Participant Handbook

Sector:
Electronics

Sub-Sector:
IT - Hardware

Occupation:
After Sales Support

Reference ID: **ELE/Q4606**

Field Technician - Networking & Storage

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> If we have to move India towards
> development then Skill Development
> should be our mission. "

Shri Narendra Modi
Prime Minister of India

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Is hereby issued by the

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Skilling Content : **Field Technician – Networking & Storage**

Complying to National Occupational Standards of

Job Role/QP : **Field Technician – Networking & Storage**, QP No : **ELE/Q4606 Level 4**

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Acknowledgements

About this Book

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational (NOS) is covered across Unit/s.
Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.
The symbols used in this book are described below.

Symbols Used

Key Learning Outcomes

Steps

Role Play

Tips

Notes

Unit Objectives

Activity

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The book on New Employability Skills is available at the following location: https://eskillindia.org/Home/handbook/NewEmployability

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Unit 1.3 – Software Basics

Key Learning Outcomes

At the end of this module, you will be able to:

- Describe the basics of computers
- Explain computer peripherals
- Explain what is a network and types of network
- Describe different types of networking devices
- Describe software

UNIT 1.1: Computer Fundamentals

Unit Objectives ◎

At the end of this unit, you will be able to:

- Define computer and its types
- Describe computer peripherals

1.1.1 Introduction to Computer

A computer is an electronic device which transforms data into meaningful information. The following image shows a computer:

Fig. 1.1.1: A computer

The basic functionality of computers, irrespective of their size or make, is shown in the following figure:

| Accepts data | Stores data | Processes data as required | Retrieves the stored data as and when required | Prints the result in the required format |
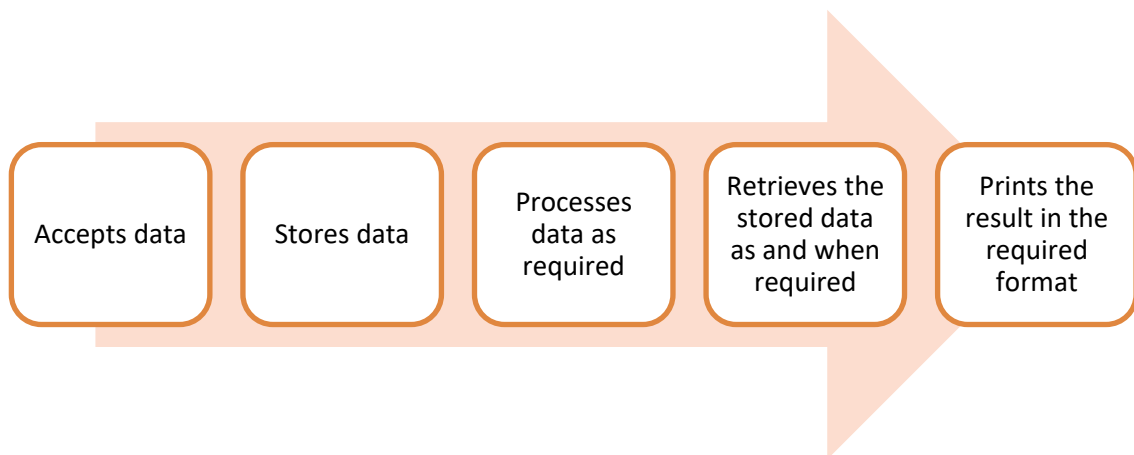
Fig. 1.1.2: The basic function of a computer

Some characteristics that have made usage of computers almost a necessity in life are they are fast, accurate, diligent, adaptable and have good storage capacity.

A computer consists of various units or parts that enables it to perform its functions.

The following figure shows a block diagram of the functional units of a computer:
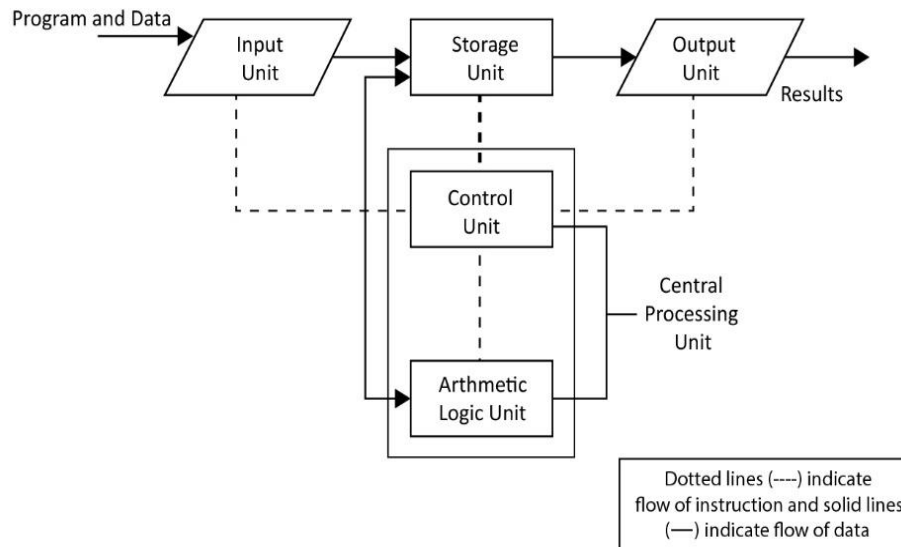
Fig. 1.1.3: Block diagram of functional units of a computer

The four main functional units of a computer is described in the following figure:

Input unit	•This unit accepts data or instructions from the user for processing by using the input peripheral device.
Storage unit	•This unit stores data and instructions before and after processing. It is mainly divided into two parts, primary storage and secondary storage.
Central processing unit(CPU)	•This unit takes data and instructions from the storage unit and processes the data as required, based on the instructions given and the type of data provided. •The data is then sent back to the storage unit after being processed, if required. • This unit includes the arithmetic logic unit (ALU) which helps in performing calculations using arithmetic operators like addition (+), subtraction (-) and so on. •This unit also uses comparison operators like greater than (>), less than (<) and equal to (=). The control unit controls all these operations, enables retrieving data from storage and helps store information back to a storage device.
Output unit	•This unit is used for displaying the result to the user in the required format by using an output peripheral device.

Fig. 1.1.4: Functional units of a computer

Types of Computers

Computers can be classified according to their size, speed and computing power. The following table lists the different types of computers:

Type	Description	Image
Microcomputer	It is a single user computer system with a single chip and moderately powerful microprocessor. The different types of microcomputers are: • Desktop Computer • Laptop Computer • Notebook • Tablet	
Mini Computer	It is a computer which can support hundreds of users simultaneously and has more powerful processors than a microcomputer. It is also called mid-range computer.	
Main Frame	It is a multi-user system, like a minicomputer but the technology is different than that of a minicomputer. It is used to handle and process large amount of data such as in banks and government offices**.	

Super Computer	It is the fastest and most expensive computer system. It is used for complex scientific computations and numerical calculations such as weather forecasting, nuclear simulations and astrophysics.	

Computers are commonly classified as:

- Laptop
- Desktop
- Server

Laptop

Laptop is a battery or alternate current (AC)-powered, portable, wireless personal computer (PC), generally smaller than the size of a briefcase. It is a small personal computer with a "clamshell" form factor, a thin Liquid Crystal Display (LCD) or Light Emitting Diode (LED) computer screen on the upper portion and a keyboard on the lower part of the "clamshell".

The following image shows a laptop and internal view of the laptop:
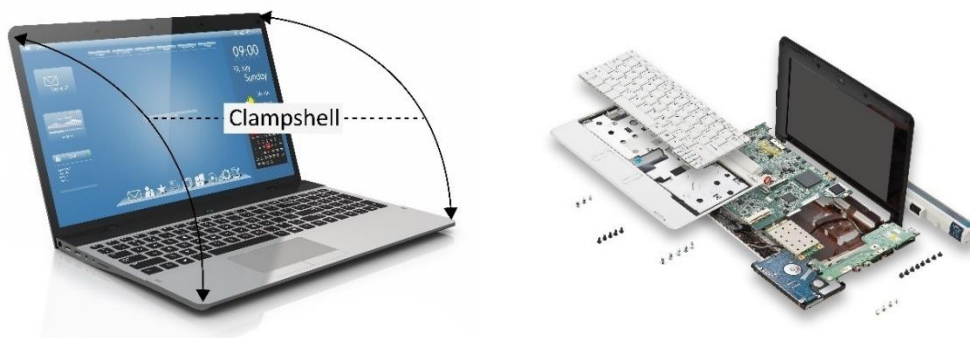
Fig. 1.1.5 Exterior and interior of a laptop computer

Desktop

A desktop is a PC that is made to be used on or near a desk or a table, and is not portable. A desktop PC has a mouse, a keyboard and a base unit which includes the computer's components. Some newer models have the base unit within the monitor to save space.

The following image shows a desktop computer along with its system unit or CPU and peripherals:
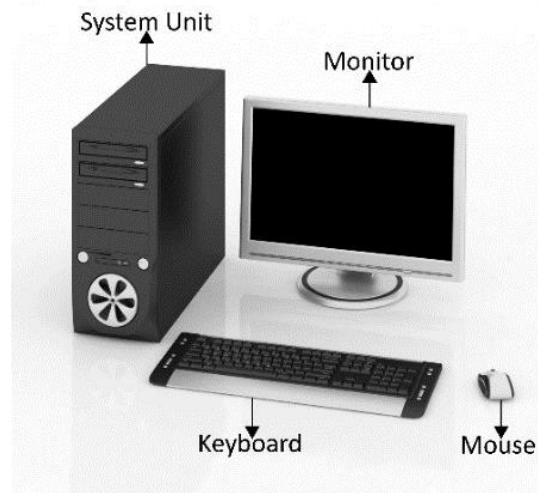
Fig. 1.1.6: A desktop computer along with its CPU and peripherals

Server

A server computer is a central computer, which comprises of collection of data and programs. It is also known as a network server as it allows all the connected systems to share and store data and applications. File servers and application servers are the two main types of servers. The following image shows a server computer connected to various other computers:
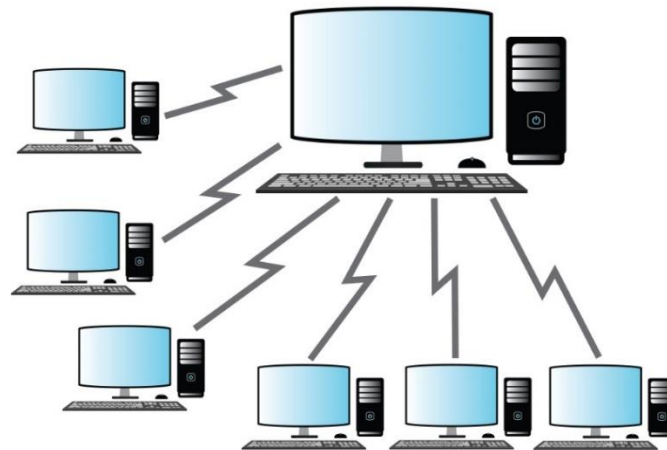
Fig. 1.1.7: A server computer linked to other computers

1.1.2 Types of Computer Peripherals

Peripheral devices are the input/output devices that are typically used to feed information and instructions into a computer for storage or processing, and to show an output.

The peripheral devices are categorized as shown in the following figure:
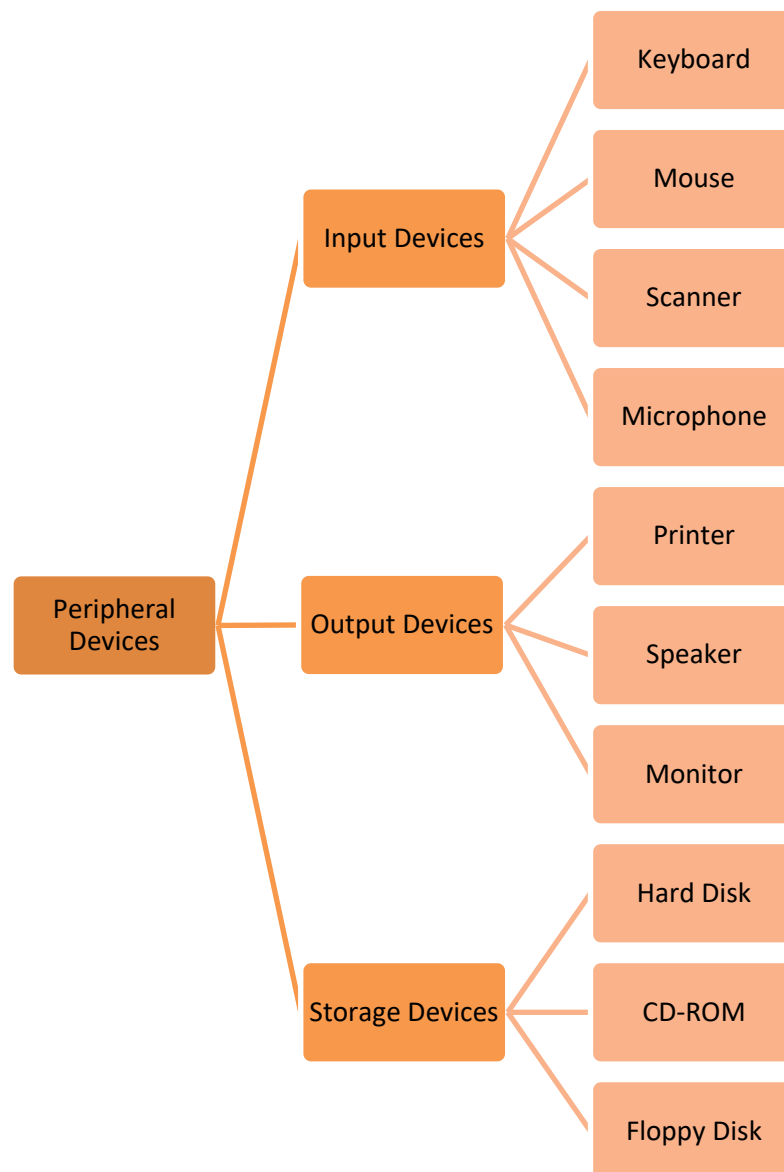
Fig.1.1.8: Different types of peripheral devices

Input Devices

An input device is any device that provides input to a computer. There are many input devices such as a keyboard and mouse. Some input devices are explained as follows:

Mouse

The mouse is an input device, used to make selections and move objects on a computer screen. A mouse can be with a laser or a ball, wired or wireless.

Some different types of mouse are shown in the following image:

Wireless Mouse   Ball Mouse   Wired Mouse   Optical Mouse

Fig. 1.1.9: Different types of mouse

Though the mouse is considered as a peripheral, it is a vital device and essential for using computers.

Keyboard

A keyboard is one of the primary input devices and it looks similar to those found on electric typewriters. The following image shows a keyboard:

Fig. 1.1.10: A keyboard

Keyboards allow users to enter letters, numbers and other symbols into a computer that can serve as commands or be used to type text.

Scanner

A scanner reads documents (text and photographs) and stores it in the computer to which it is connected. The physical document is converted to digital format after it gets scanned. The digital document can be viewed and modified on a computer. Earlier a software needs to be installed in the computer for scanners to work but now all the systems have inbuilt settings to detect the scanner automatically. Basic scanning software allows the user to import data from it.

Scanners with flat scanning surface are suitable for books, pages, photographs and so on. The following image shows a scanner:

Fig. 1.1.11: A scanner

Output Devices

An output device receives information from the CPU and presents it to the user in the required format. The processed data, stored in the memory of the computer is sent to the output unit, which then converts it into a form that can be understood by the user. The output is typically presented either on a display device such as a monitor, or on paper (hard copy) with the help of a printer.

Some output devices are explained as follows:

Monitor

The monitor is an output device, also called a visual display unit (VDU) that shows the graphical and textual information of the computer. The following image shows a LCD monitor:

Fig. 1.1.12: A monitor

Printer

Printer is a peripheral device which is used to display graphics or text on paper. They are a great resource but they should be used in a controlled way. Their overuse puts unnecessary wear and tear on them and also uses up expensive ink and paper. There are thr types of printers based on its usage:

- **Personal printers**: These printers are designed for personal use and may be connected to only a single computer. They are used for low-volume smaller printing, requiring minimal setup time to produce a hard copy of a given document.
- **Networked or shared printers**: These are typically used for high-volume and faster printing. They are shared by multiple users on a network.
- **Virtual printer**: It is a piece of software whose user interface resembles a printer driver but it is not connected to a computer printer. It is generally used for archival purposes or as an input for another software.

