs include an option to test whether the current computer hardware and software can be upgraded or not. Run the following command from the */i386*folder on the CD-ROM drive:

winnt32 /checkupgradeonly

When the test is complete, it displays the compatibility report. This report issaved as the file *UPGRADE.TXT*.

- ***Checking application compatibility***

  You will need to ensure that the currently installed applications are compatible with the new OS. If they are not compatible, choose whether you will need to obtain newer versions of applications or apply updates to make them so.

Installing additional Windows components

When upgrading a previous version of Windows to a newer version, you might need to apply OS updates before starting the installation. The updates can be in the form of a service pack(SP), hotfixes, or patches. For example, if you want to upgrade a Windows 2000 Professional computer to Windows XP Professional, you will first need to install Windows 2000 Service Pack 4 (SP4).

Network compatibility

If the computer is connected or will be connected to a network, ensure that the new OS supports the network adapter and its driver. You might also need to obtain information on protocol configuration such as TCP/IP addresses.

Upgrade utility

You must decide on a built-in utility to perform the upgrade. Depending on the currently installed OS on the computer, you can use one of the following utilities:

- Use *winnt.exe* to upgrade from a 16-bit OS such as Windows 95 and MSDOS.
- Use *winnt32.exe* to upgrade from a 32-bit OS such as Windows 98 and later.

Backing up user data

Considering that the upgrade installation is successful, the user data, desktop, and application settings will be migrated to the new OS. But you should not take chances and always plan to back up at least user data files before starting the installation.

Performing the upgrade

- *Upgrading to NTFS File System*
- *Upgrade the PnP driver files*
- *Upgrade report*

Installing devices and drivers

- ***Identifying the PnP and non-PnP devices***
- ***Permissions and rights***
- ***Driver signing***
- ***Obtaining device drivers***
- ***Connecting the device***
- ***Installing and configuring the driver***

Verifying device driver installation

Optimizing performance

- ***Virtual memory***

Windows operating systems use virtual memory to temporarily storedata when it is running out of the physical memory (RAM) in the computer. Thisdata is stored in a file on the hard disk(which is known as swap file or pagingfile). For most Windows installations, the OS automatically manages the size ofthe paging file. You can manually increase or decrease the size of this file or splitthe file across multiple hard disks depending on your requirements.

If you feel that the system performance is poor, you can increase the size of thisfile or divide the file into multiple disks. The following steps explain how you canchange the virtual memory settings in Windows XP:

1. Click Start →Control Panel →System.
2. Click the Advanced tab.
3. Click the Settings button in the Performance area.
4. Click Advanced.
5. Click Change in the Virtual Memory area.
6. Enter the “Initial size” and “Maximum size” and click Set.
7. Close all windows.

Defragmenting hard disks

Defragmenting hard disks helps improve their read/write performance. Hard disks become fragmented when some applications are installed or after a large number of files are moved or deleted. *Fragmentation* refers to the state of a hard disk when it no longer has contiguous space available to store new files or folders. The Disk Defragmenter utility can analyze hard disks and defragment them to free up contiguous space. Disk Defragmenter works onFAT, FAT32, and NTFS volumes.

There are several ways to access the Disk Defragmenter:

- ClickStart →All Programs →Accessories →System Tools →DiskDefragmenter.
- Open Windows Explorer; open the properties of disk or volume. Select the Tools tab. Click Defragment Now to open the Disk Defragmenter snap-in.
- Right-click My Computer, and click Manage to open Computer Management.

At the top of the window you can select the disk or volume that you wish toanalyze or defragment. The two buttons on the bottom of the screen give you thefollowing two options:

- The Analyze button

  Used to analyze the entire disk and display the results in the graphical form.
- The Defragment button

  Used to start the defragmentation process. The diskisautomatically analyzedbefore it is defragmented.

2.4. Troubleshooting Techniques

In order to troubleshoot problems related to the operating system, you mustunderstand the Windows boot sequence, the advanced boot options available,and basic diagnostic procedures. Additionally, you must have good knowledge ofusing built-in troubleshooting utilities. Familiarity with different types of errormessages and common operational problems will help you resolve problems easilyand quickly.

Understanding boot sequence

The following discussion explains the boot sequence in both Windows XP andWindows 2000:

- Pre-boot sequence

When the computer is started, it performs a *pre-boot sequence* inthe following manner:

1. A POST is performed to checkthe hardware components, which includephysical memory (RAM), video, and the keyboard. In case the computerBIOS supports Plug and Play (PnP), the configuration of PnP-compatiblehardware devices is performed.
2. The Master Boot Record (MBR) is loaded from the selected boot device. TheMBR in turn loads the NTLDR file from the boot device. In case thecomputer has a Small Computer System Interface (SCSI) device as the bootdevice without its own BIOS, the *NTBOOTDD.SYS* file is loaded.

- **Boot sequence**

NTLDR takes charge of the process from here on and performs thefollowing steps:

1. NTLDR switches the processor to 32-bit flat memory mode and loads thefilesystems driver to access the FAT, FAT32, or NTFS partitions.
2. NTLDR reads the *BOOT.INI* file and selects an operating system. If multipleoperating systems are installed on the computer, the *BOOT.INI* file promptsthe user to select an operating system. If the MS-DOS operating system isselected, NTLDR loads the boot sector from the *BOOTSECT.DOS* file.
3. NTLDR calls on the *NTDETECT.COM* file to perform hardware detection,which displays error messages if any hardware problems exist. If thecomputer has more than one hardware profile, the user is given a choice toselect an appropriate profile.

- **Kernel Load and initialization**

The Kernel Load phase begins and performs the following steps:

1. NTLDR calls on NTOSKRNL.EXE file (the Windows Kernel), which changes the screen color from black to blue. The Kernel loads another module known as the hardware abstraction layer (*HAL.DLL*).
2. The kernel initializes by creating a registry key known as HKEY_LOCAL_MACHINE\HARDWARE. This key contains information about the hardwaredevices on the computer based on the results of *NTDETECT.COM*.
3. The kernel creates a Clone Control Set by copying the control set in theHKEY_LOCAL_MACHINE\SYSTEM\Select sub-key of the registry.
4. The kernel loads low-level device drivers and filesystems. The device driversinitialize as they are loaded. The user mode subsystem is loaded and thecomputer display changes to the GUI mode.

5. Once the kernel has loaded and is initialized, the system services are started.

- **Logon process**

The logon process starts as soon as the *Winlogon*service is started.The Local Security Authority displays the logon screen. The Service Control Manager scans the HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services subkey of the Registry to look for services that should start automatically.After you log on successfully to the system, the operating system copies theClone Control Set to the Last Known Good control set.

Understanding the Advanced Boot Options

Some of the Windows startup problems can be resolved using the Advanced BootOptions during the startup phase. The most commonly used advanced optionsinclude Safe Mode, Last Known Good Configuration and Recovery Console.When Windows fails to complete the boot process, you can access any of theseoptions by pressing the F8 key immediately after the POST is complete.