Speakers

Speakers receive audio signals as input from the sound card of the computer and produce them in the form of sound waves as audio output. The following image shows speakers:

Fig. 1.1.13: Speakers

Storage Devices

Storage devices, also called storage media, are hardware devices which are used to store data or information. It can store information temporarily or permanently. These devices can be added to computers externally or internally. Storage devices are of two types:

- **Magnetic storage**: Includes hard disk drive, magnetic tapes, floppy drive and so on.
- **Optical storage**: Includes CD-R, CD-RW, Blue ray disk, DVD, flash drive and so on. It uses laser ray or light to access data in it.

Hard Disks

A hard disk is a device that stores data on a computer permanently. A hard drive is collection of one or more disks or platters shielded with magnetic material to which data is written with the help of a magnetic head. Hard disks are connected to the motherboard using special cables such as PATA (Parallel ATA), SATA (Serial ATA), USB or SAS (Serial attached SCSI) cables and they are powered by a power supply unit.

The following images shows hard disk drives:
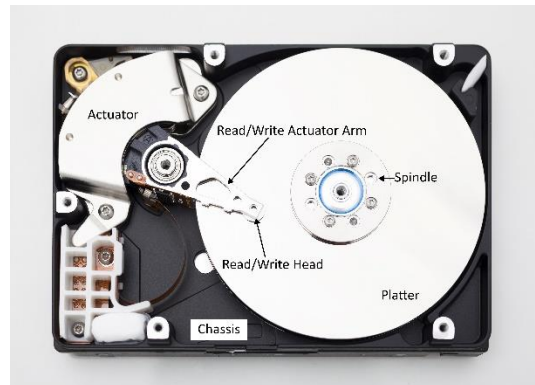
Fig. 1.1.14: Hard disk drives

In case of a laptop, the hardware components and devices that come along in the package are same as that of a desktop except a few changes; instead of mouse, laptops have touchpads or track pads and instead of external power source, laptops have an internal battery.

CD/DVD

CD/DVDs are types of optical disk drives that use laser light or electromagnetic waves for reading and writing data. Different types of CD/DVDs are:

- CD/DVD-R where R stands for recordable. CD/DVD can be written once and read many times.
- CD/DVD-RW where RW stands for rewritable. CD/DVD-RW allows reading of data many times and also the data can be erased and written again.
- CD/DVD-ROM where ROM stands for read only memory. CD/DVD-ROM allows reading of data which is already present on the CD.

Floppy Disk Drive

Floppy disk drive was a common storage device and can be still found in many old desktop computers. It can be read and written using a floppy disk drive. It is a disk of thin and flexible magnetic storage which is sealed in a rectangular plastic enclosure. Floppy disks are available in different sizes:

- 8-inch (200 mm)
- 5¼-inch (133 mm)
- 3½-inch (90 mm)

Activity

Match the following devices with their types:

1.	Mouse	a.	Optical disk drive
2.	Keyboard	b.	Magnetic disk
3.	Hard Disk	c.	Sound waves
4.	CD/DVD	d.	Pointing device
5.	Speakers	e.	Input device

UNIT 1.2: Networking Fundamentals

Unit Objectives 🎯

At the end of this unit, you will be able to:

- Define network
- Identify the types of network
- Describe networking devices

1.2.1 What is a Network?

A network is an interconnection of a group of computers that can communicate and share resources such as hard disks and printers. It is a group of computers and other devices that are connected by some type of transmission media. The initial idea of a network was perceived by the department of defense (DOD) in USA for the purpose of security.

Some advantages of networks are:

- Sharing of information across different systems (connected in a network)
- Optimum utilization of hardware resources
- Centralization of data management

Based on the physical connectivity or distance, that a network can span, the network is classified into different types.

Types of Networks

The following figure shows the different types of networks used for sharing information:

Local Area Network (LAN)

Metropolitan Area Network (MAN)

Wide Area Network (WAN)
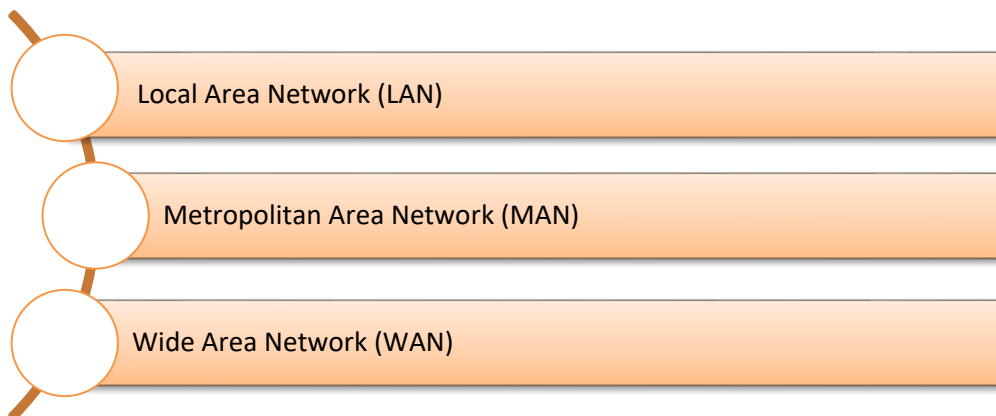
Fig. 1.2.1: Different types of networks

LAN

It is the interconnection of computers that share information over relatively small distances such as within an office building, residence, school premises and locality.

The following image shows interconnection of computers in LAN:
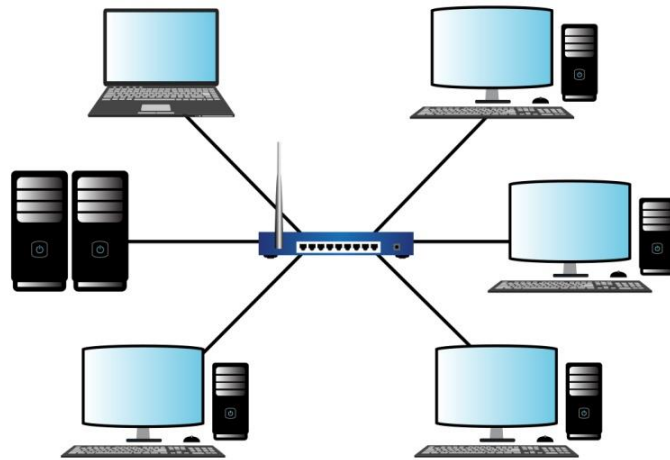
Fig. 1.2.2: Interconnection of computers in LAN

MAN

It is the interconnection of users with computer resources in a region larger than that covered by LAN but smaller than the area covered by wide area network (WAN).

The following image shows interconnection of users using MAN:
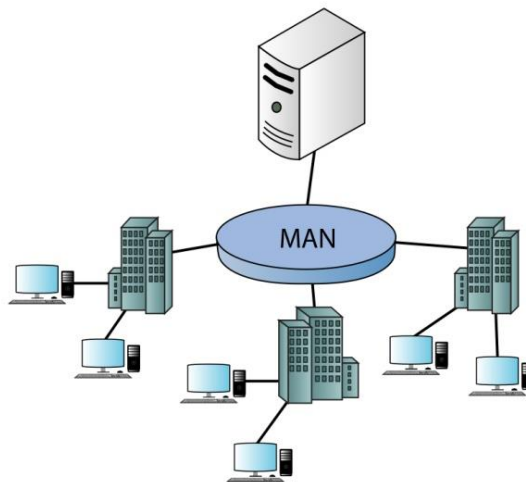
Fig. 1.2.3: Interconnection of users using MAN

WAN

WAN is used to connect devices over much larger distances than LAN. It is established by connecting LANs using routers. It is not limited to a single person or organization, for example, the Internet, which is a network of networks spread across the globe for exchange of information and services.

The following image shows connectivity of users using WAN:
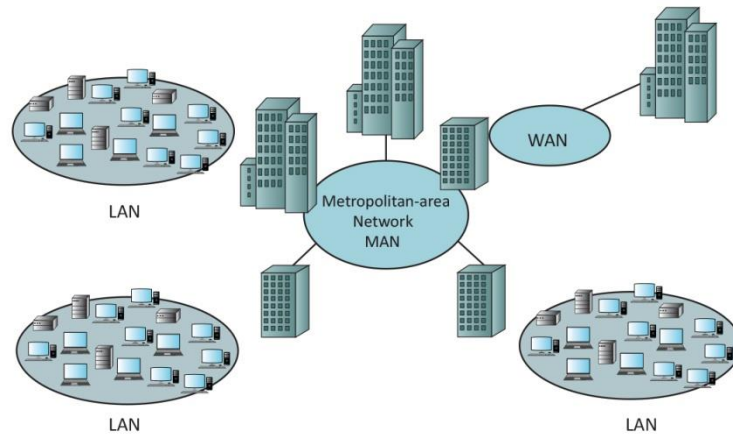
Fig. 1.2.4: Connectivity of users using WAN

1.1.2 Network Architecture

Network architecture is a structural model that specifies the type, layout and components of a network along with data format, different protocols and services provided. The following figure shows the types of network architecture:
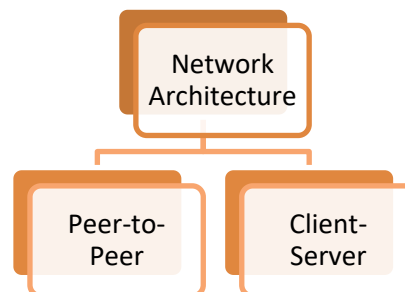
Fig. 1.2.5: Types of network architecture

Peer-to-Peer Network Architecture

Peer-to-peer is a type of network architecture in which all the computers connected to the network have similar capabilities to use the resources that are available on it. There is no central server in this architecture and each workstation on the network shares its files equally with the others. Peer-to-peer networks are usually simple but they do not offer the same performance in case of heavy network loads.

The following image shows a peer to peer network architecture:
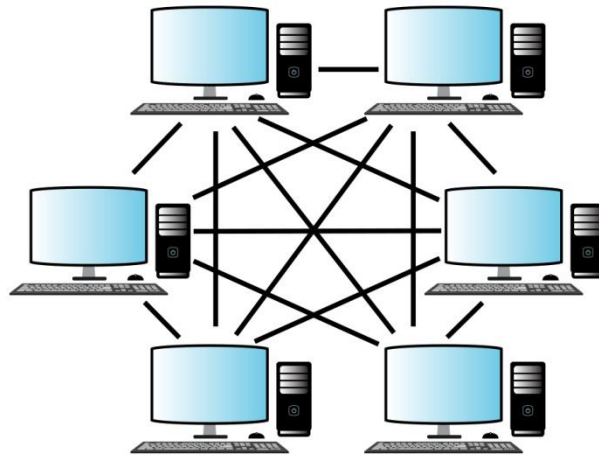
Fig1.2.6: Peer to peer network architecture

Client-Server Network Architecture

Client-server is a type of network architecture in which each computer on the network is either a client or a server. The following image shows a client-server network architecture:
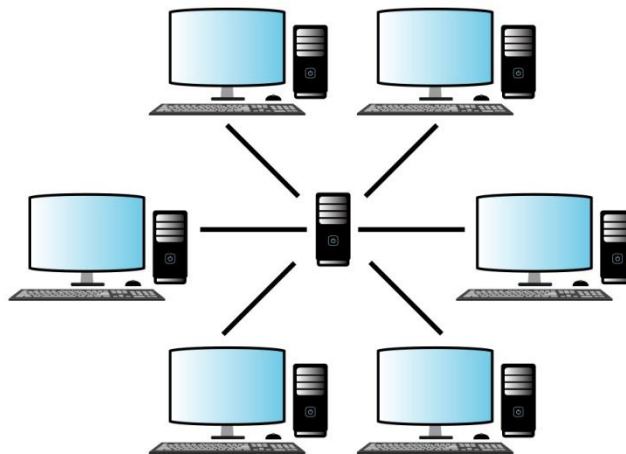
Fig. 1.2.7: Client- server network architecture

Server

A computer which holds programs, network operating systems and the shared files is called a server. Servers are computers dedicated to manage disk drives (file servers), printers (print servers) or network traffic (network servers). They provide access to the network resources to all the devices which are using the network. There are different kinds of servers such as file servers, communication servers, print servers, database servers, mail servers, fax servers and so on.

The following figure lists some types of servers along with their description:

File Server

- It provides data such as data files, e-mail and printer access programs, which are shared among various clients in the network.
- It has large hard disks which all users in the network share.
- Application software and shared data reside in this server.

Print Server

- It acts as a buffer for the print jobs sent by the users to the shared printers or centralised printers.

Communication Server

- It grants the outside users access to the network through a telephone line.

Mail Server

- It provides electronic mails (e-mails) to users of the network.

Fig. 1.2.8: Different types of servers

Client

Client computers access the network and use various shared resources in the network. They rely on servers for resources, such as files, devices and even processing power. They receive services from the servers as per their request.

2.1.3 Network Devices

Network devices are components which are used to connect computers and other electronic devices to share resources such as printers, fax machines, database and so on. The functions of network devices, working together, are as follows:

- Controlling traffic: Network devices filter and isolate the data traffic.
- Providing connectivity: Using various network protocols, network devices connect different types of networks.
- Addressing as per hierarchy : These devices segment the network and deliver data to the right destination using the destination address.

The following figure enlists devices used in networking:
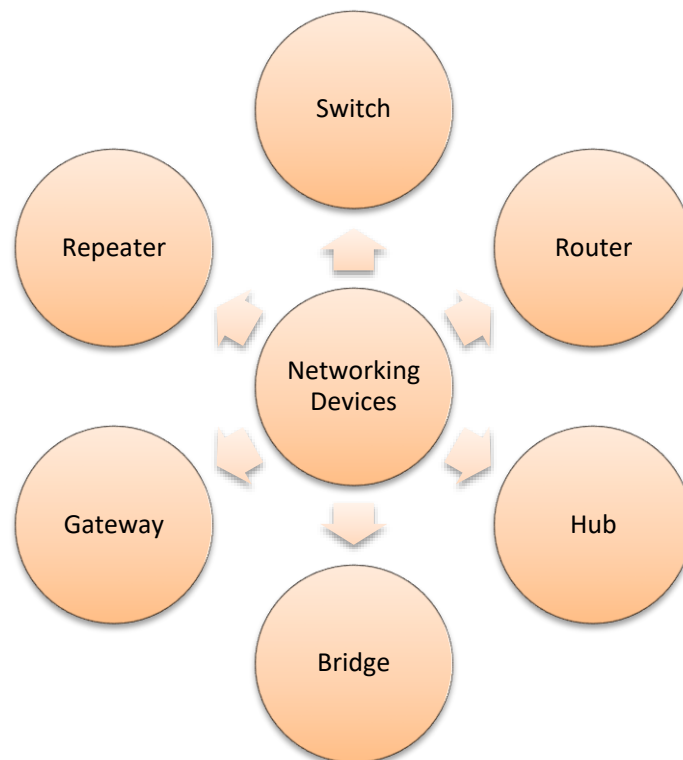
Fig 1.2.9: Networking devices

Switch

A switch, in a computer network, connects other devices electrically and logically. It enables communication between networking devices by plugging data cables into them. It transmits network packets to their assigned destination and thus manages flow of data in the network. Each networked device is identified by its network address, which allows the switch to regulate traffic and increase the efficiency of the network.

When an ethernet switch replaces a hub, the scope of collision is reduced as the single large collision domain of the hub is split into smaller parts and leads to increase in the potential throughput. A switch works at the second layer of the open system interconnection (OSI) model.

The following image shows the interconnection of devices with a switch:
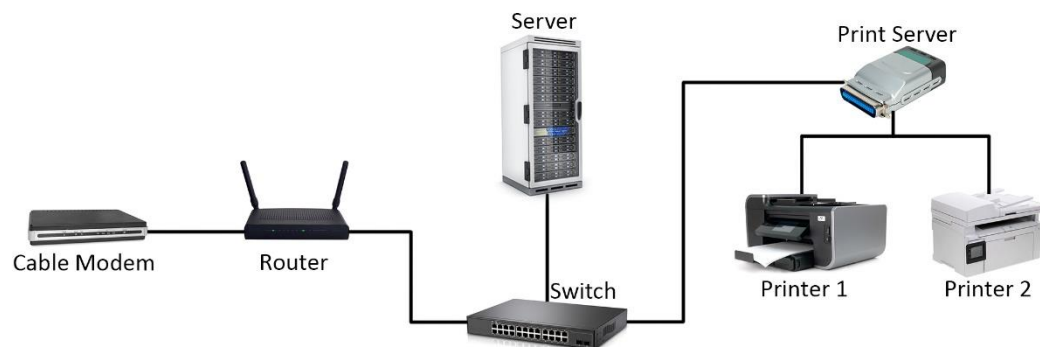
Fig. 1.2.10: Interconnection of devices with a switch

Router

IP routing is the process of sending packets from a host on one network to another host on another remote network. This process is done by routers. They examine the destination IP address of a packet, determine the next-hop address and forward the packet.
They use routing tables to determine the next hop address to which the packet should be forwarded. The following image shows a router:

Fig 1.2.11: A router

Consider the following image which is representing IP routing:
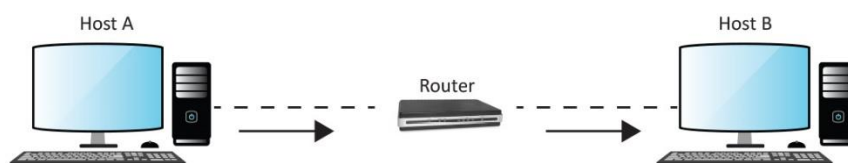
Fig 1.2.12: IP routing

Host A wants to communicate with host B but host B is on another network. Host A is configured to send all packets destined for remote networks to router R1. Router R1 receives the packets, examines the destination IP address and forwards the packet to the outgoing interface associated with the destination network.

Hub

A hub, also known as network hub, is a hardware network device that connects ethernet devices together, making them a single network. A signal is introduced at one of the input ports of the hub and it appears at every output port except the original one. It operates at the physical layer of the OSI model.

A hub lacks the intelligence to determine where the information has to be send as it has no routing table unlike a switch and a router. It broadcasts information across each connection (multiple ports), which increases risk issues. Earlier, a hub was preferred over a switch and a router because it was cheaply available. However, now switch is in demand as it is of the same cost as a hub and a router and has better transmission of information. The following image shows connection of a hub with other devices:
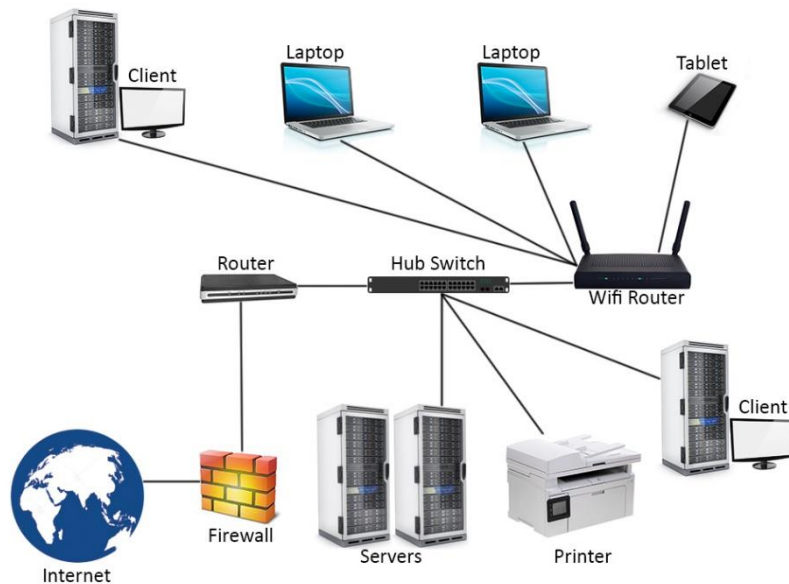
Fig 1.2.13: Connection of a hub with other devices

Bridge

A network bridge helps to join two otherwise separate computer networks together to enable communication between them. Bridge devices are used with LANs to extend their reach and cover larger physical areas.

They inspect incoming network traffic and determine whether to forward or discard it according to its intended destination. An Ethernet bridge, for example, inspects each incoming Ethernet frame - including the source and destination MAC addresses and sometimes the frame size - in making individual forwarding decisions. Bridge devices operate at the data link layer (Layer 2) of the OSI model.

The following image shows connection of a bridge in a network:
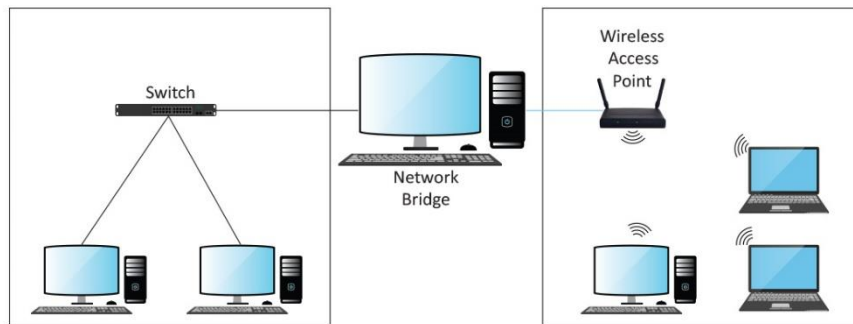
Fig 1.2.14: Connection of a bridge in a network

Gateway

A gateway acts as an interface between dissimilar networks with different protocols translating one data format to another. It is responsible for communication and sending of data back and forth. It can operate at any network layer of the OSI model.

Gateways are nodes that connect different networks. A gateway node is a computer that controls traffic among company networks and provides connection to the internet users.

The following image shows a gateway connection with a switch and a hub:
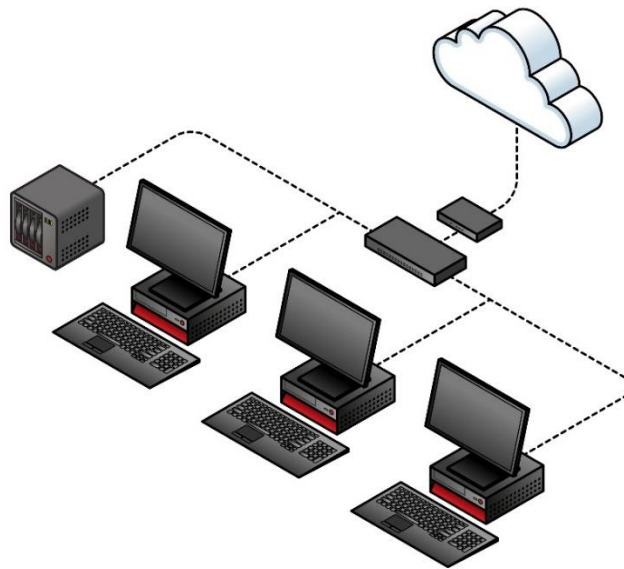
Fig 1.2.15: A gateway connection with a switch and a hub

Repeater

A repeater is a networking device which is used in a transmission system to regenerate distorted signals. It receives the signal and regenerates it to transmit it over long distances so that it can be received on the other side. It regenerates the network signals so that they can travel longer distances on the network.

The following image shows the connection of a repeater in an antenna for transmission of information:

Fig 1.2.16: Connection of a repeater in an antenna for transmission of information

Activity

Choose the correct answer for the following questions:

1. Which of the following networking devices has no routing table?

    a. Hub   b. Router   c. Switch

2. At which layer of the OSI model does a switch operate?

    a. Physical layer   b. Data link layer   c. Network layer

3. Which network is the largest?

    a. LAN   b. MAN   c. WAN

4. Which networking device is used to regenerate signals?

    a. Switch   b. Repeater   c. Router

Practical

Perform the task of networking of two computers.

Hardware:

1. Network Card
2. Wireless Network Adapter
3. CAT5 strait-trough Cables
4. Networking Hub or Wireless Router

UNIT 1.3: Software Basics

Unit Objectives

At the end of this unit, you will be able to:

- Explain operating system
- Define application software
- Explain security software and its importance

1.3.1 Introduction to Operating System

An operating system is a type of system software that serves as an interface between programs or applications and the computer hardware. It manages computer hardware and software resources to provide services to the user, except the firmware such as ROM BIOS. Apart from giving an interface to the user, it performs tasks like memory management, process management, file management, and controlling input/output devices (I/O). The following figure shows a block diagram of a computer with respect to the operating system:
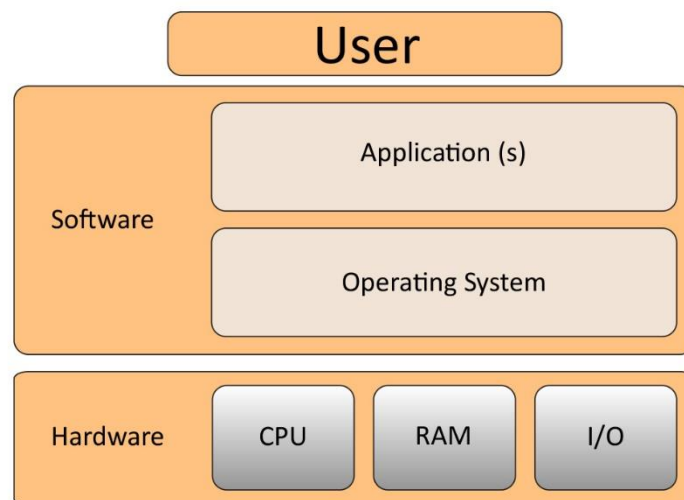
Fig. 1.3.1: Block diagram of a computer with respect to the operating system

The operating system architecture or framework is broadly classified into kernel mode and user mode as shown in the following figure:
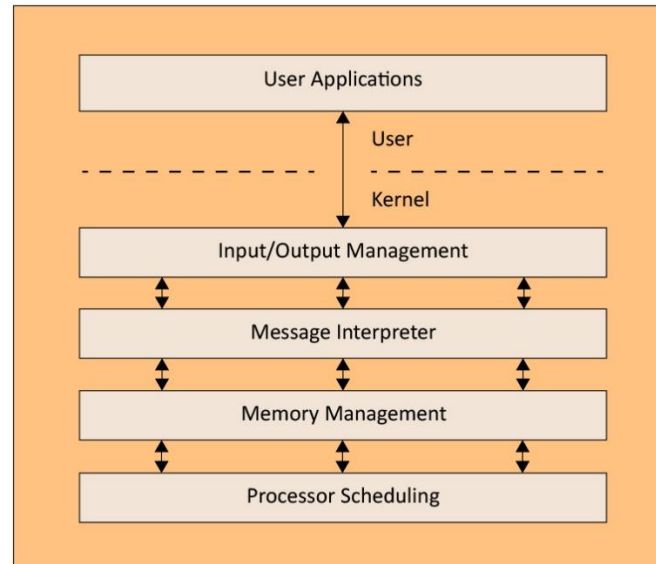
Fig. 1.3.2: Operating system architecture or framework

Kernel is the core of the operating system and is the first program that gets loaded in the computer system at start up. It then supports the start-up process and handles the hardware. In kernel mode, CPU instructions are executed and memory is referenced for storing data. A crash of kernel stops the functioning of the computer system.

In contrast, the CPU instruction, codes or programs running in the user mode has no direct access to the hardware or memory. They request the system application programming interface(APIs) to access these. Because of a layer of system API, user mode is recoverable in case a crash happens. Most of the codes running in the computer will execute in the user mode.

The following figure shows some of the important functions of an operating system:

Function	Description
User Interface	• Provides a user interface for example, graphical user interface (GUI) and command line (text based)
Resource Management	• Handles system resources such as computer's memory and sharing of the CPU time by various applications or peripheral devices
Memory Management	• Keeps track of primary memory usage such as, being used by whom, what parts are not in use • Does priority-wise memory allocation for a process request in case of multiple programs being executed • De-allocates the memory when a process no longer needs it or has been terminated
Processor Management	• Keeps track of processor and status of process with the help of a program known as traffic controller • Allocates the processor (CPU) to a process • De-allocates the processor when a process is no longer required
Device Management	• Keeps track of all devices with the help of a program known as the I/O controller • Decides which process gets the device when and for how much time • Allocates the device in an efficient way • De-allocates devices
File Management	• Keeps track of information, location, uses and status and also maintains the file system
Security	• Enables use of passwords to prevent unauthorized access to data or the system
System Performance Management	• Manages system performance such as recording delays between a request for a service and response from the system
Coordination	• Assigns software such as, compilers, interpreters, assemblers and other software to the computer systems, other software and users
Communication	• Enables network communication by establishing connection between network devices and the computer or any other program
Error Detection	• Provides debugging and error detecting aids and gives appropriate error messages

Fig. 1.3.3: Functions of an operating system

Windows

Windows is an OS which is owned by Microsoft. It is different from any open source software in the sense that only Microsoft can make changes to the code. It can be installed on different kinds of computers, by various manufacturers, giving a wide range of choice for hardware to the user.

The latest version Windows is 10 which includes touchscreen support. This combines the usability of a touchscreen tablet and the power of a desktop/laptop computer. It also includes the "Play To" and "Remote Media Streaming," features that allow a user to play media from the computer on another device. These features also allow the user to access media when away from his/her computer.

Configuration/Installation

The steps that should be performed in order to install the Windows operating system on a computer are shown in the following figure:
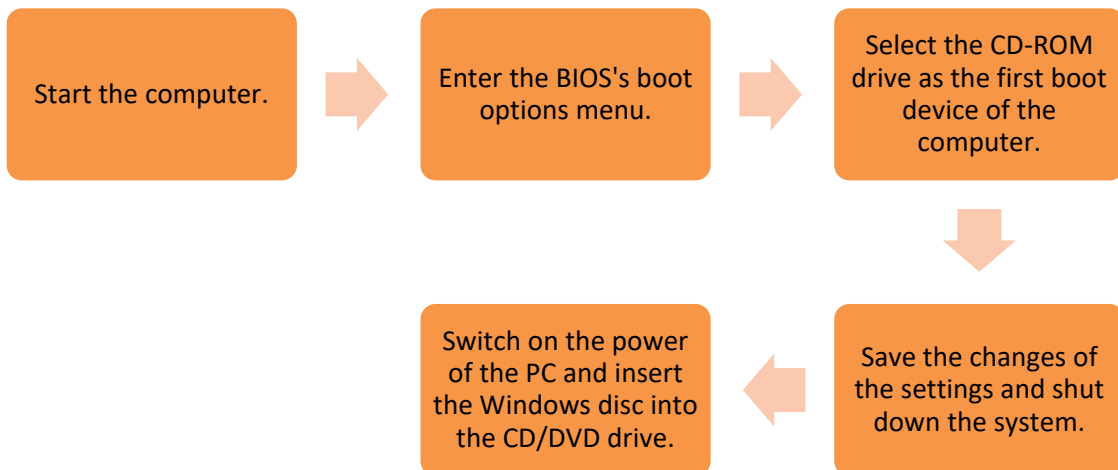
Fig. 1.3.4: Steps to install windows operating system

Linux

Linux is a free and open-source software. The main component of the Linux OS is the Linux kernel.

The user interface, called shell, may be a command-line interface (CLI) or a GUI. For any desktop system, the default mode is usually GUI. The CLI is also available either through a terminal emulator Windows or an independent virtual console.

Configuration/Installation

Installing, updating or removing a software in Linux is usually done through the use of package managers such as:

- Synaptic Package Manager
- Package Kit
- Yum Extender

Most of the major Linux distributions contain extensive repositories. However, all the software that can run on Linux are not available from these official repositories. Users can:

- download the pre-compiled packages from websites directly
- install the packages from unofficial repositories or
- compile the source code by themselves.

Mac OS

Mac OS which was known as Mac OS X earlier, is a Unix-based graphical OS developed by Apple Inc. and is designed to be run only on Apple's Macintosh computers. After Microsoft Windows, Mac OS is the second most widely used desktop OS. In the earlier years, Mac OS had a negligible number of types of spyware and malware which have affected the Windows users. The share of usage of Mac OS is smaller compared to Windows. Apple regularly releases security updates for Mac OS. The latest version of this is Mac OS 10.12 Sierra.

Configuration/Installation

One can install Mac OS over any earlier version, without removing the data. The following figure lists the steps to reinstall the Mac OS:
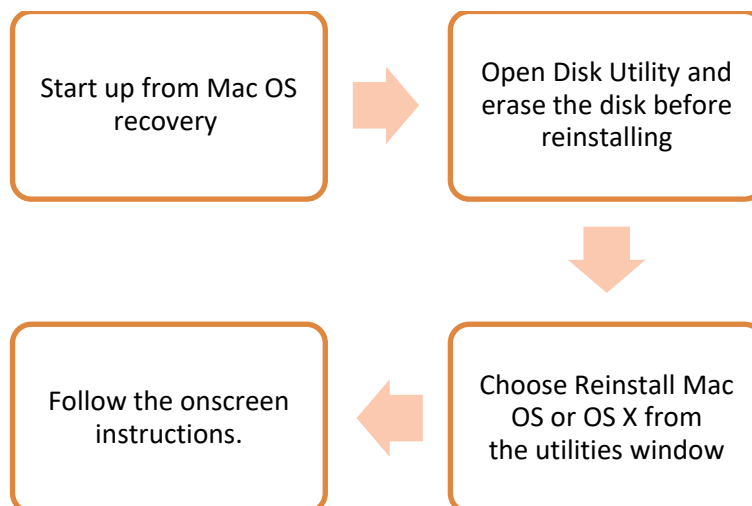
Fig. 1.3.5: Steps to reinstall Mac OS

1.3.2 Application Software

Application software are the end user program designed to create documents and spreadsheets; do online research and online business; and play online games. The two-basic application software are:

- Microsoft Office (MS-Office)
- Web Browsers

MS-Office

MS Office is a suite of computer programs developed by Microsoft. Although meant for all users, it offers different versions that cater specifically to students, home users and business users. All the programs are compatible with both, Windows and Macintosh.