- Safe Mode

In the Safe Mode, Windows XP loads with minimum basic system servicesand device drivers sufficient to boot the operating system. These componentsinclude the keyboard, mouse, hard disks, the VGA monitor, and other mostessential system services. Safe Mode provides access to all system and deviceconfiguration options so that you can enable or disable components one byone and try to pinpoint the problem.

- Safe Mode with Networking

  Safe Mode with Networking is similar to Safe Mode except that networkingdevices, drivers, and services are also initialized.

- Safe Mode with Command Prompt

Safe Mode with Command Prompt loads the command interpreter, just likein MS-DOS, instead of the GUI.

- Last Known Good Configuration

The Last Known Good Configuration option loads the last used systemconfiguration that allows you to return the system to the previous workingconfiguration. Windows saves two types of configurations in the Registry:Default and Last Known Good. The Default configuration is saved to theregistry when you shut down the system. The Last Known Good Configurationis saved when you log on to the system.

Note:

The Last Known Good Configuration will not be useful if you have already logged on to the system with incorrect configuration. This option must be used before a successful logon happens.

- Enable Boot Logging

  This mode enables the boot logging option that stores the boot process informationin a file named *NTBTLOG.TXT*. This file is stored in the */WINNT*directory and is helpful is diagnosing startup problems.
- Enable VGA Mode

  This mode loads Windows with basic VGA device drivers and other normal configuration. This mode is helpful in diagnosing problems with the displaydriver.

Recovery Console

The Recovery Console is useful in resolving system startup problems when the Safe Modes and Last Known Good Configurations do not work. The Recovery Console allows you to repair critical system files that might have been corrupted by copying original files from the Windows XP/2000 Professional setup CDROM.You can also enable or disable services that you thinkmight be causing theproblem. The Recovery Console can either be started from the Windows setupCD-ROM or can be installed as one of the Advanced Boot Options as explained inthe following paragraphs.

Once the Recovery Console is installed, you can type help and press the Enter keyat any time to get a list of available commands. Type exit and press the Enter keyagain to close the Recovery Console and restart the system.

- Starting Recovery Console from the Windows XP/2000 setup CD-ROM

1. Insert the Windows XP/2000 setup CD-ROM into the CD-ROM drive. Makesure that the computer BIOS is set to start from the CD-ROM. Restart thecomputer.
2. Press Enter when the Setup Notification message appears.
3. At the Welcome screen, press R to repair a Windows XP Installation UsingRecovery Console.
4. In case there is more than one Windows XP installation on the computer,type the installation number corresponding to the installation that you wishto repair, and press Enter.
5. Press C at the Windows XP Recovery Console screen to start the RecoveryConsole.
6. Type the Administrator password when prompted and press Enter. This password must be the password of the Local Administrator.

7. The Recovery Console displays a command prompt.

- Installing Recovery Console as Advanced Boot Options

1. Insert the Windows XP setup CD-ROM in the CD ROM drive while running Windows XP Professional.
2. Select NO when you are prompted to upgrade to Windows XP Professional.
3. ClickStart→Run to open the Run dialog box. Type cmdand press Enter to open the command prompt.
4. At the command prompt, type the following command, replacing the word*drive* with the drive letter of your CD-ROM drive:

   drive:\i386\winnnt32.exe /cmdcons

5. Restart the computer.

Once installed, the Recovery Console appears as one of the options in theAdvanced Boot Options menu when you press F8 during the startup process.

System Restore (Windows XP)

The System Restore in Windows XP helps restore the system to a working stateafter you make changes to the system settings or install applications that make itunstable. It uses system restore points to store a snapshot of system settings atregular intervals. When you run the System Restore, a calendar is displayed inwhich you can picka particular System Restore point. The System Restore can beaccessed in one of the following methods:

- Open the Help And Support Center, located in the Start menu. Under PickaTask, click Undo Changes to Your Computer Using System Restore.
- Click Start →All Programs →Accessories →System Tools →System Restore.

You can also create System Restore points manually when you expect to makechanges to your system. The following steps explain how you can create a SystemRestore point:

1. Click Start →All Programs →Accessories →System Tools →System Restore.
2. Click Create A Restore Point. Click Next.
3. Type a name to identify the restore point in the Restore Point Descriptionbox.
4. Click Create.

Automated System Recovery (Windows XP)

The Automated System Recovery (ASR) Wizard in Windows XP is located in theBackup utility. This utility is used to restore the system after a major failure. Clickthe Automated System Recovery Wizard on the Backup Utility window to preparean ASR backup for the computer. You will need a blank floppy disk and a fullbackup of the system partition of the computer.

The following procedure explains how the Automated System Recovery Wizardcan be used to back up critical system components:

1. Click Start → Programs → Accessories → System Tools → Backup.
2. Clickthe Automated System Recovery Wizard from the Backup Utilitywindow. This opens the Automated System Recovery Wizard dialog box.Click Next.
3. Select the Backup Media Type and the Backup Media or Filename. Click Next.
4. Checkthe information on the Completing the Automated System RecoveryPreparation Wizard page. If correct, click Finish.
5. It takes the system about an hour or so to back up the system files. You areprompted to insert a blank floppy disk.
6. The backup completes writing to the floppy disk and presents an option toview the report.
7. Click Close to close the backup process and close the Backup Utility window.

When you need to restore the system using the ASR, you can use the floppy diskto restore the system partition of the computer. You must also restore criticalsystem files that you backed up on the tape drive or a network file share. Otherapplications and data can be restored using your regular backup sets.

Emergency Repair Disk (Windows 2000)

In Windows 2000 you can prepare Emergency Repair Disks (ERDs) or boot disks(a set of four floppy disks) to help start the system when it cannot boot normallyfrom the hard drive. You will need the setup CD-ROM to create the boot disk set.As with the ASR utility in Windows XP, the ERD utility in Windows 2000 is alsolocated in the Backup utility. You can also create the ERD disks by running thefile *MAKEBOOT.EXE* from the BOOTDISK folder on the setup CD-ROM.

In order to use the ERD, you will need to choose the Repair option after startingthe installation using the setup CD-ROM. The installation process will thenprompt you to provide the ERD disk set.

Troubleshooting procedures

The troubleshooting process starts when someone reports a problem and asks for your help to resolve it. The first step to troubleshoot a problem is to talk to the user and gather as much information as you can. This is followed by identifying potential causes and isolating the problem. The discussion that follows explains the troubleshooting process that you are expected to know for your workplace.

- Talking to the user

  As noted earlier, the first step in troubleshooting a problem is to gather information about the problem and its symptoms. You will need to talk to the computer user to gather necessary information that can help you get started in the process of resolving the problem. You might need to ask a few questions and should be patient when listening to the user. Do not jump to a conclusion at this point.

- Gathering information

  Gathering sufficient information from the user or from the system event logs will ensure that you know what happened between the time the computer was working and when it stopped. The problem might be due to a user error, a malfunctioning device, or a configuration change. Find out if a new application was installed, if a new hardware device was added, if a device driver was updated, or if the user tried to install a new version of a game or just tried to openan application. Unless you have enough information, you will not be able tocorrectly identify the cause of the problem.