Most Popular Office Products

Some of the most popular and universally used MS Office applications are:

- **Microsoft Word**: Allows users to type text and add images to a document.
- **Microsoft Excel**: Allows users to enter data into a spreadsheet and create calculations and graphs.
- **Microsoft PowerPoint**: Allows users to add text, pictures and media and create slideshows and presentations.
- **Microsoft Outlook**: Allows users to send and receive email.
- **Microsoft OneNote**: Allows users to make drawings and notes with the feel of a pen on paper.
- **Microsoft Access**: Allows users to store data over many tables.

Web Browsers

A web browser is used to retrieve and go through information resources available on the world wide web (www).
It is a software application which provides a way to look at and interact with the information on the web. It is a client program which uses Hypertext Transfer Protocol (HTTP) for making requests to the Web servers through the Internet on behalf of the user of the browser.
The following image shows the basic layout of a web browser:
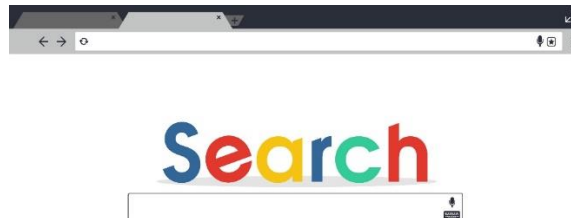
Fig. 1.3.6: Layout of a web browser

Configuring a Web Browser

The web browser can be customized by configuring it with the help of settings menu on the browser. A browser can be configured for managing privacy, network connection settings, appearance of the browser, download location and user accounts by going to 'Show Advanced Settings'.

The following screenshots show configuring network connection settings from a browser:
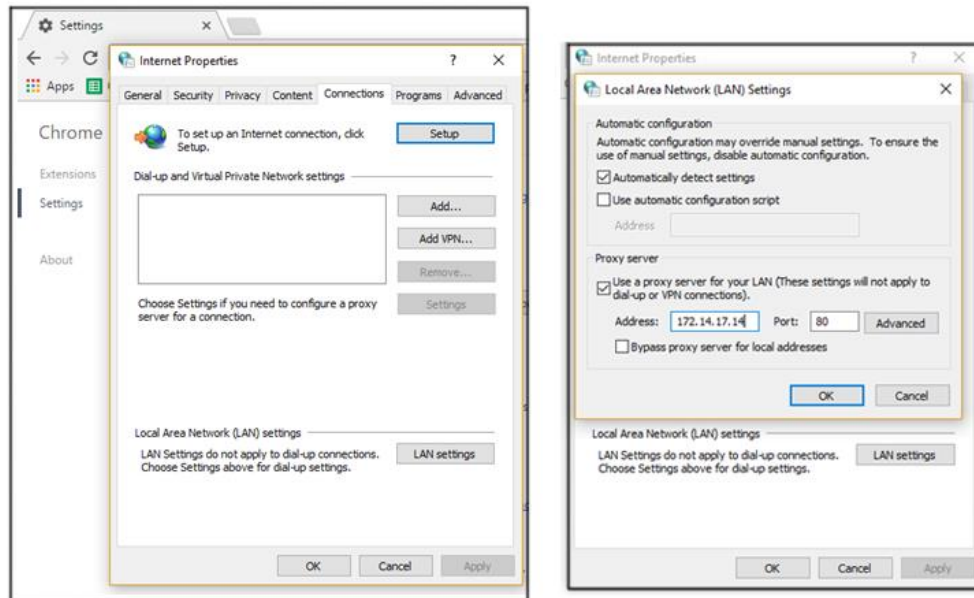
Fig. 1.3.7: Configuring network connection settings from a browser

Privacy settings of a browser help the user to manage the cache and cookies. The following screenshot shows privacy settings option of a browser:
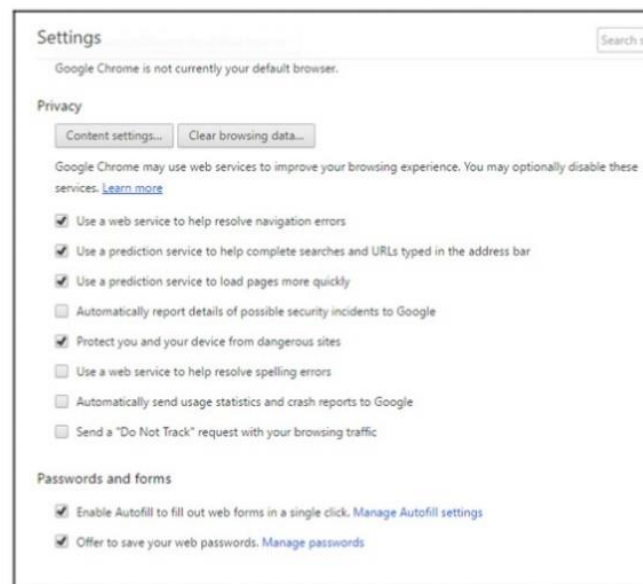
Fig. 1.3.8: Privacy settings option of a browser

1.3.3 Security Software

The security of a computer depends on the proper working of various technologies. An OS provides access to the resources available to the software which are running on the system and also to the external devices such as networks through the kernel. The OS contains various built-in tools, such as antivirus utilities and firewall set up, for protecting the system against security threats. These are known as security software.

Some of the security software are as discussed below:

- Firewall
- Antivirus
- Anti-Spyware

Firewall

A firewall is a utility software which monitors sending and receiving of files and blocks unauthorised network. It enables network security as it monitors incoming and outgoing network traffic thereby facilitating controlled data access between the networks.
The following image shows firewall security in a computer:

Fig 1.3.9: Firewall security in a computer

Antivirus Software

An antivirus is also known as anti-malware software. It is a set of programs that are used to prevent, detect and remove software viruses, worms, adware, Trojans and so on. This software needs to be up-to-date as a system without an antivirus can be infected within a few minutes of being connected to the Internet.

The following image shows an antivirus software installed in a computer:

Fig. 1.3.10: An antivirus software installed in a computer

Anti-Spyware

A spyware is a malware that collects a user's personal information such as credit card and browsing history and passes it to a third party without the user's knowledge.

An anti-spyware is a utility program that removes such malware or unwanted programs which could be present in the computer, to protect the user's personal information. Avast anti-spyware is a popular software to remove malware.

Activity

Fill in the blanks for the following statements:

1. The security software which monitors sending and receiving of files is known as
    _____.

    a.   Firewall   b.   Antivirus   c.   Antispyware

2. A web browser is a _____ used to search information online.

    a.   Application   b.   System software   c.   Security software
         software

3. An operating system serves as an interface between programs and
    _____.

    a.   System hardware   b.   System software   c.   Applications

Practical

Perform the task of creating restore point and restoring computer for windows 8.

Hardware:

1. Computer with windows 8 system

2. Basic Electronics

Unit 2.1 – Fundamentals of Electronics

Unit 2.2 – Other Electronic Concepts

Key Learning Outcomes

At the end of this module, you will be able to:

- Explain the fundamentals of electronics
- Define electronic circuits and components
- Define fundamentals of electricity
- Describe PCB and its layout
- Explain other concepts of electronics

UNIT 2.1: Fundamentals of Electronics

Unit Objectives 🎯

At the end of this unit, you will be able to:

- Define electronics
- Explain the basics concepts of electronics
- Identify electronic components
- Explain the fundamentals of electricity

2.1.1 Introduction to Electronics

Electronics is the branch of science which involves the study of flow and control of electrons (electricity) and their behaviour and effects. This branch deals with electrical circuits involving active electronic components such as transistors, diodes and integrated circuits and passive electronic components such as resistors, capacitors and inductors, along with interconnection technologies.

The following figure shows some concepts that form the basics of electronics:

Components and Devices	• Active • Passive
Circuits	• Analog Circuit • Digital Circuit • Basic Circuitry
Electricity	• Ohm's Law • Kirchoff's Law • Alternating Current (AC) • Direct Current (DC)
Measuring Instrument/ Equipment	• Digital multimeter • Clamp meter • Power Supplies • Voltage Source • Current Source • Oscilloscopes • Generators
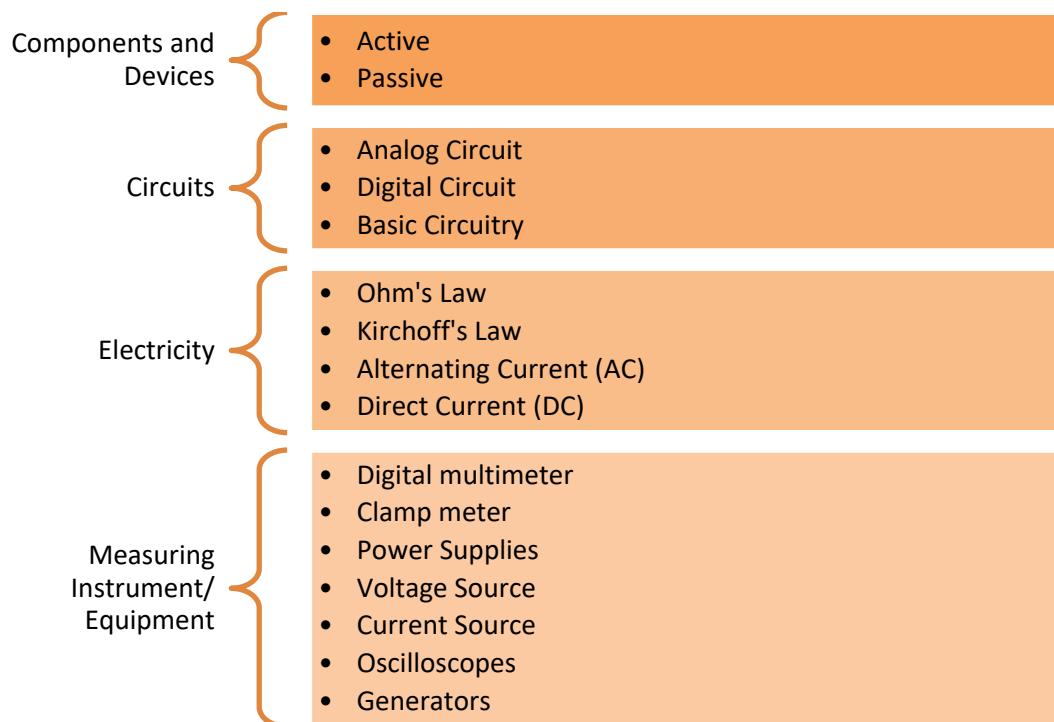
Fig. 2.1.1: Concepts of basic electronics

2.1.2 Electronic Components

All the circuits of a computer are made up of various basic electronic components. These components are the fundamental building blocks of the electrical/electronic circuits. They are generally found on the hard disk drive, motherboard and on the other parts of a computer and its peripherals. For a field technician, it is necessary to identify these components correctly.

The electronic components are embedded on Printed Circuit Boards (PCBs). A PCB acts as a base for the components that are mounted on its surface and soldered. The components are generally soldered on the circuit board according to a specified design. The circuits are initially build and tested on a breadboard before being embedded on a PCB. The following image shows a mother board PCB and a few electronic components embedded on it:
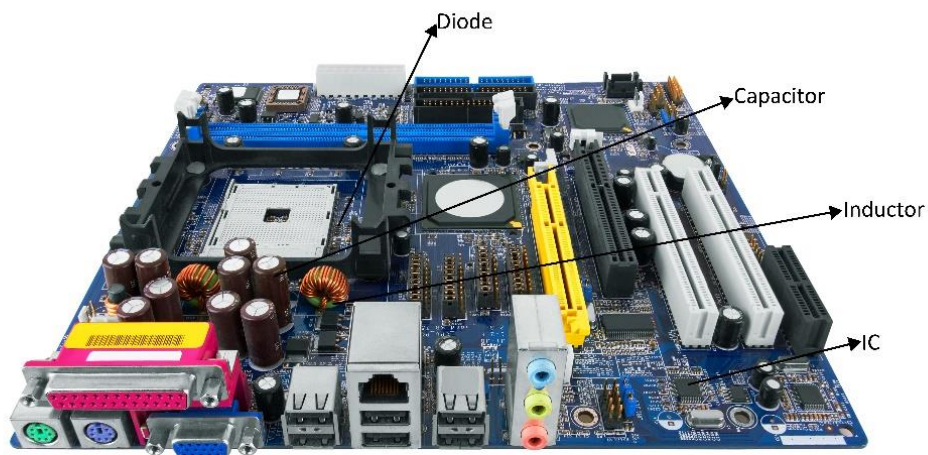
Fig. 2.1.2: Some electronic components on a motherboard's PCB

Electronic components that may be embedded on a PCB are of two types:

- Active
- Passive

Active Components

These components depend on a source of energy to perform their functions. They can amplify current and produce a power gain. The following figure represents a list of active components:
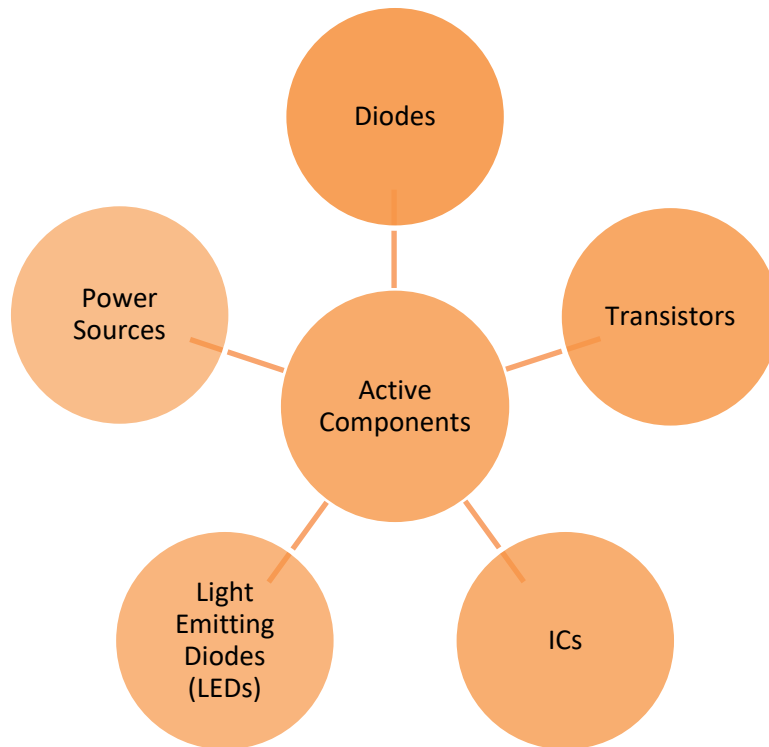
Fig. 2.1.3: Active components

Diode

A diode is a specialized electronic component with two terminals known as the anode and the cathode. It has asymmetric conductance, which means that it conducts mainly in one direction. It has very less resistance (ideally zero), to the flow of current in one direction. It has high resistance (ideally infinite), in the other direction. Diodes are usually made up of semiconductor materials such as germanium, silicon or selenium. The following image shows diodes:

Fig. 2.1.4: Diodes

Transistors

A transistor is an electronic device, made up of semiconductor material. Usually, it has at least three terminals to connect to an external circuit. It is used to amplify or switch electrical power and electronic signals. The following image shows a transistor:
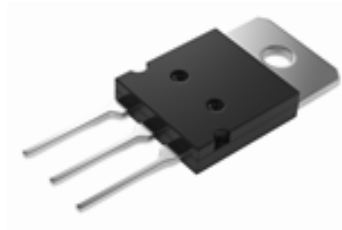
Fig. 2.1.5: A transistor

IC

An IC, also known as a microchip, is a semiconductor wafer on which a number of small resistors, capacitors and transistors are fabricated. It can work as an oscillator, an amplifier, a timer, a counter, a microprocessor or as computer memory. The following image shows an IC:

Fig. 2.1.6: An IC

Light Emitting Diode (LED)

It is a p-n junction diode which gives out light when it is activated. It is a two-lead semiconductor source of light. Energy is released as photons when a suitable voltage is applied to the leads. The following image shows an LED:

Fig. 2.1.7: An LED

Power Source

A power source is a source which provides power to a circuit. Generally, it is a generator or a battery.

The following image shows a battery:
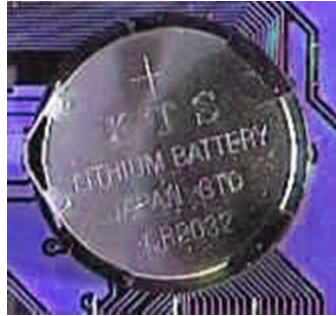
Fig. 2.1.8: A battery

Passive Components

These components do not require any power source to perform their specific functions. They are not capable of controlling the current. The following figure lists different passive components in a circuit:
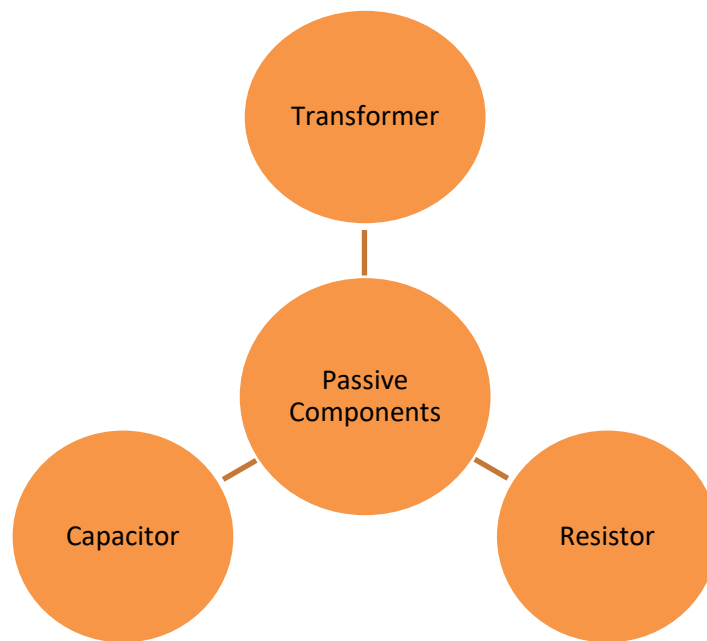
Fig. 2.1.9: Passive components

Transformer

A transformer consists of a metal core with coils of wire around it. It is a device used to convert AC to the required values by decreasing or increasing the alternating voltages in an electronic or electric system.

The following image shows a transformer:
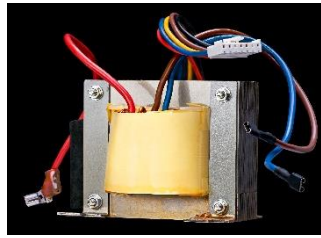
Fig 2.1.10: A Transformer

Resistor

A resistor is a component in an electronic circuit which is built to resist or limit the flow of current in that circuit. It may be a small carbon device or a big wire-wound power resistor. Its size varies in length from 5mm up to 300mm. The following image shows different types of resistors:
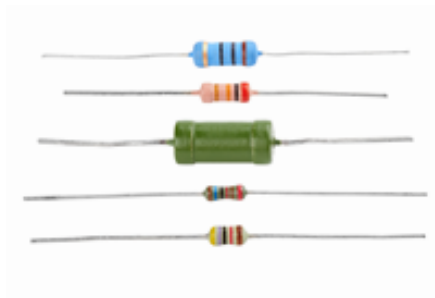
Fig. 2.1.11: Resistors

Capacitors

A capacitor is a device which is made up of one or more pairs of conductors and an insulator separating them. It is used to store electric charge. The following image shows capacitors:

Fig. 2.1.12: Capacitors

2.1.3 Fundamentals of Electricity

Electricity is a natural force that comes into existence whenever there is a flow of electric charge between any two components. The flow of electric charge is called current. Voltage is the potential difference between negative and positive charged components. When working with circuits, basic knowledge of electricity is very important to ensure that all connections are

correct. A wrong connection in a circuit may cause high damage to people and the circuit components.

Introduction to PCB

In personal computers, a motherboard is the PCB that provides connectors for peripherals and has many important components on the board.

It is the main circuit board of a computer. A motherboard includes the following devices:

- CPU
- Chipset
- I/O ports
- BIOS
- ROM chip
- Memory
- Expansion slots
- Peripheral controllers

Motherboard is also known as "Main board" or "System Board".

Types of PCB

There are two types of mother boards:

- **Non-Integrated PCB (older):**

  Peripheral controllers were not on the motherboard. Addition boards (called add-on-cards) were installed in expansion slots as per requirement. For example, video card, floppy disk drive (FDD) controller card, hard disk drive (HDD) controller card, Serial and parallel port card and sound card.

- **Integrated PCB (latest):**

  Most of the peripheral controller cards are integrated on the mother-board itself. Electronics of these logics are integrated on the motherboard and connectors are visible on the rear panel of the PC.

Chipset:

A chipset is a motherboard component that includes the CPU and other chips that support basic functions of the computer.

The two main chips in the chipset are:

Northbridge:

North bridge is the part of the computer chipset that provides a network between the CPU and the other interfaces of the computer. These interfaces may include memory, Accelerated Graphics Port (APG) port and Peripheral Component Interconnect (PCI) bus. It is also linked to the south bridge.

Southbridge:

South bridge is the portion of the computer chipset that provides a network between the north bridge and the slower speed interfaces and then further connects the interfaces to the

CPU. These interfaces may include parallel ports, serial ports, Universal Serial Bus (USB) ports and PS/2 ports.

The south bridge controls the slower I/O components like the Serial ports, USB ports and the integrated development environment (IDE).

The following image shows the connection of south bridge and north bridge in a PCB:
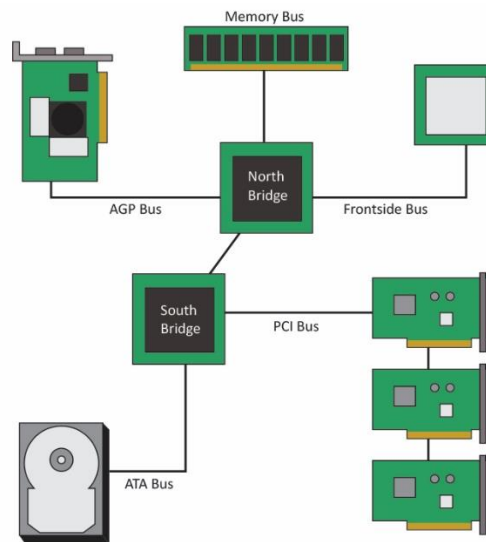
Fig 2.1.13: Connection of south bridge and north bridge in a PCB

The form factor of the motherboard determines the physical organization, general shape, the sorts of cases and power supply usage of PCB. It also specifies the physical layout, order of the board and the arrangement of mounting holes in the PCB. For example, a company can manufacture two motherboards with the same functionality but having a different form factor. The real differences lie in the physical layout and the position of the components on the board.

PCB Components

PCB has many components embedded in it. The two main components are:

- Processors
- Buses

Processors

A processor is a logical circuitry unit embedded in a PCB (or motherboard), which helps in running the system software such as OS and other applications such as window office. It also executes instructions given by the user.
It is also known as CPU and contains a silicon chip. It can perform complex calculations.
There are different types of processors such as advanced micro devices (AMD), digital signal processors (DSP) and Intel processors.

A processor contains three basic components:

- I/O unit
- Control unit (CU)

- Arithmetic logic unit (ALU)

The following image shows the basic components of a processor:
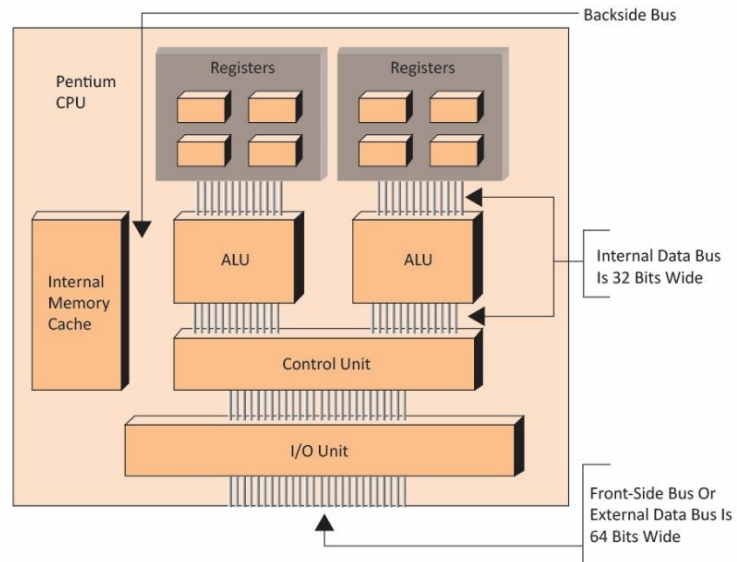
Fig 2.1.14: The basic components of a processor

The components of a processor are discussed in the following figure:

I/O unit
- The I/O unit manages the entering and leaving of the data and instructions from the processor.

Control Unit
- The control unit controls the activities inside the processor.

ALU
- The ALU performs logical comparisons and calculations.

Register
- Registers hold the instructions, data and addresses being processed by the ALU.

Cache
- The internal memory caches (L1, L2, and possibly L3) holds the data and instructions that have to be processed by the ALU.

Front side bus (FSB)
- The FSB sends instructions, data, control signals and addresses into and out of the processor.
- It is called FSB because of its connection to the outside of the processor.

Back side bus
- The back side bus is used to connecting the processor to the internal memory cache.
- Its operating frequency is much higher than that of the external bus (also called as system bus).

Fig. 2.1.15: Components of a processor

Processor Frequency or Speed

The speed of the processor at which it operates internally is known as processor frequency. For example, the processor's internal operating speed is 3.2 GHz but external operating speed is 800 MHz. In this case, 3.2 GHz is the frequency of the processor and 800 MHz is the frequency of the system bus.

Processor Technologies

Processor technologies can be used by AMD only, by Intel only or by both the vendors. These technologies help in distinguishing in between different processors in terms of their performance or features.

The processor technologies can be classified as:
- Over clocking
- Voltage regulator module (VRM)
- Throttling
- Hyper threading (HT Technology)

Overclocking

The default frequencies of motherboard and processors can be altered just by changing a BIOS set-up setting. Over clocking is the process in which a motherboard or processor work at a higher speed or velocity than that recommended by the manufacturer. Stability of the speed is not guaranteed in running the motherboard or processor in overclocking. Hence, it is inadvisable to run the motherboard or processor in it. In addition, a much higher speed or velocity can create overheating, which can damage the processor. So, the major area of concern to deal with while overclocking a system is overheating.

VRM

A CPU is a collection of transistors. These transistors work at a specific voltage level. If excessive voltage is supplied to the transistor, it will burn off. Hence the motherboard manufacturers have to take special care of the CPU voltages.

Throttling

Throttling is a process which is responsible for maintaining the rate at which the processing of application is conducted. Whenever the system is overheated, it lowers down the frequency which also helps in conserving power. It is also known as dynamic frequency scaling.

HT Technology

Intel developed a technology known as HT Technology. Two execution threads are processed by the HT technology inside a processor. On enabling it in the BIOS of the system, the single processor appears as two processors to the operating system.

Buses

In the architecture of a computer, a bus works as a communication system that transmits data amidst various computers or components within a computer. A computer is comprised of many components such as the CPU, I/O devices and the memory chips. A bus is a common passage or a group of wires that interconnects all these subsystems of a computer. Thus, the different components are able to exchange information through the bus.

Based on the flow of data between different devices, buses are classified as follows:

Types of buses

There are four types of buses connecting different devices as shown in the following figure:

System Bus
- System bus refers to the bus which connects the CPU with the system memory.
- The system bus is the main communication path between the CPU and memory.

Address Bus
- The address bus is necessary to provide the address of the location where the data can be stored or retrieved.

Data Bus
- Data bus is bidirectional and the data is transferred to and fro from the CPU.

Control Bus
- The control bus is used to coordinate the data between the CPU and the peripherals devices or memory.

Fig. 2.1.16: Types of buses

The following image shows the connection of different buses with the devices:
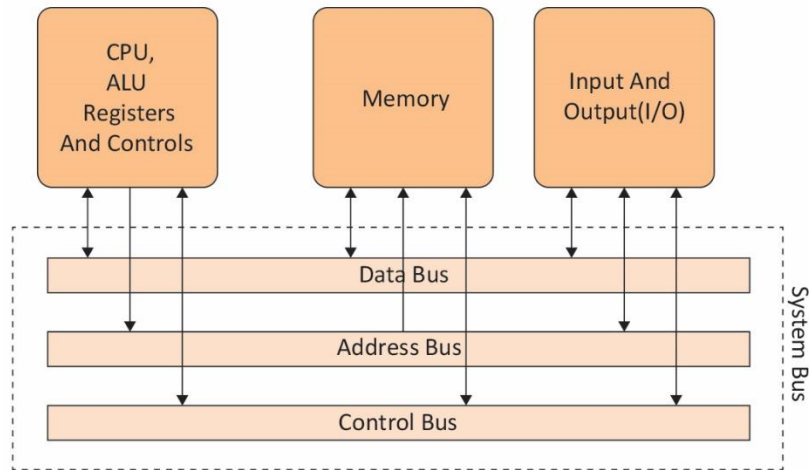
Fig 2.1.17: Connection of different buses with the devices

The various bus slots differentiated on the base of their features are discussed as follows:

- Industrial Standard Architecture (ISA) Bus Slots:
    - The expansion slots are used to enhance the features of the PC.
    - An ISA bus is present in 80286, 80386, 80486 and in Pentium systems and is of 16-bit slot.
    - Jumpers or switches are used to configure the ISA card.

The architecture of an ISA bus slot is as shown in the following image:
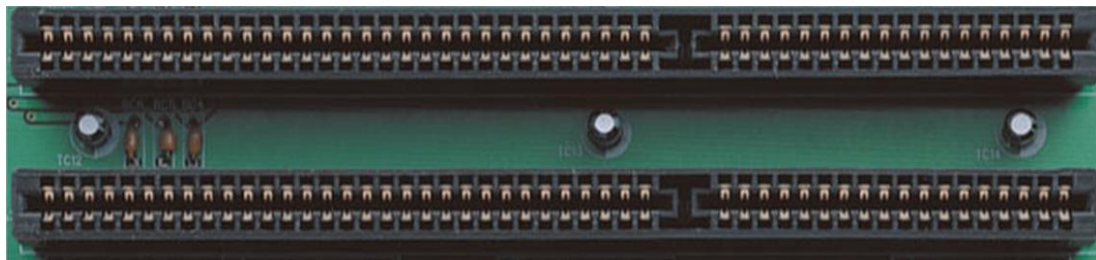
Fig. 2.1.18: Architecture of an ISA bus slot

- PCI Bus Slots:
    - It supports plug and play and it is self-configuring.
    - It operates at a speed of either 33 MHz or 66 MHz.
    - It is a 64-bit bus.
    - It communicates with the processor via a bridge circuit.

The following image shows PCI bus slot inside a motherboard:
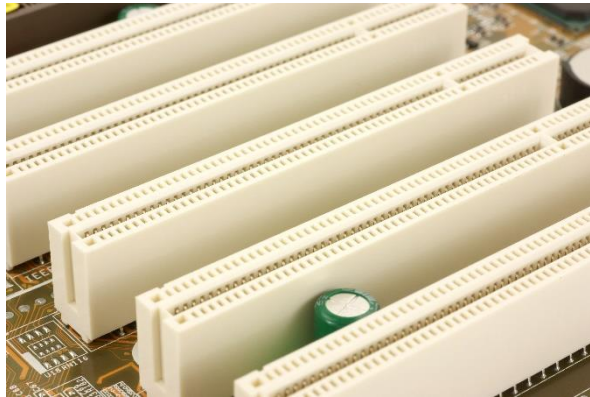
Fig. 2.1.19: PCI bus slot inside a motherboard

- Peripheral Component Interconnect Extension (PCI-X) Bus Slots:

  o Speed of operation: 133 MHz bus speed
  o Offered Bandwidth: 64-bit
  o Data transfer rate: 1 GB/sec
  o Efficient bus operation supported: Yes
  o Backward compatibility is provided: Yes

The following image shows PCI-X bus slots inside a motherboard:
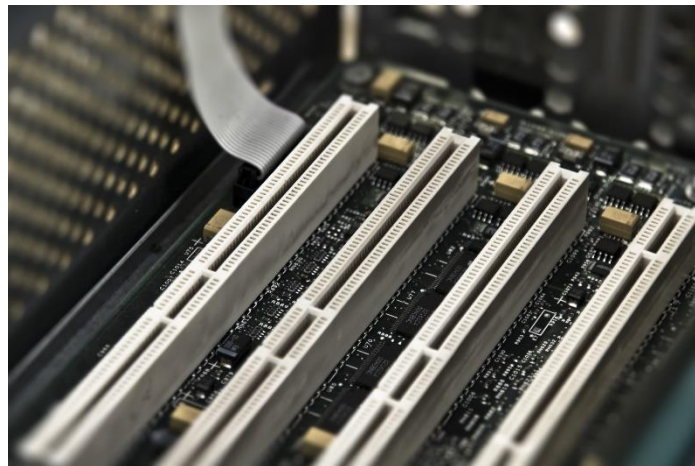
Fig 2.1.20: PCI-X bus slots inside a motherboard

- Extended Industry Standard Architecture (EISA) Bus Slots:

  o EISA bus has a feature called bus mastering which enables the components to communicate with each other without the interference of the CPU.