- Identifying potential causes

  One you have enough information about the problem,the next step is to lookinto several possible causes that could result in the specificproblem. Try not to make assumptions on initial information and do not overlookeven the least important cause.

- Isolating the problem

  Once you have identified a number of potential causes for theproblem, you will need to eliminate the causes that do not directly relate to theproblem. In case of a hardware problem, you might need to disable one or morehardware devices and try starting the

computer with minimum configuration.Isolating the problem ensures that you have correctly identified the cause of it.

- Testing related components

  Sometimes problems do not come alone. One problemleads to another and the process continues. When you have identified the cause ofthe problem, checkwhether the problem itself created other problems. This willensure that you take care of other problems as well when applying a correctivesolution.

- Apply a solution and test results

  Next, decide on what you need to do to rectify theproblem. The solution may be as simple as reconnecting a networkcable or ascomplex as reinstalling the operating system. Whatever is the solution to theproblem, you must first make sure that it will work as expected and will returnthe computer to its working state. You might need to consult your seniors, refer tothe instructional manuals, or search the Internet to find a resolution. Apply thesolution and test the results before you finally hand over the computer to the enduser.

- Document the solution

  Once the problem is rectified, you should make a note of theproblem in the logbook, which is usually available with the help desk department.Include the day and date, the computer name, the installed OS, the name ofthe user, the type of problem reported the cause of the problem and what you didto rectify the problem. Documentation is helpful in backtracking future problemswith the same computer or user. It is also helpful in getting quickhelp when theproblem is repeated on some other computer.

Operational problems

Some of the problems with operating systems appear as users do their regular jobson computers. These problems are termed as operational problems, as summarizedin the following paragraphs.

- Blue Screen

A Blue Screen error in Windows is also commonly known as the *STOPError* or *Blue Screen of Death*. This error is seen in many Windows operatingsystems and is considered one of the most critical errors. In most cases, the STOPerrors are related to hardware issues and are identified by an 8-digit hexadecimalnumber such as STOP 0X0000000A, STOP 0X0000007F, etc. Windows writes theerror in event logs. You can use the Event Viewer to diagnose these errors. If thisis not helpful,

you can also search Microsoft's TechNet or search Knowledge Basearticles on how to resolve these errors.

- System lock up

System lockup or system freezing is usually caused when the systemis out of resources. It causes long delays in launching applications, delayedresponses to user's keystrokes, or even results in permanent lockup of the system.The most common reason for a system lockup is shortage of RAM. The mosteffective resolution for system lockup problems is to increase physical RAM inthe system and configure the size of paging files (virtual memory). In case youhave recently added a hardware component or a software application, you shouldremove it to see whether the problem is resolved.

- I/O device not accessible or does not function

Each I/O device has an associated softwaredevice driver, which must be installed if it is not automatically installed andconfigured by the OS. When you configure the device driver, you must be carefulabout allocation of system resources. You can use the Device Manager utility tofind more information about a device that does not respond. If required, reinstallthe device driver to see whether it resolves the problem.

- Application failed to start

This error is a result of a misconfigured application or amissing component of the application. An incorrectly installed application is alsolikely to cause this error. Reinstalling the application usually resolves thisproblem.

- Printing problems

Printing problems are also common operation issues. The"Printers and Scanners" section later in this chapter covers printing problems indetail.

- Dr. Watson errors

  The Dr. Watson utility (*drwtsn32.exe*) is included in mostWindows operating systems to interpret errors and inform the user of potentialcauses. The information provided by this utility can be helpful in diagnosingproblems. Dr. Watson creates a text file named *DRWTSN32.LOG*, whichcontains critical information about the error.

- Illegal operation

  The illegal operation error is reported when an applicationattempts to perform an action that is not permitted by the operating system. Thetext of the error message reads as:

  > The application has performed an illegal operation and will be shut down. Ifthe problem persists, contact the program vendor.

Windows displays a text box containing this error message and three buttons:OK, Cancel, and Details. The Details button displays more information about theerror. You can clickeither the OK button or the Cancel button to close theapplication.

- General protection fault (GPF)

  A GPF occurs when an application attempts to accessthe areas of memory that are used by other applications. To resolve GPF errors,reboot the computer, and the computer memory will be cleared. If the errorcontinues to appear, you may need to identify the application that causes thiserror. Once the rogue application is detected, you can contact the vendor to seewhether they have a fix for the problem.

Common error messages

The following sections cover some more common error messages that you arelikely to encounter:

- **Missing NTLDR**

  The "NTLDR is Missing" error is accompanied by a "Press Any Key toRestart" message. This error is caused if any of the system startup files aremissing or have become corrupt. The files that can cause this error include*NTLDR*, *NTDETECT.COM*, and *BOOT.INI*. You can restore these files byusing the Recovery Console, an Emergency Repair Disk(ERD in Windows2000), or by using the setup CD-ROM and selecting the Repair option whenthe installation starts. You can also restore these files using a system restoreutility in Windows XP.

- **Invalid Boot Disk**

  This error is displayed when the system BIOS cannot access the diskpartition that is supposed to contain system startup files. You might have toreinstall the OS to address this problem.

- **Operating System Not Found**

  This error means that the BIOS cannot find an operating system on theconfigured boot partition or boot device. This error is common in newcomputers that do have a boot partition configured in the BIOS and on whichno OS has been installed so far.

- **Inaccessible Boot Device**

  This error is displayed when the computer finds a critical error with a bootdevice. This can be due to a malfunctioning device driver or to some resourceconflicts.

- **Device or Service Failure**

If the operating system has started, you may still receive an error saying that aparticular device or a service has failed to start. You can open the EventViewer console and locate the appropriate error message to get help infinding the cause of the problem.

- **Missing Registry Entry**

  Windows Registry is a database of complete system configuration. Everysystem service, driver, and application is registered in Registry before it can Workwith the installed operating system. If a component fails to create anentry in the appropriate Registry key, it will not be able to start. One of theeasiest methods to resolve these errors is to reinstall the driver or applicationthat has generated the error.

Troubleshooting utilities

Windows XP and Windows 2000 include some built-in management utilities that are helpful in troubleshooting problems as well as optimizing system performance. These are mainly classified as disk management, system management, and file management. This section covers a summary of these utilities.

- Disk Management utilities

  In this section, we will lookat some common diskmanagementtools that can be run from the Windows command prompt.

    - DEFRAG

The *defrag.exe* command is used to defragment hard disks. It can be used toanalyze and perform diskdefragmentation. Diskdefragmentation rearrangesfiles on contiguous sectors on the hard disk, which improves the disk read-writeperformance. You can also run the DiskDefragmenter utility from theComputer Management console. Another way to start the defragmentationutility is to open the Properties window of a diskpartition and select DefragNow from the Tools tab.

    - NTBACKUP

The *ntbackup.exe* command starts the Windows backup utility. You can alsorun the backup utility from the System Tools folder under Accessories in theAll Programs menu.