The following image shows various bus slots of EISA:
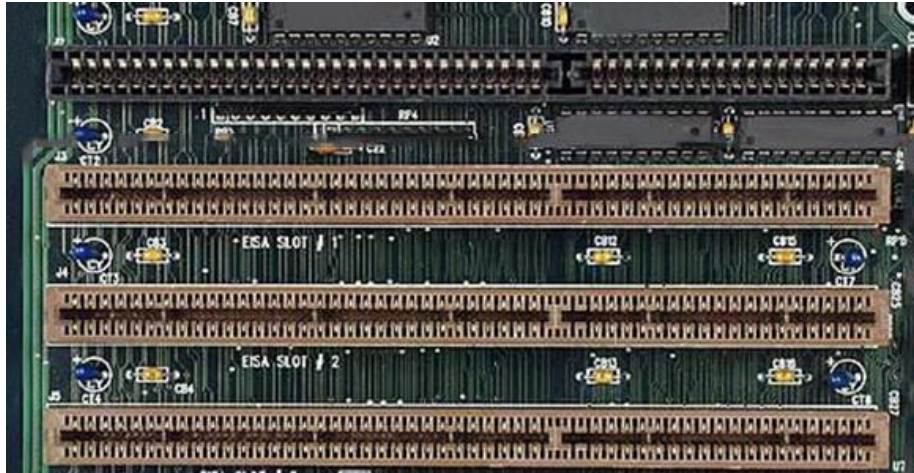
Fig. 2.1.21: Various bus slots of EISA

- Micro Channel Architecture (MCA) Bus Slots:
  o MCA bus supports additional features like 32-bit data transfer and automatic configuration of expansion cards.

The following image shows the architecture of an MCA bus slot:
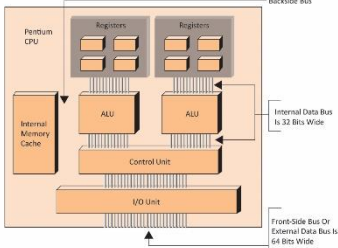
Fig. 2.1.22: Architecture of an MCA bus slot

- Video Electronics Standard Association (VESA) Bus Slots:
  o It is designed to hold the video cards of days prior to Accelerate Graphics Port (AGP).

Activity

Match the following devices with their respective images:

1.	Processor	A.	
2.	ISA bus slot	B.	
3.	PCI-X bus slot	C.	
4.	EISA bus slot	D.	

UNIT 2.2: Other Electronic Concepts

Unit Objectives

At the end of this unit, you will be able to:

- Define voltage and power
- Identify voltage and power requirement for different hardware devices

2.2.1 Voltage and Power

Voltage is the potential difference between a negatively charged component and a component with positive charge. It is the amount of energy carried by the charge and is the "energy per unit charge". It is measured in volts.

Power is the amount of electrical energy per unit time given by an electric circuit. It is measured in watts (W) or joules per second.

Voltage and Power Requirement by Hardware Devices

Computer is an electronic machine and hence it can only be operated with a source of energy. It requires a standard power and voltage range for its operation. Every electronic device or circuit is fed by the power supply unit (PSU).

2.2.2 Computer Power Supply Voltages

All the hardware components present in a computer, require some amount of DC voltage to function. This amount may differ from component to component. The following table lists a few components and their voltage requirement:

Component	Voltage Requirement (in volts)
Mainboard or motherboard	12
CPU	3.3
Graphic cards	12
CPU fan	5
USB ports	5

So, in a computer broadly three types of DC voltages are required, which are +12V, -12V, +5V, -5V, and +3.3Volt.

Power ratings and voltages outside the permissible range can cause system failure.

PSU

A PSU draws the AC voltage from the source (generally from the socket) and converts it to the desired level of DC voltage. It is usually found at the back side of a computer case. The following figure lists the parts found on the backside of a PSU:

A point of connection for connecting the power cord to the computer.

A fan opening for drawing out the air from the power supply.

A red switch for changing the voltage of the power supply.

A rocker switch for turning on and off the power supply.

Fig. 2.2.1: Components of a PSU

The following image shows a PSU:
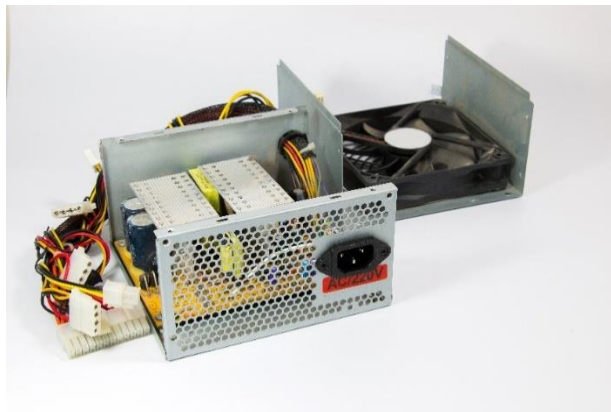
Fig. 2.2.2: Interior view of a PSU

There are different types of power supplies available in the market, but switched-mode power supplies are globally used today in personal computers.

There is also a stack of different coloured cables inside a PSU.

The following figure lists the colour codes of the PSU cables:

Black Wires	•These wires are used to provide grounding. •Every other color should be paired with a black wire.
Yellow Wires	•These wires denote +12V
BlueWires	•These wires denote -12V
Red Wires	•These wires denote +5V
White Wires	•These wires denote -5V
Orange Wires	•These wires denote 3.3V
Green Wires	•These are control wires to check the DC voltage
Purple wires	•These wires denote +5V on standby mode

Fig. 2.2.3: Colour codes of PSU cables

Power supply and computer can be protected from a surge and voltage drops by simply adding a UPS (backup) to the computer.

Activity

Write the voltage requirement of the given components:

1. USB ports
2. CPU fan
3. Motherboard
4. Graphic cards
5. CPU

3.Networking Essentials

Unit 3.1 – Networking Concepts

Unit 3.2 – TCP/IP Protocol

Unit 3.3 – Wireless Network

Unit 3.4 – Cables and Connectors

Key Learning Outcomes 💡

At the end of this module, you will be able to:

- Understand basic concept of networking
- Describe TCP/IP protocol and their layers
- Discuss wireless networks
- Identify cables and connectors

UNIT 3.1: Networking Concepts

Unit Objectives 🎯

At the end of this unit, you will be able to:

- Define network topology
- Identify different types of topology
- Describe the Open system interconnection (OSI) model and its layers

3.1.1 Network Topology

Network topology refers to the arrangement of the different elements (links and nodes) of a network. It is the layout of a network and may be depicted as:

- Physical topology: It is the arrangement of the various network components.
- Logical topology: It describes how data flows in a network.

Distances between the nodes, physical connections, rate of transmission or types of signal may differ between two networks, but still topologies may be identical.

Types of Topology

There are five types of network topologies based on the type of exchange of information through the network. They are as discussed:

Bus Topology

In bus topology, each node is connected to a single cable using interface connectors. The central cable, known as bus, is the backbone of the network. The packets that are transmitted in both directions along the bus contain the destination address. As single high capacity cable is required, this topology needs minimum cabling and the cost is also low. The entire cable setup needs to be reconfigured to add a node. It is a time consuming process to troubleshoot as every point needs to be checked to locate the fault.

The following figure shows bus topology where all nodes are connected to the same terminal:
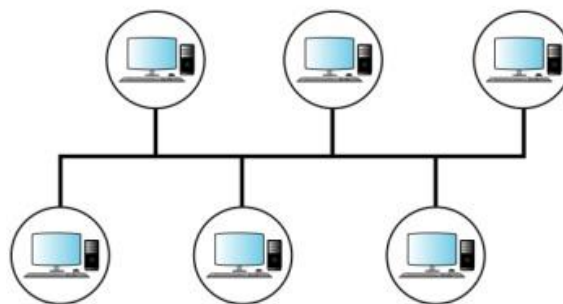
Fig. 3.1.1: Bus topology

Star Topology

The star topology links the nodes over a network, utilizing a central control unit which is known as hub. Nodes in a star-based network can be easily attached to the hub. All the nodes are connected to the hub, thus, requiring lot of cabling and high cost. A faulty hub can disrupt the entire network.

The following figure shows star topology:
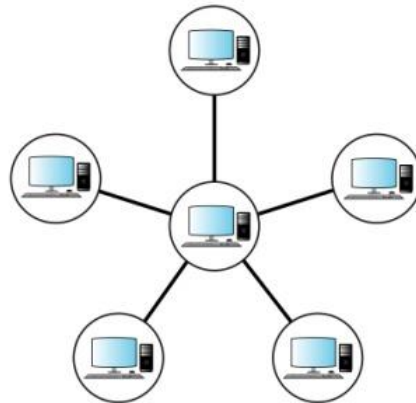
Fig. 3.1.2: Star topology

Ring Topology

The ring topology links the nodes through a point-to-point connection over a network. It is easy to locate cable faults in a ring and if any of the nodes in the network malfunctions, the entire network stops functioning.
The nodes in the network make a closed loop. The flow of data is unidirectional around the ring. The data is passed through the nodes from the sender to the receiver.

The following figure shows the closed loop connection in ring topology:
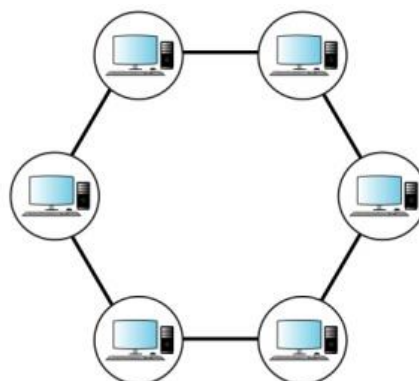
Fig. 3.1.3: Closed loop connection in ring topology

Mesh Topology

The mesh topology involves point-to-point connection between every node in the network. It is highly reliable as network connectivity does not depend on any one node. It is used for large network connections. It involves high installation and setup costs due to the complex

cabling required to connect each node with the other. This topology becomes difficult to manage if the size of the network increases.

The following figure shows the architecture of mesh topology:
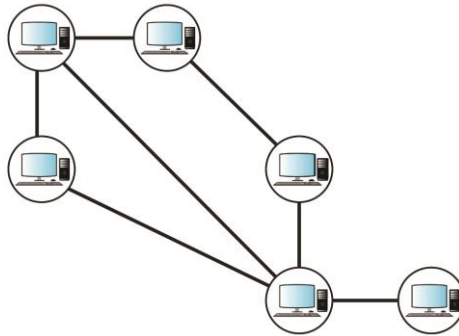
Fig. 3.1.4: The architecture of mesh topology

Cellular Topology

The cellular topology is a wireless topology, where geographic area is divided into cells or regions. Each cell is a separate entity that is controlled by a central station. This topology operates on wireless media which does not require cabling.

It is easy to install as the only requirement is the availability of a central location and signal strength. Data transmission happens in a cellular digital packet data (CDPD) format.

The following figure shows a cellular topology connection:
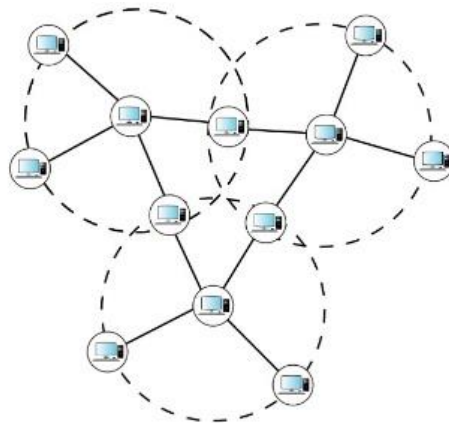
Fig. 3.1.5: A cellular topology connection

3.1.2 OSI Model

The OSI model is a conceptual or networking framework designed to implement a set of rules, known as protocols, for transfer of information between different layers. It was designed by the International Organization for Standardization (ISO).

The model divides network communications into seven layers:
- Physical layer
- Data Link layer
- Network layer
- Transport layer
- Session layer
- Presentation layer
- Application layer

The following figure describes the seven layers of an OSI model:
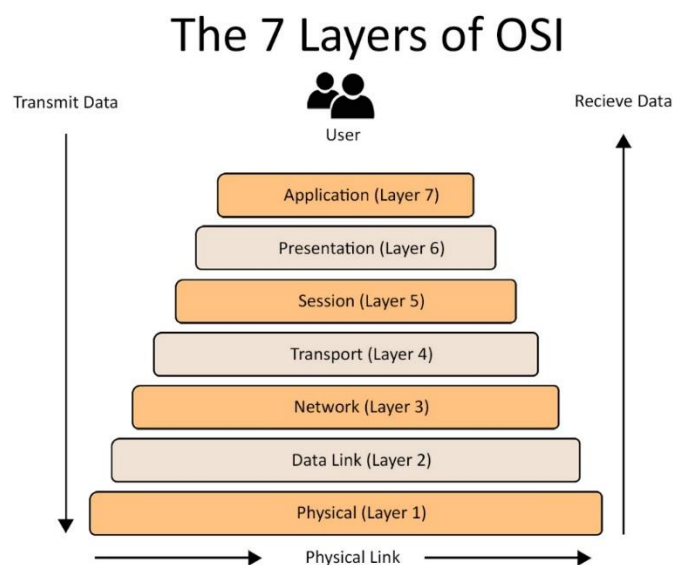
Fig. 3.1.6: The OSI model

Every layer protocol performs specific services which is unique for that layer. The protocol interacts with the protocols which are directly above and below it, while performing the services.

The description of the seven layers on the basis of their functions are as follows:

Physical Layer

It is the first layer of the OSI model. This layer protocol transmits bits rather than packets in the form of a physical signal over the connecting network. It interfaces with the data link layer and performs coding, decoding and transmission of information in the form of bits.

It passes the information bit by bit and detects and accepts signals which are passed to the data link layer. It monitors error rates in data but cannot perform error corrections.

The following figure shows flow of data from the data link layer to the physical layer and vice-versa:
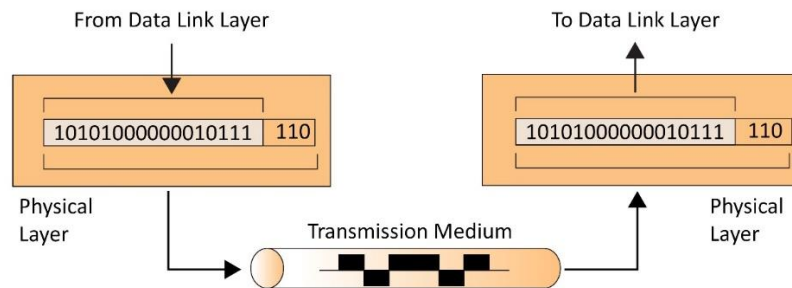
Fig. 3.1.7: Flow of data from the physical layer to the data link layer and vice-versa

Data link Layer

It is the second layer of the OSI model which transmits information in the form of packets. These packets contain the source and the destination address which are required to transmit them to their assigned destination. It also performs error checking, which is not done by the physical layer, to ensure that the packets arrive error free.

The main functions of data link layer are:
- It provides interface to the network layer
- It deals with transmission error to ensure that the frame arrives without any problem
- It controls the flow of data

The following figure shows the flow of data from the network layer to the data link layer:
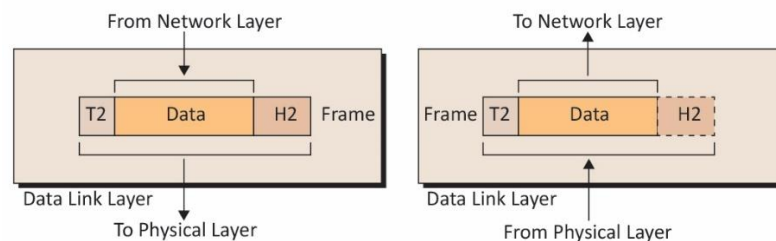
Fig. 3.1.8: Flow of data from the network layer to the data link layer

Network Layer

It is the third layer of the OSI model. It transmits data packets in a logical way and assigns network addresses to these packets which is translated into their equivalent physical addresses. Every device in the network has a unique identification number which is known as addressing. There are two types of address assigned to each node:
- Network address
- Physical address

In this protocol layer, each packet is assigned a network address which works on a hierarchical addressing design. It accepts the data segments, which are known as packets,

from the transport layer. The header part of these packets are added with the logical addressing information before being sent back to the transport layer.

The following image shows the flow of data in packets from the transport layer to the network layer:
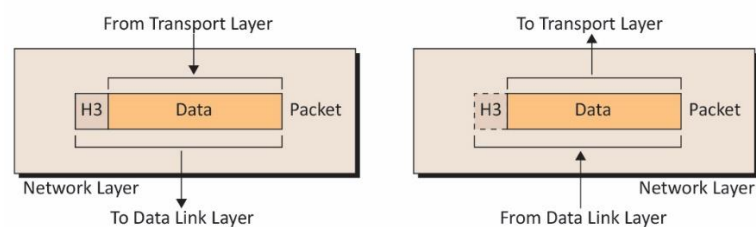
Fig. 3.1.9: Flow of data in packets from the transport layer to the network layer

Transport Layer

The fourth layer in the OSI model is the transport layer. On the basis of its application, this layer can be either connection oriented or connectionless.

It accepts data from the layer above it (session layer) and performs end to end delivery of the data. It ensures that the data is transferred from the sender to the receiver without any error and is understandable by the receiver.

This layer protocol forms data packets and assigns sender's and receiver's address to the header part of the packets. This is known as multiplexing of data.

The following image shows the flow of data in segments from the session layer to the transport layer:
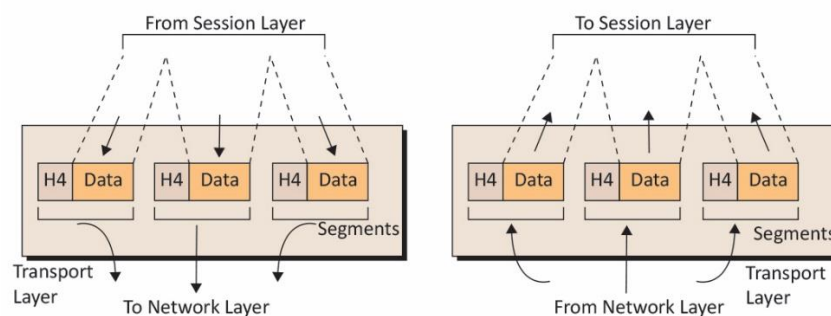
Fig. 3.1.10: Flow of data in segments from the session layer to the transport layer

Session Layer

It is the fifth layer of the OSI model. This layer performs different functions between two nodes in the network:

- Coordinates and maintains communication between nodes
- Establishes and maintains a secure communication link between the nodes

The following image shows the flow of data from the presentation layer to the session layer:
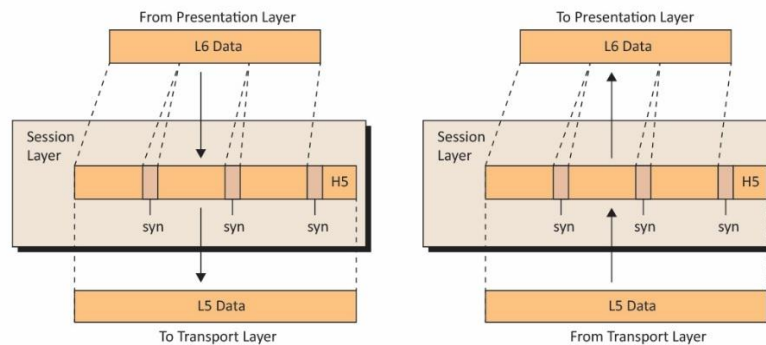
Fig. 3.1.11: Flow of data from the presentation layer to the session layer

Presentation Layer

It is the sixth layer of the OSI model. Its function is to accept data from the layer above it (application layer) and format the information.

It acts as a translator and performs the function of compressing and encoding the information received from the above layer. This layer performs various functions such as:

• Data encryption

• Data compression

• Data conversion

The following image shows the flow of data from the application layer to the presentation layer:
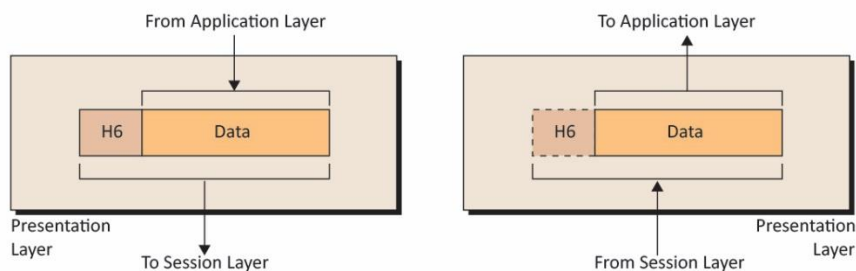
Fig. 3.1.12: Flow of data from the application layer to the presentation layer

Application Layer

It is the top layer of the OSI Model. It deals with the user end applications such as e-mail, transfer of files, dealing with software and web browsing.

Unlike other layers, it does not serve but can interact with the layer below it to transfer its data to the host.

The following image shows the connection of user and presentation layer with the application layer:
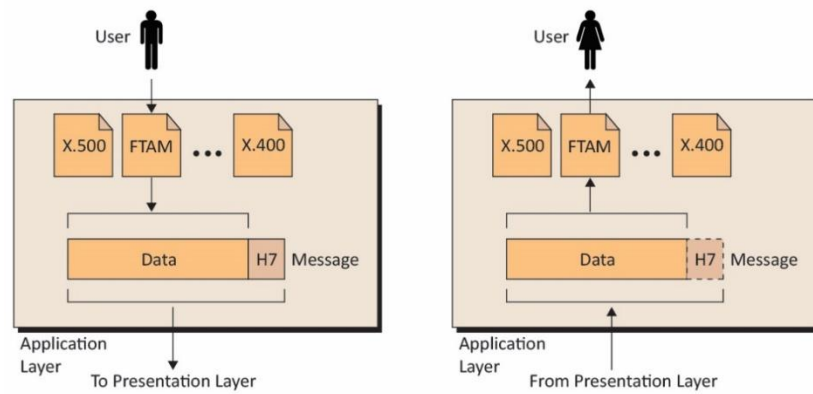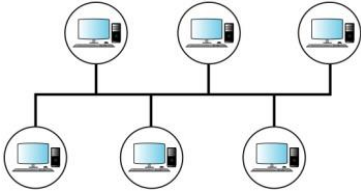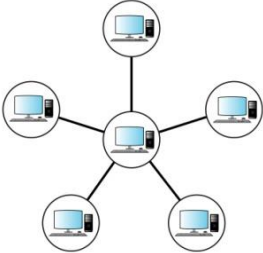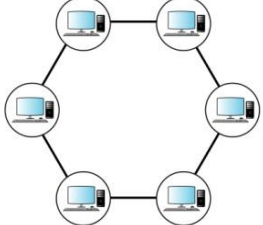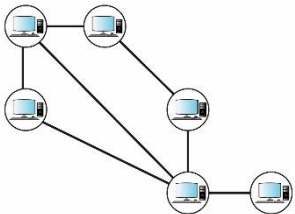
Fig. 3.1.13: Connection of the user and the presentation layer with the application layer

Activity

Match the following images with their respective topologies.

1.		A.	Star Topology
2.		B.	Ring Topology
3.		C.	Mesh Topology
4.		D.	Bus Topology

UNIT 3.2: TCP/IP Protocol

Unit Objectives ◎

At the end of this module, you will be able to:

- Explain TCP/IP protocol and its layers
- Describe IP addressing
- Discuss IPv4 addressing

3.2.1 Introduction to TCP/IP Protocol

TCP/IP is the communication protocol for Internet. It is a protocol suite which has two protocols:

- Transmission Control Protocol:
  - Assembles the message to be transmitted over network into smaller data packets
  - Reassembles the received packets into the original message
- Internet Protocol:
  - Manages the address of each data packet so that the data packet reaches the right destination. This is known as IP addressing.

It is also known as Internet Protocol Suite. TCP/IP is based on the client/server model of communication. The client computer sends requests to the server such as opening a web page. The server provides services such as connecting to the web page and giving access to that web page. Each client request in TCP/IP is an independent request, not related to the previous one. Hence it does not require a dedicated connection.

TCP/IP Model

The TCP/IP model is a set of protocols which defines how two or more computers can communicate with each other on Internet. There are many protocols working within the TCP/IP model. These protocols provide various functionalities which are important for the data transmission over the networks.

TCP/IP is composed of four layers, as shown in the following figure:
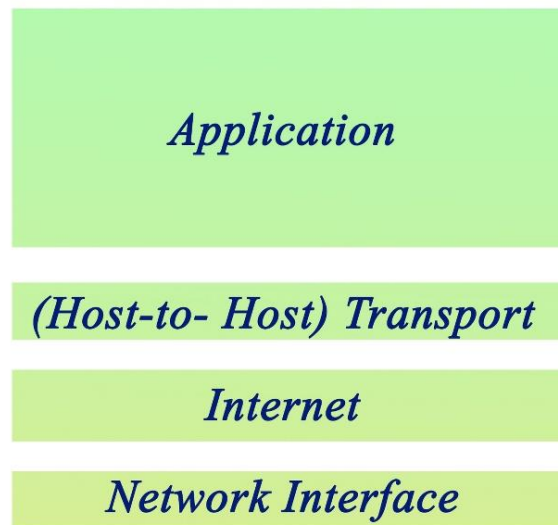
Fig. 3.2.1: Layers of TCP/IP network

The following image shows the description of TCP/IP layers:

Network Interface Layer/ Network Access Layer	•responsible for the placing or receiving of TCP/IP packets on or off the network medium. •includes Ethernet, token ring and WAN technologies.
Internet Layer	•responsible for IP addressing and routing functions
Transport Layer	•manages rate of data flow •manages reliability of data
Application Layer	•provides the applications with access to services •defines the protocols that the applications will use for exchanging data

Fig. 3.2.2: Description of TCP/IP layers

Layers of TCP/IP Protocol

There are four layers of TCP/IP protocol which are further classified on the basis of their functionalities as shown in the following image:

Application layer protocol	Transport layer protocol	Internet layer protocol	Network access layer protocol
Telnet	Transmission control protocol (TCP)	Internet protocol (IP)	Ethernet
Secure shell (SSH)	Usergram data protocol (UDP)	Internet control message protocol (ICMP)	Token ring
File transfer protocol (FTP)		Address resolution protocol (ARP)	Fiber distributed data interface (FDDI)
Trivial transfer protocol (TFTP)			
Hyper text transfer protocol (HTTP)			
Domain name system (DNS)			

Fig. 3.2.3: Layers of the TCP/IP protocol

Application Layer Protocol

This layer provides the applications with access to services and defines the protocols that the applications will use for exchanging the data

It is further subdivided into six layers as described below:

Telnet

Telnet is a protocol used by the network users to communicate with and to access the network devices. To access telnet, the user must have installed telnet client software.

SSH

It is a network protocol which is used by the administrators to access a remote device in a secure way. Unlike telnet, SSH uses encryption, which means that all the data is transmitted securely over the network.

FTP

It is a standard protocol. It is responsible for the transfer of computer files to the client from a server using the server-client model architecture. FTP supports user authentication and sends all data in clear text.

TFTP

It is a utility internet software used to transfer simpler files between remote devices. Unlike FTP, TFTP is less capable of transferring heavy files and lacks advanced features of FTP.

HTTP

HTTP is an application protocol also known as client-server protocol. It allows the client to request web pages from the web servers. It is the base for data communication of World Wide Web (www).

DNS

DNS is an internet service protocol. It is responsible for translating domain names into their corresponding IP addresses. It is user friendly because domain names are easier to remember than IP addresses.

Transport Layer Protocol

Transport layer protocol is also known as host to host protocol because it provides host to host services such as flow control, reliability and communication services. The two main layers of transport protocol are described as follows:

TCP

It assembles the message to be transmitted over network into smaller data packets and reassembles the received packets into the original message. It is connection-oriented, which means before data is sent, a connection between the two hosts must be established.

UDP

UDP is a transport layer protocol and it is used with internet layer protocol for transmission of data between applications running on a TCP/IP network.
UDP is also considered to be a connectionless protocol, since no virtual circuit is established between the two endpoints before the data transfer takes place. Because it does not provide as many features as TCP, it uses lesser network resources than TCP.

Internet Layer Protocol

Internet layer protocol performs IP addressing as well as routing functions. It enables the packet to travel on its own to the destination. The pattern in which the packets are received is altered before they are dispatched.

The list of important protocols at the internet layer are described as follows:

IP Protocol

IP protocol is a set of internetworking methods in the IP suite. Its responsibility is to send packets from the host to the destination, as described by the IP address. This IP address is defined by the IP.

ICMP

ICMP is also known as error reporting protocol because it is used by the networking devices like router to generate or send error messages such as, error in delivery of IP datagrams (packets) or non-availability of a requested service.

ARP

It is a communication protocol which is used to map an IP address to its corresponding physical or hardware address.

Network Access Layer Protocol

It is responsible for the placing or receiving of TCP/IP packets on or off the network medium and includes Ethernet token ring and WAN technologies.

The protocols used at network access layer are as discussed:

Ethernet

It is a local area network (LAN) technology which describes how the networking devices format the data for transmission to other network devices. It is in connection with the first layer or the second layer of the OSI model.

Token Ring

It is another LAN technology where all the computers are linked together in the form of ring or star topology. In this, to prevent the data collision between two computers, a token scheme is used.

FDDI

FDDI is used for data transmission of information. It uses fiber optic lines as its physical medium in a LAN. It works on token ring scheme and its range can extend up to 200 km.

3.2.2 Introduction to IP Addressing

An IP address is an exclusive identifier for a computer or any other device attached to the network. It is a 32-bit value. IP addresses are written in four decimal numbers, which are separated by dots. Each section ranges from 0 to 255. For example, 172.16.254.2 would be

the IP address of a node. When the address is converted to binary, each section contains 8-bit, which is called an octet.

IP Terminology

- **Bit:** It represents either 1 or 0.
- **Byte:** A byte consists of 7 or 8 bits, depending on the parity digit.
- **Octet:** An octet is made up of 8 bits.
- **Network Address:** It is the starting up address of a network. It is the identity of that network.
- **Broadcast Address:** It is the last IP Address of a network and is used to send information to all the available nodes on the same network.

The following figure depicts the dotted decimal notation of the given IP address:
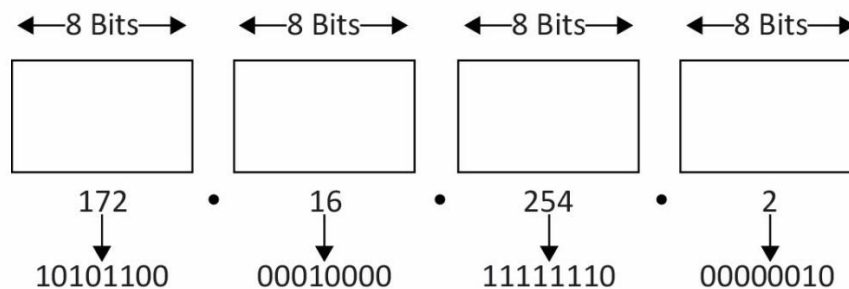
Fig. 3.2.4: Example of an IP address

IP addresses are also known as host addresses.

In a TCP/IP network the routers pass data packets between networks without knowing exact location of the destined host. They only know the network of the host. They deliver a packet to the network and then using the information stored in the router, the packet is delivered to the host. For this purpose, the IP address contains two parts:

- First part is the network address
- Second part is the host address.

To locate devices in a distributed environment, which is different networks connected to each other, the nodes are assigned explicit addresses which identify the network in which the device is on and also identify the device in that particular network. When these two unique identifiers are combined, it is a globally unique address.

Example

IP Address: 192.168.13.123

Network Address: 192.168.13.0

Host Address: 0.0.0.123

Types of IP Addresses

Based on their operational characteristics, the IP addresses are divided into three categories as shown in the following figure:

Unicast IP address	Multicast IP address	Broadcast IP address
•It is an address of a single interface. • The IP addresses of this type are utilized for one-to-one communication. • Unicast IP addresses are utilized to send direct packets only to a specific host.	•It is used for one-to-many communication. •IP multicast group addresses receives multicast messages from this IP address. •Only those hosts that need to receive the message will process the packets.	•It is utilized to send data or information to all available targets in the broadcast domain (the one-to-everybody communication). •In this, the packets send by the host is accepted by every server in the broadcast domain.

Fig. 3.2.5: IP addresses

3.2.3 IPv4 Addressing

IPv4 is a 32 bit address which is displayed in dotted decimal notation.

In this, the five classes of IP addresses, which are class A, B, C, D, and E, are defined by TCP/IP. Each class has a unique set of valid IP addresses.

The class is determined by the value of the first octet. Host address uses the first three classes of IP addresses (A, B and C). The remaining two classes are used for other purposes such as class D for multicast and class E for experimental purpose.