    - CHKDSK

The *chkdsk.exe* utility is used to checkdisk s for filesystem errors and then fixthem. It can also be started from the Properties window of a diskpartitionand by selecting Check Now from the Tools tab.

    - FORMAT

The *format.exe* command is used to format a diskpartition using FAT orNTFS filesystems. You can also format a diskin Windows Explorer. Rightclickadiskpartition and select Format from the context menu. Formatting adisk deletes all the contents on a disk partition.

- DISKPART (Windows XP)

The *diskpart.exe* is a new diskmanagement utility in Windows XP that can beused to manage all aspects of disks, volumes, and partitions except forformatting the disk. This is a very advanced utility and must be used withcaution.

System management utilities

In this section, we will lookat some common systemmanagement tools that can be helpful in diagnosing problems related to systemservices, devices, and applications.

- Computer Management Console

The Computer Management Console is a centralized place to manage theentire system, services, and applications. You can also manage disks, sharedfolders, and manager users and groups. It includes the Event Viewer utility,which is a great troubleshooting tool. To start the Computer Managementconsole, right-clickthe My Computer Icon on the desktop and selectManage. You can also access this console from the Administrative Toolsfolder in the Start menu.

- Device Manager

The Device Manager utility helps manage and troubleshoot hardware devicesand drivers. This utility is a part of the Computer Management console. Youcan also access this utility from the Hardware tab inside System Properties inthe Control Panel. Device Manager can be used to checkwhether a device isworking or not and what resources it is using, to uninstall or update drivers,and to rollbackto a previously working driver in case a newly installed driverdoes not work.

- Task Manager

The TaskManager provides a real-time view of system performance includingCPU, memory, processes, networking, and applications. You can end anapplication or a process if it is stalled or not responding. The Processes tabprovides a view of how much memory and CPU time each process is using.The Performance tab provides a graphical view of the CPU and paging fileusage. The Networking tab (Windows XP) provides statistics about networkconnection and percentage of networkutilization. The Users tab (WindowsXP) provides information about users currently connected to the computer.

- MSCONFIG (Windows XP)

The *msconfig.exe* command opens the System Configuration Utility window.This utility is helpful in verifying the system startup environment. The optionsfor managing system startup include boot options,

services, and applicationsconfigured for auto-start. You can use this utility to configure the system tostart in a diagnostic mode by selecting items from a given menu.

- REGEDIT and REGEDT32

The *regedit.exe* and *regedt32.exe* commands are used to edit the settingsstored in the Windows Registry. The Windows Registry is a collection ofsystem configuration settings in a hierarchical data file. The configurationdata includes the operating system settings, user specific settings, applicationdata, hardware components, and all installed device drivers. Under extremecircumstances, if you need to make changes to the Registry, you should firstmake a backup copy of the existing Registry files. It can either be run fromthe command prompt or from the Run option in the Start menu.

- Event Viewer

The Event Viewer console displays error messages, warnings, and other informationabout system activities. It is also used to view the contents of log filesand includes tools to search particular events from the logs. You can open theEvent Viewer console from the Administrative Tools utility in the ControlPanel or from the Computer Management console. The Application Logcontains errors, warnings, or other information generated by applicationprograms. The Security Log contains errors, warnings, and information aboutsecurity events and security problems such as incorrect logons that areincluded here by default. The System Log contains errors, warnings, andinformation about system events such as system startup and shutdown,services, and devices and drivers. You can use the Log Filtering feature in theevent viewer to search for specific events.

File management utilities

In this section, we will lookat some common file managementtools that can be helpful in troubleshooting problems related to files andfolders.

- Windows Explorer

  Windows Explorer is perhaps the most commonly used utility to manage filesand folders. You can manage all aspects of files and folders, configuresharing, set sharing and NTFS permissions, copy and move files and folders,and even format disk partitions.

- The ATTRIB command

The *attrib.exe* command is run from the Windows command prompt to viewor change the attributes of a file or folder. File attributes include System (S),Read-only (R), Hidden (H), and Archive (A). The System attribute protectscritical system files from being displayed or deleted by making them readonlyand hidden. The Read-only attribute prevents a file from being deletedaccidentally or

deliberately. The Hidden attribute prevents a file or folder tobe displayed in Windows Explorer. The Archive attribute sets the archive biton files so that they are included in the next backup. Use the plus sign (+)with an attribute to set it and use the minus sign (–) to remove the attribute.For example, the command attrib textfile.doc +h will make the filehidden.

- The EDIT command

  The *edit.com* command is used to edit text files in the Windows commandshell. The files are saved in ASCII file format.

- COPY and XCOPY commands

  Although most of the file copy operations can be performed using Windows Explorer, the *copy* and *xcopy*commands are still used frequently from the command line to copy files from one location to another. These commands include a number of optional parameters. You can type copy /? orxcopy /?at the command prompt to view the syntax of the commands and a list of available switches.

Windows Reporting

Windows includes a utility called Error Reporting that sendserror messages and symptoms of the error to Microsoft when an application fails.This utility works well for those computers that are connected to the Internet.Microsoft collects this information to checkthe cause of application failure andmake improvements in its applications such as MS Word, MS Excel, etc. Thisutility is enabled by default. If disabled, you can enable the utility by completingthe following steps:

1. ClickStart →Control Panel →System, or right-clickMy Computer and selectProperties.
2. Clickthe Advanced Tab and clickError Reporting to open the ErrorReporting window.
3. Click the Enable Error Reporting radio button.
4. ClickChoose Programs and select the appropriate options by clicking theAdd button.
5. Click OK and close all Windows.

2.5. Preventive Maintenance (PM)

PM for the operating system helps maintain system performance and reduces thechances of system failures. In this section, we will take a look at some commonpreventive maintenance procedures.

Software updates

Software updates keep the operating system and application software up-to-date.Software vendors regularly release updates to fix known bugs in their applications.For example, Microsoft

regularly releases updates for its operating systemsand applications such as MS Office to address operating problems. These updatesare described in the following list.

Note:

Although most vendors provide software updates free of cost, it is good to test them before installing them on multiple computers. Do not install updates only because it is offered without charge. Verify with the vendor or from documentation about the specific issues that an update addresses.

- Hotfixes

  Small pieces of software that are used to address a specific problem with the operating system or an application.

- Patches

  Usually meant to immediately address some security-related issue with the operating system.

- Service Packs

  A collection of a number of hotfixes and updates released by the software manufacturer. Manufacturers usually test service packs on a variety of hardware platforms and check their compatibility with various applications.

Windows Update

Windows Update (or Automatic Updates) is a built-in feature for Windows-based operating systems. This feature can be configured to automatically check for, download, and install updates to the installed operating system. This utility can be accessed from the Start menu or from the System properties window located in the Control Panel. A user can configure Windows Update options in one of the following ways:

- Automatic (with user selected days and timings).
- Download updates for me, but let me choose when to install them.
- Notify me but don't automatically download or install them.
- Turn off Automatic Updates.

When Automatic Updates are configured for particular days and times, the computer should be left connected to the Internet so that Microsoft's web site can check for new updates and install them as required.

Data backup and restoration

Data backup is one of the most important aspects of preventive maintenance. It ensures that data will be available even when a system crashes or in the event of a disaster. As a technician, you must be aware of the software or built-in utilities available for data backups. Data can be backed up using one or more types of backup methods. Magnetic tapes are very popular as backup media due to their large storage capacity, but you can also backup on CD-RW disks or on a network drive. Backup tapes must be safely stored at an off-site and secure location.

On Windows operating systems, backup of a single computer can be taken using the Windows Backup utility. Remember that this utility can also back up datastored on other network drives. This utility can backup the entire contents of a disk including the operating system data, which is called the *System State Data*.You can also create ASR disks that are helpful in restoring the system in the eventof a system crash.

Note:

Remember that Windows XP and Windows 2000 cannot backup data directly onto CD-RW and DVD disks. However, you can copy data to a hard drive or to a shared network folder and then burn a CD-RW or a DVD disk.

Backed-up data is useless if it cannot be restored. You must perform test restores periodically to ensure that the restoration methods used are working properly and that the data is being correctly backed up as desired.

Antivirus software

Antivirus software keeps track of viruses and other malicious software. It helps protect the system from viruses, Trojan horses, worms, and other malware such as spyware and adware. Antivirus software uses virus signatures to detect the presence of malicious software. You must run antivirus software often to detect the presence of malicious code in the computer. Virus signatures must be updated regularly so that the antivirus application can effectively detect and clean the system of any new viruses.

Creating System Restore Points

The System Restore utility in Windows XP uses System Restore Points to restore an unstable system to a working state. A System Restore Point stores a snapshot of system settings at regular intervals. You can create System Restore Points manually when you expect to make changes to your system. The following stepsexplain how you can create a System Restore Point:

1. Click Start → All Programs → Accessories → System Tools → System Restore.
2. Click Create A Restore Point, and then click Next.
3. Type a name to identify the restore point in the Restore Point Description box.
4. Click Create.

Practical Laboratory Exercises/Projects

WOLAITA SODO UNIVERSITY

SCHOOL OF INFORMATICS

DEPARTMENT OF INFORMATION TECHNOLOGY

COMPUTER MAINTENANCE AND TROUBLESHOOTING

Lab Exercises

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May 2023

LAB Practical Manual For Computer Maintenance and Technical Support

Instruction

- Apply all Precautions required before working on computer components

A] Identify the name, function and characteristics of the following Computer Components (with their usage)

1. System unit/Cassis (is it Tower case/Desktop/mini-tower)
2. USB port
3. Parallel Port
4. Serial Ports

7. PS/2 Port
8. RJ-11
9. Power chord
10. DisplayPort / HDMI / DVI / VGA

B] **Identify the following internal components of a computer**

1. Motherboard. The motherboard is the computer's main circuit board.
2. CPU/processor, Heat sink & fan
3. RAM (random access memory)
4. Hard drive& its connector
5. CD/DVD Driver & its connector
6. Power supply unit & its connectors (Molex, mini Molex, AT/ATX)
7. Video card
8. Network card

5. Audio/video ports
6. RJ-45 port/Ethernet

9. Expansion cards
10. CMOS Battery
11. Chipsets
12. RAM Slot
13. EIDE/PATA/SATA Controller
14. Data Bus
15. SATA Cable
16. ATX/AT Connector
17. CPU Power Connector
18. Is the motherboard AT or ATX 20. What about Power Connector?

C] ROM and RAM

ROM

Read-only memory (ROM) chips are located on the motherboard. ROM chips contain instructions that the CPU can access directly. ROM stores basic instructions for booting the computer and loading the operating system. ROM chips retain their contents even when the computer is powered down. The contents cannot be erased, changed, or rewritten by normal means. ROM types include the following:

Programmable read-only memory (PROM):- Information is written to a PROM chip after it is manufactured. A PROM chip cannot be erased or rewritten.

Erasable programmable read-only memory (EPROM): Information is written to an EPROM chip after it is manufactured. An EPROM chip can be erased with exposure to UV ***light. Special equipment is required.***

Electrically erasable programmable read-only memory (EEPROM): Information is written to an EEPROM chip after it is manufactured. EEPROM chips are also called flash ROMs. An EEPROM chip can be erased and rewritten without removing the chip from the computer.

RAM

Random-access memory (RAM) is the temporary storage for data and programs that are being accessed by the CPU. RAM is volatile memory, which means that the contents are erased when the computer is powered off. The more RAM in a computer, the more capacity the computer has to hold and process large programs and files. The different types of RAM are as follows:

Dynamic RAM (DRAM) is a memory chip that is used as main memory. DRAM must be constantly refreshed with pulses of electricity to maintain the data stored in the chip.

tatic RAM (SRAM) is a memory chip that is used as cache memory. SRAM is much faster than DRAM and does not have to be refreshed as often.

Fast Page Mode (FPM) DRAM is memory that supports paging. Paging enables faster access to the data than regular DRAM. Most 486 and Pentium systems from 1995 and earlier use FPM memory.

Extended Data Out (EDO) RAM is memory that overlaps consecutive data accesses. This speeds up the access time to retrieve data from memory because the CPU does not have to wait for one data access cycle to end before another data access cycle begins.

Synchronous DRAM (SDRAM) is DRAM that operates in synchronization with the memory bus. The memory bus is the data path between the CPU and the main memory.

Double Data Rate (DDR) SDRAM is memory that transfers data twice as fast as SDRAM. DDR SDRAM increases performance by transferring data twice per cycle.

Double Data Rate 2 (DDR2) SDRAM is faster than DDR-SDRAM memory. DDR2 SDRAM improves performance over DDR SDRAM by decreasing noise and crosstalk between the signal wires.

Rambus DRAM (RDRAM) is a memory chip that was developed to communicate at very high rates of speed. RDRAM chips are not commonly used.

Memory Modules

Early computers had RAM installed on the motherboard as individual chips. These individual memory chips, called Dual Inline Package (DIP) chips, were difficult to install and often became loose on the motherboard. To solve this problem, designers soldered the memory chips on a special circuit board called a memory module. The different types of memory modules are as follows:

Dual in-line package (DIP) is an individual memory chip. A DIP had dual rows of pins used to attach it to the motherboard.

Single in-line memory module (SIMM) is a small circuit board that holds several memory chips. SIMMs have 30-pin and 72-pin configurations.

Dual in-line memory module (DIMM) is a circuit board that holds SDRAM, DDR SDRAM, and DDR2 SDRAM chips. There are 168-pin SDRAM DIMMs, 184-pin DDR DIMMs, and 240-pin DDR2 DIMMs.

Rambus in-line memory module (RIMM) is a circuit board that holds RDRAM chips. A typical RIMM has a 184-pin configuration. ***Note***

Memory modules can be single sided or double sided. Single-sided memory modules contain RAM on only one side of the module. Double-sided memory modules contain RAM on both sides of the module.

Cache Memory

SRAM is used as cache memory to store the most frequently used data. SRAM gives the processor faster access to the data than is possible by retrieving it from the slower DRAM, or main memory. The three types of cache memory are as follows:

- L1 is internal cache integrated into the CPU.
- L2 is external cache originally mounted on the motherboard near the CPU. L2 cache is now integrated into the CPU.
- L3 is used on some high-end workstations and server CPUs.

Error Checking Memory errors occur when the data is stored incorrectly in the RAM chips. The computer uses different methods to detect and correct data errors in memory. Three different methods of memory error checking are as follows:

- **Nonparity** does not check for errors in memory.
- Parity contains 8 bits for data and 1 bit for error checking. The error-checking bit is called a parity bit.
- **Error-correcting code (ECC)** can detect multiple bit errors in memory and correct single bit errors in memory

Types of Drive Interfaces

Hard drives and optical drives are manufactured with different interfaces that are used to connect the drive to the computer. To install a storage drive in a computer, the connection interface on the drive must be the same as the controller on the motherboard. Here are some common drive interfaces:

■ IDE: Integrated Drive Electronics, also called Advanced Technology Attachment (ATA), is an early drive controller interface that connects computers and hard disk drives. An IDE interface uses a **40-pin connector.**

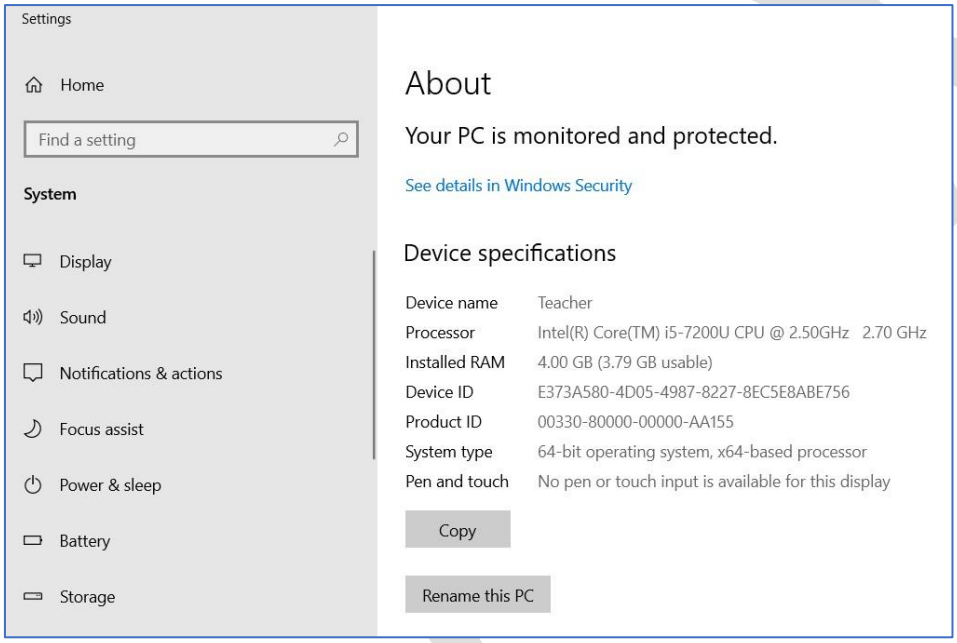
■ EIDE: Enhanced Integrated Drive Electronics, also called ATA-2, is an updated version of the IDE drive controller interface. EIDE supports hard drives larger than **512 MB**, enables direct memory access (DMA) for speed, and uses the AT Attachment Packet Interface (ATAPI) to accommodate optical drives and tape drives on the EIDE bus. An EIDE interface uses a **40-pin connector.**

■ PATA: Parallel ATA refers to the parallel version of the ATA drive controller interface. This is just another name for IDE and EIDE.

■ SATA: Serial ATA refers to the serial version of the ATA drive controller interface. A SATA interface uses a **7-pin** data connector.

D] Identify the CPU Model, System Type, Manufacturer and its speed Step 1

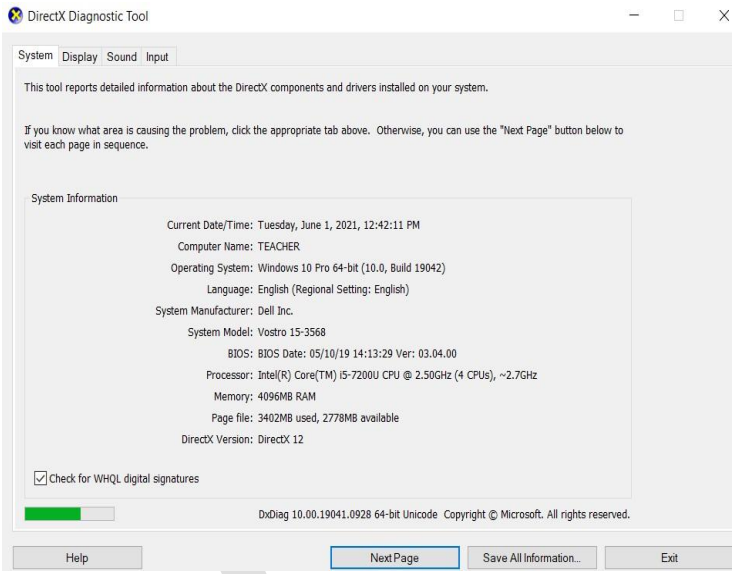
1. Right Click on This PC from desktop
2. Click On propert ies
   It will be displayed as follow on Windows 10pro



Step 2 Using CMOS/BIOS Settings

1. While your computer is booting, press appropriate function key to enter setup and search the information you are looking for.
   Step 3 Using dxdiag (DirectX Diagnostic Tools)

2. Type **dxdiag**
3. Click on ok then click yes/no as

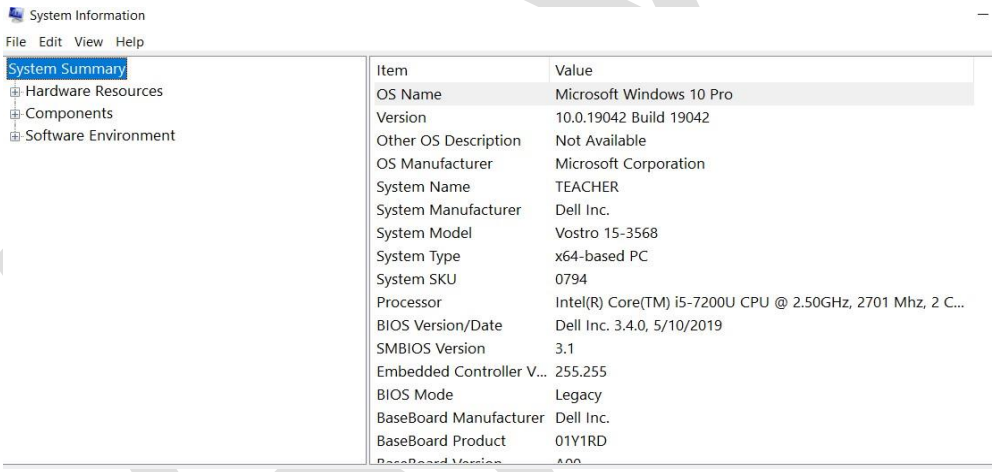


The DirectX diagnostic Tool will be displayed as follo ws:-

Step 4 Using System Information

1. Open the run command
2. Type msinfo32. exe
3. Click on ok

   It will display the windows a s below:



Using **systemfino32.exe** do the following questions

a) Operating system installed &its version on the PC

b) Operating system Manufacturer

c) System name

1. Press Windows flag/ Key +R

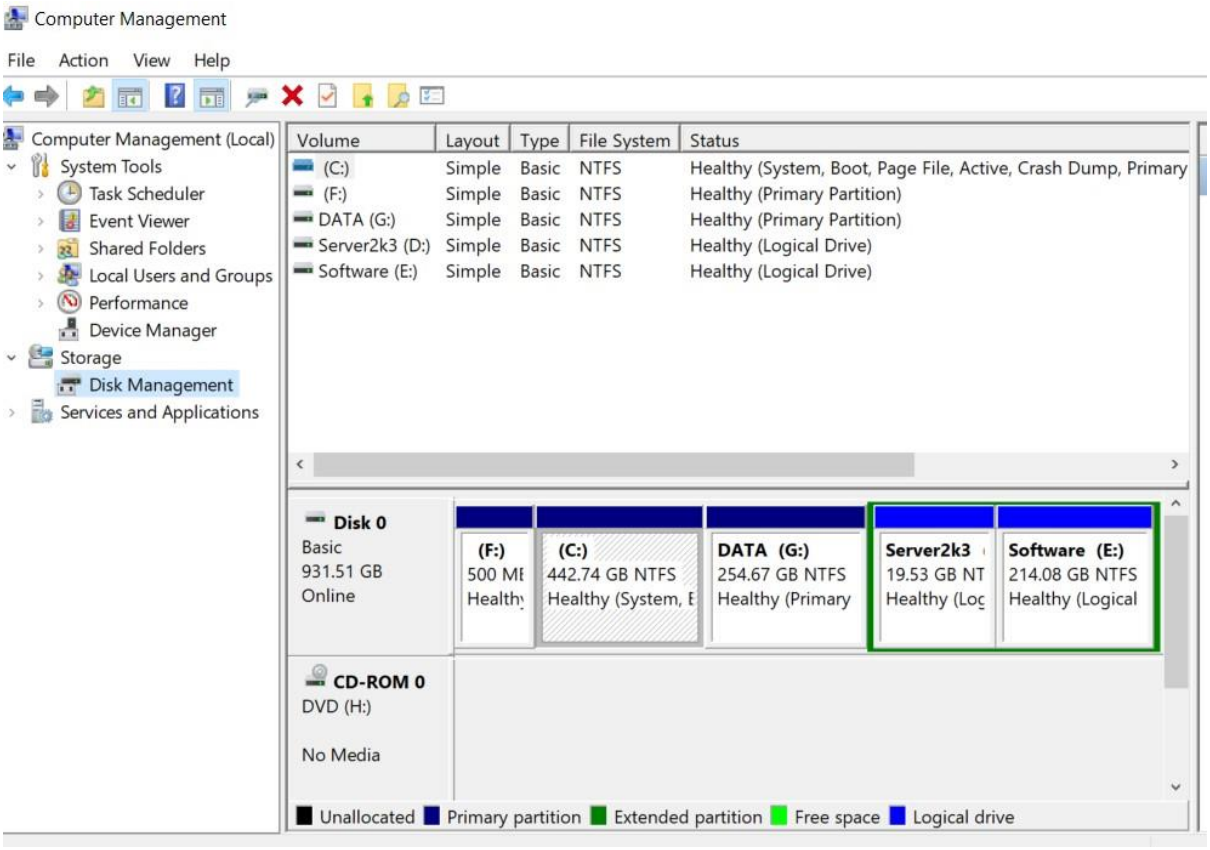
d) System model
e) System Type
f) Processor (manufacturer, Speed, Type, PROCESSOR_ARCHITECTURE)
g) BIOS version
h) BIOS mode
i) Windows Directory
j) System Directory
k) Installed physical memory
l) Available memory
m) Input device
n) Storage devices
o) Problems of device
p) Hard disk name, manufacturer, Bytes/sector, Total hard disk size

q) IRQs- see the details

r) E] Disk Management

s) **Disk Management** is a system utility in Windows that enables you to perform advanced storage tasks. Here are some of the things Disk Management is good for:

- To setup a new drive, see Initializing a new drive.
- To extend a volume into space that's not already part of a volume on the same drive, see Extend a basic volume.
- To shrink a partition, usually so that you can extend a neighboring partition,
- To change a drive letter or assign a new drive letter, see Change a drive letter.



Using Disk Management do the following:-

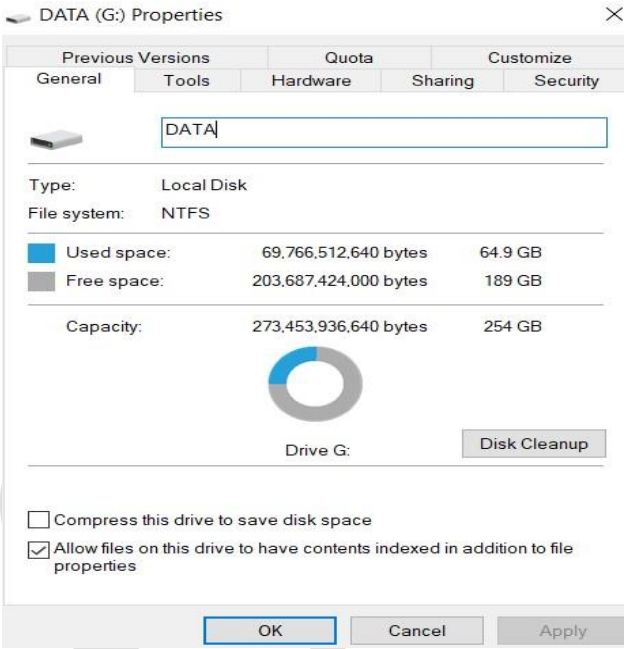
1. Clean your disk
2. Error Check checking
3. Optimize and defragment drive
4. Shrink the volume
5. Create a Volume/partition
6. Format a drive letter

7. Change drive letter and path displayed
8. Observe the hard disk capacity

Steps (1)to run disk clean up

1. Right click on the partition you want to clean
2. Click properties

   The window on the right will be



3. Click on the Disk Cleanup
4. Follow the wizard

Step 2 Disk Cleanup

1. Open This PC
2. Right click on the partition you want to clean
3. Click on properties
4. Click on disk cleanup
5. Follow the instruction

How to defrag your partitions?

1. Open This PC
2. Right click on t he partition you want to clean
3. Click on properties
4. Click on Tools
5. Click on Optimize

Or

1. Open Command prompt and
2. type **defrag** drive letter followed by colon and backward slash then enter key
3. It will start to defrag the fragmented files after analyse

How to check errors for volumes?

1. Open This PC
2. Right click on the partition you want to clean
3. Click on **properties**
4. Click **Tools** menu
5. Click on **Check** button

Or

1. Open command prompt
2. Type chkdsk /r
3. Press enter key

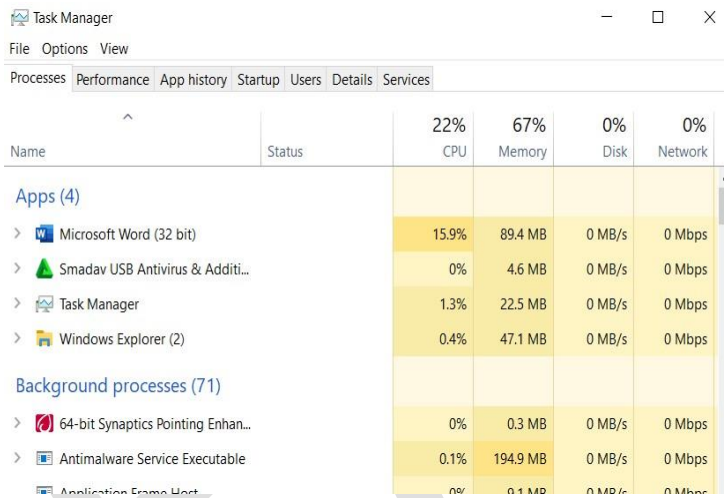
Task Manager(Taskmgr)

✞ ***Identify applications running on foreground and background, CPU, Memory hard disk, network Usage and their performance***

Step 1 Using Task manger

1. Press CTLR+ALT+DELETE
2. Click on Task Manger

a. Open command prompt and
b. Type **Taskmgr**



key

Or

c.

How to kill tasks

III. How many memory it consumes?

To kill the task Select the program or task you want to delete/kill and click on End Task

Or Open Command prompt

1. Type TASKKILL /PID Proce ss ID and enter key
2. The task will be vanished

Click ok

I. Open a notepad

II. Open task manger

IV. Kill notepad

F] Microsoft Management Console (MMC)

The Microsoft Management Console (MMC) is an application that provides a graphical-user interface (GUI) and a programming framework in which consoles (**collections of administrative tools**) can be **created, saved, and opened**.MMC is considered to be a container for the actual operations, and is known as a **"tools host".**

Consoles are used to manage Windows-based hardware, software, and networking components, and include items such as controls, wizards, tasks, documentation, and snapins which may be from Microsoft or other software vendors, or user-defined.

To create a console, the administrator runs the MMC executable file to open an empty console and chooses from among a list of all the tools installed on the system (such as, for example, certificate server manager, device manager, and DNS manager). Because consoles exist as files, an administrator can create them and then send them as e-mail attachments to developers responsible for specific tasks.

Steps to start MMC

Way 1: Turn it on though Run .

1: Press Windows + R to open Run, type **mmc** in the empty box and tap OK .

2: Select Yes in the User Account Control window .

Way 2: Open it by searching .

Input mmc in the search box on the taskbar and click mmc on the top of the list .

Way 3: Open it via Command Prompt .

1: Turn on CMD .

2: Input mmc and press Enter .

Way 4: Run it fro m Windows PowerShell .

1: Open Windows PowerShell through searching .

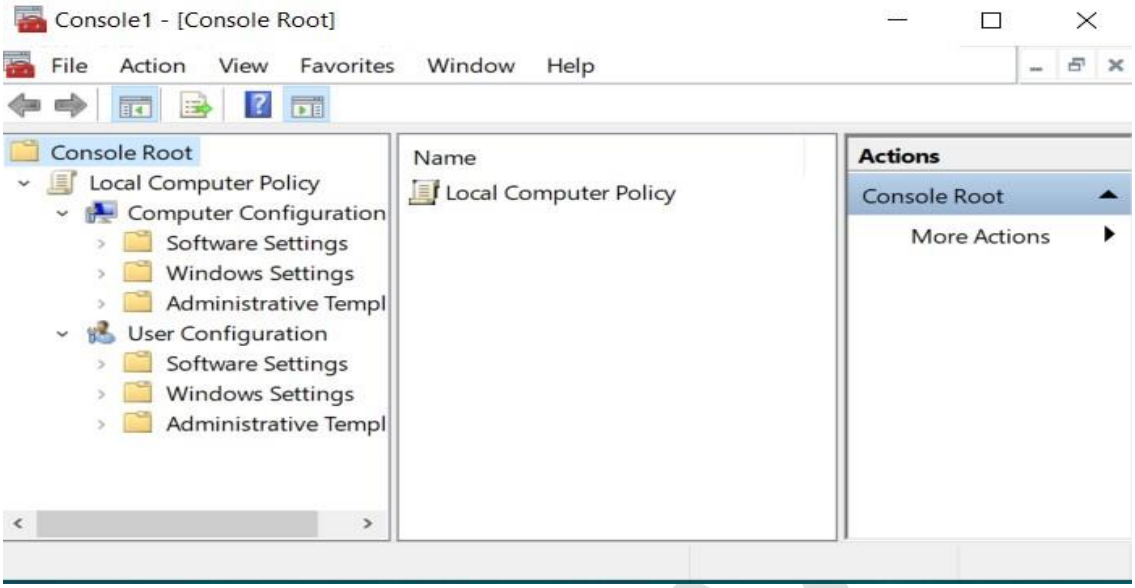
2: Type mmc.exe and hit Enter .

Using one of the above way open mmc and it look like the following

1. Click on File/ Add/Remove snap -in…
2. Study available snap -ins:
3. Eg. Click on Group policy object and click on ADD button
4. Click on ok
5. Local computer policy will be added to Console Root as follow:-

Eg. To remove and prevent access to the shutdown, restart, sleep and hibernate commands from start menu

a. Expand Computer configuration
b. Administrative Template
c. Start menu and task bar
d. Double click on Remove an dPrevent access to shutdown, restart and sleep
e. Click on Enable radio button and then **ok**
f. Restart your computer using the command Restart from start menu. Can you?



Exercise 2

1. *Disables all Control Panel programs and the PC settings app.*
2. *Start Contro l panel*
3. *Change the screen saver & background of your desktop*
4. *Make th e computer to open word and notepad only.*

   Note: After you have been practiced return to previou s settings.

Exercise 3 Installing Windows XP and 10

1. Create three Partition namely C: / 30%, D:/ 30% and E:/2 5% of the hard disk capaci ty
2. Install Windows XP on Partition D while Win dows 10 on C:/
3. Install Device drivers and application software
4. Create one addition partition and name it's drive letter P: using disk management.
5. Using computer management identify the inst alled and uninstalled drivers
6. Enable and disable drivers. Eg. Disable DVD/CD driver

   Can we install two O perating Systems on a single Partition say C:? Yes or Not? Justify your answer