The following table represents different types of classes used in IPv4 addressing:

Class	Leading Bits	Number of Networks	Address per Network	Start Address	End Address
Class A	0	128 (2^7)	16,777.216 (2^{24})	0.0.0.0	127.255.255.255
Class B	10	16,384 (2^{14})	65,536 (2^{16})	128.0.0.0	191.255.255.255
Class C	110	20,97,152 (2^{21})	256 (2^8)	192.0.0.0	223.255.255.255
Class D (multicast)	1110	Not defined	Not defined	224.0.0.0	239.255.255.255
Class E (reserved)	1111	Not defined	Not defined	240.0.0.0	255.255.255.255

Activity

Find out the network address and host address for the given IP addresses.

IP Address	Network Address	Host Address
10.10.48.80		
28.212.250.254		
10.10.250.1		

UNIT 3.3: Wireless Network

Unit Objectives ◎

At the end of this unit, you will be able to:

- Define wireless network
- Identify different types of wireless networks
- Define bluetooth

3.3.1 Wireless Network

A wireless network uses wireless connections between two network nodes. Wireless networking helps to avoid the costly process of setting up cable connections in a building. Examples of wireless network are Bluetooth, cellular network and so on.

Types of Wireless Network
Wireless networks are classified on the basis of the coverage area or span (range) in which they can operate.

Wireless Local Area Network (WLAN)

WLAN is used to connect two or more devices that are available over a short distance. A wireless distribution method is needed to set up a WLAN. It gives a connection for accessing the Internet through the access point. It is utilized to associate network connection in two or more buildings without introducing a wired connection. The following figure shows WLAN:

Fig. 3.3.1: WLAN

Wireless Wide Area Network (WWAN)

WWAN is used to connect different devices over a large area. It covers a large geographical area using wireless technology.

The following figure shows WWAN:
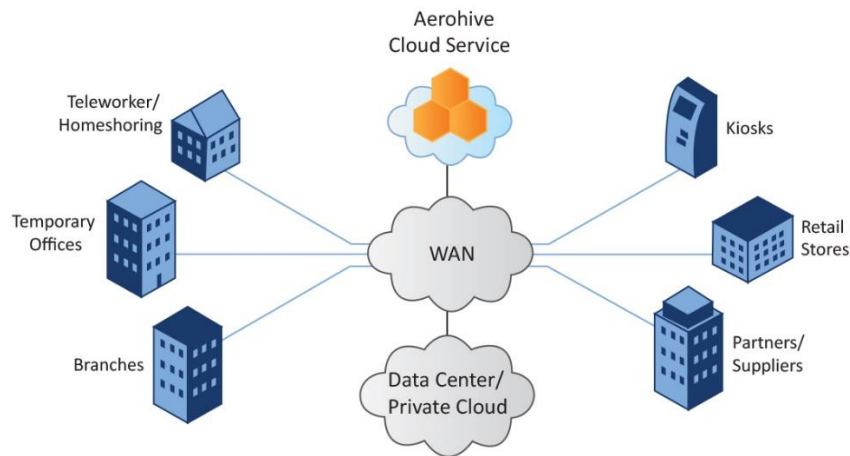
Fig. 3.3.2: WWAN

Wireless Personal Area Network (WPAN)

WPAN is a wireless network used to connect devices around an individual's workplace. It spreads within a range of 10 meters (short range). It is used to connect peripheral devices like two computers within the assigned range.

The following figure shows WPAN:
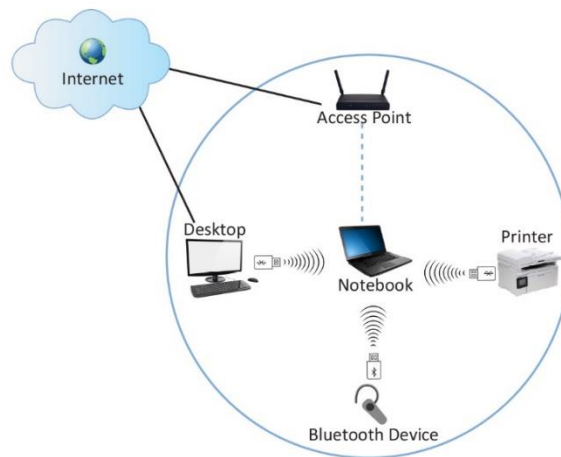
Fig. 3.3.3: WPAN

Standards for WLAN

Institute of Electrical and Electronics Engineers (IEEE) has set a few standards for WLAN, some of which are as follows:

- IEEE 802.11
- IEEE 802.11a
- IEEE 802.11b
- IEEE 802.11g
- IEEE 802.11n

- IEEE 802.11ac

Bluetooth

Bluetooth provides a wireless technology standard to exchange data from any fixed or mobile device over a short distance and thus build a personal area network (PAN).

The specifications of bluetooth are:

- Range: 3-6 meters
- Low-speed
- Operating frequency: 2.5 GHz

Using this technology, a user can talk and listen on the Bluetooth headset while the phone is in the pocket of the user. Bluetooth cannot operate on high bandwidth for devices like printer but can be used for a wireless mouse.
IEEE organization has developed the standards for Bluetooth which is 802.15.

The following figure shows a Bluetooth headset:

Fig. 3.3.4: Bluetooth

UNIT 3.4: Cables and Connectors

Unit Objectives 🎯

At the end of this unit, you will be able to:
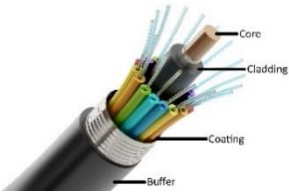
- Define cable and its types
- Explain connectors
- Describe the process of crimping

3.4.1 Cables

Cable form the transmission media for a network. Transmission media or channels, also known as links, lines or path, are used to interconnect the nodes in a network. Transmission channels are of different types of communication wires and cables such as coaxial/helix cable, optical fibre cable, twisted pair cable and cross over cable.

The following table lists different types of cables used in networking:

Type of Cable	Image	Description
Twisted pair		Have two conductors that are twisted together to cancel out the electromagnetic interference that may come from external sources. This type of cable is almost the same as a paired cable. The difference is in the two twined inner wires which are insulated unlike the paired cable. Used for transmission of data over networks such as, LAN.

Coaxial/Helix cable		Has a thin conducting wire inside a tubular conducting shield, which is protected by a tubular insulating jacket. Used to connect video equipment and carry television signals.
Optical fibre cable		Contains one or more optical fibres for carrying light. The optical fibres are coated with plastic layers and secured in a protective tube. Used for long distance communication.
Optical fibre cable (Single Mode)		Has small sized diametric core and permits a single mode of light to propagate through it. As a result, it reduces the number of light reflections when the light passes through the centre. This decreases the attenuation and enables the signal to travel further. Used for a long-distance coverage with a very high bandwidth requirement.

Optical fibre cable (Multi Mode)		Has big diametric core and permits several modes of light to propagate through it. The number of light reflections formed when the light passes through the centre are more. This enables larger quantity of data to pass through at a given time. The strength of the signal decreases over long distances because of the increased dispersion and attenuation. Used for backbone applications in buildings because of the reliability and high capacity.
Cross over cable		Connects computing devices, often of the same type such as two switches.

3.4.2 Connectors

There are various connectors used for connecting cables in networking as shown in the following figure:

CAT 5E Ethernet RJ 45 Connector

CAT 6 Ethernet RJ 45 Connector

CAT 6A Ethernet RJ 45 Connector

Telephone Network Connector

Coaxial Connector

Wire Connector and Terminal

Fig 3.4.1: Connectors

3.4.3 Crimping

Crimping means joining of two pieces of metal, generally a wire and a connector, together by deforming one of them and enabling one to hold the other. The resultant deformity is known as a crimp. The following image shows the various steps involved in crimping:

1. Place the Connector

2. Adjust and Position

3. Crimp

Result
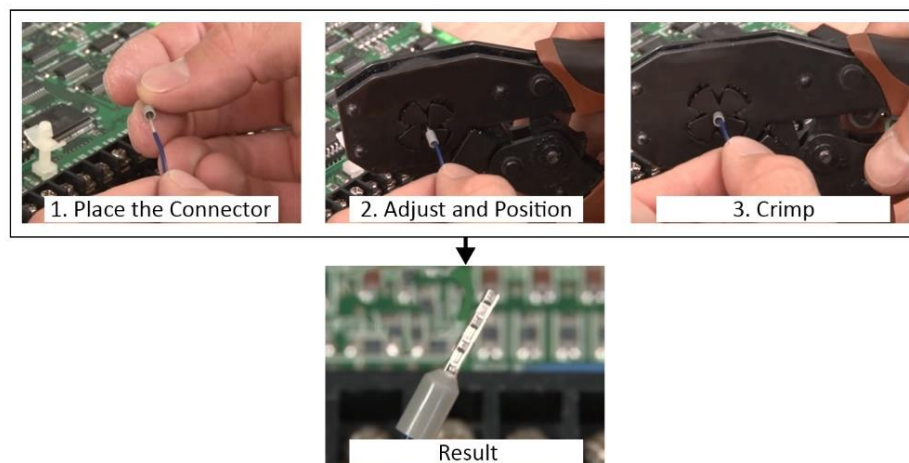
Fig. 3.4.2: Crimping

- In case of crimping, pliers should not be used as the deformity cannot be formed properly.
- If there is air in between the crimp and the connector, it collects moisture. This eventually causes corrosion in the wire and can lead to a connection failure.

Steps for Crimping RJ45 Cable

For crimping RJ45 cable a colour code of the internal wires is to be followed.

- To make a straight cable, the colour code is listed in the following figure:

Orange-White

Orange

Green-White

Blue

Blue-White

Green

Brown-White

Brown

Fig. 3.4.3: Color code for crimping RJ45 straight cable

- To make a crossover cable, the colour code is listed in the following figure:

Green- white

Green

Orange-White

Blue

Blue-white

Orange

Brown-White

Brown

Fig. 3.4.4: Color code for crimping RJ45 crossover cable

The steps for crimping RJ45 cable are as follows:

Step 1: Strip 2 inches of the outer cover from the cable end with a utility knife as shown in the following figure:
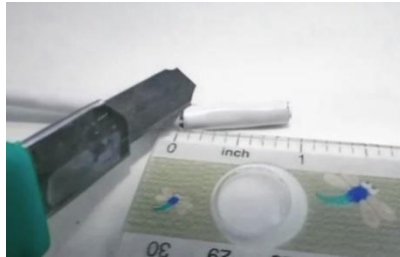
Fig. 3.4.5: Stripping the cable

Step 2: Pull the twisted pairs of wires backward and cut the core as represented in the following figure:
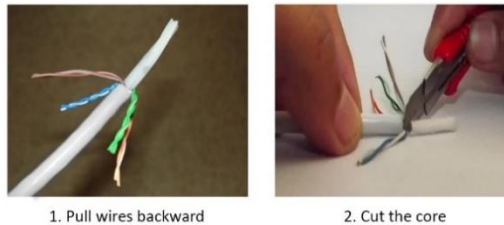
1. Pull wires backward   2. Cut the core

Fig. 3.4.6: Cutting the core

Step 3: Make the twisted wires straight using tweezers and keep them arranged in a row as shown in the following figure:
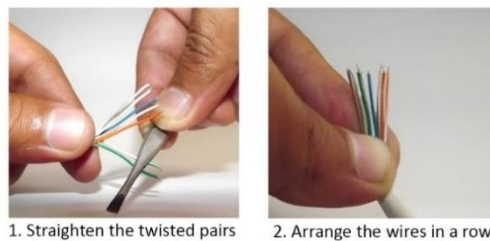
1. Straighten the twisted pairs   2. Arrange the wires in a row

Fig. 3.4.7: Straightening and arranging the wires

Step 4: Place the untwisted wires in a position from right to left according to the color code of the wires and then trim the wires up to a suitable length as shown in the following figure.

Fig. 3.4.8: Trimming of wires

Step 5: The wires are to be inserted into RJ-45 connector. RJ45 connector must be crimped to the cable using a crimping tool by compressing the jacket as well as the cable into the connector in such a way that the wedge at the base of the connector is pushed into the jacket as shown in the following figure:
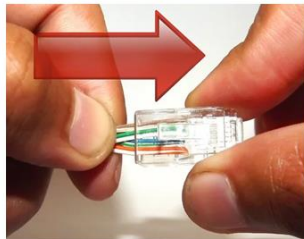
1. Insert into connector   2. Crimp   3. Result
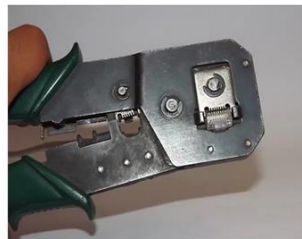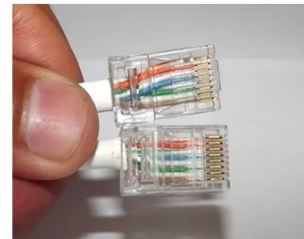
Fig. 3.4.9: Crimping the connector

Activity

Identify the different cables and write down their name in the box given below:

1.

2.

3.
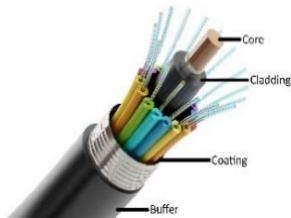
4.

5.
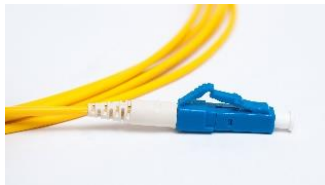
4. Installing Hardware and Software

Unit 4.1 – Installing hardware

Unit 4.2 – Configuring and setting up peripherals

Unit 4.3 – Completing the Installation Process

Key Learning Outcomes

At the end of this module, you will be able to:

- Install the hardware
- Configure and set up peripherals
- Set up the software
- Verify the installations

UNIT 4.1: Installing Hardware

Unit Objectives ◎

At the end of this unit, you will be able to:

- Explain the installation procedures
- Identify the specifications for setting up the system
- Check site conditions and customer requirements
- Connect the system
- Follow standard operating procedures

4.1.1 Installation Requirements – Reading Product Manuals

A field technician is responsible for visiting a customer's site, reading the product or equipment manual and understanding how the equipment works and should be installed. Reading the manual plays a vital role in the correct installation/repair of the product. One of the common causes of non-functioning of components of a system may be its improper installation, which may happen due to non-compliance of user manual instructions. Hence, it is important for a field technician to always follow the process and guidelines mentioned in the product manual.

Product manuals, also known as user manuals, contain all essential information for the user to make full use of the computer system. They include a description of the system functions and capabilities, contingencies and alternate modes of operation and step-by-step procedures for system access and use.

A user manual generally has five sections. The following figure shows the five sections of a user manual:

Sections of a user manual				
Introduction	System capabilities	Description of system functions	Operating instructions	Error handling
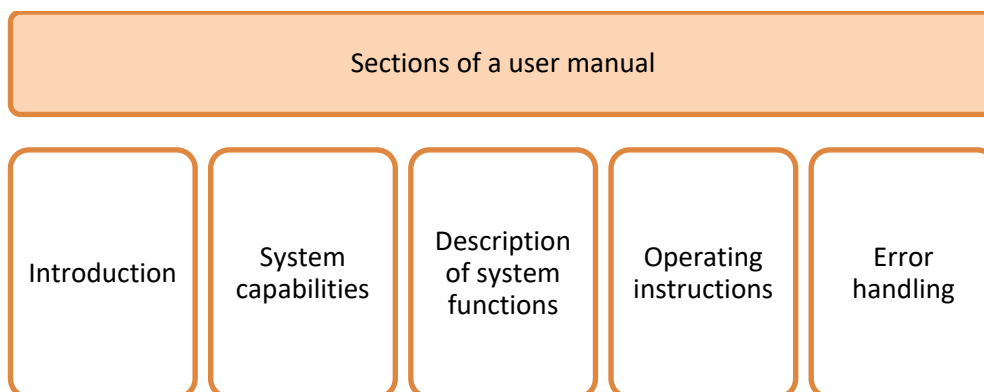
Fig. 4.1.1: Sections of a user manual

There is a help facilities section also available in the manual which describes a help desk facility that the user can contact for error resolution. Help desk telephone numbers are also included.

There are various sections in a typical help book of particular equipment. As a procedure for installing equipment and devices, the field technician should educate and inform the customer about the various help and user tips that can be referred to by the customer when using the system/equipment.

4.1.2 Specifications for Setting up a System

To be utilized productively, all computer software need certain hardware components or other software assets to be available on a computer. These essentials components are known as computer system necessities and are frequently utilized as guidelines as opposed to an absolute rule.

Most of the software specifies two types of system necessities that are the minimum requirements and are recommended. With expanding interest for higher processing power and assets in latest versions of software, system necessities need some increment after some time. Industry experts recommend that this pattern has a greater influence in driving upgrades to existing computer systems than technological advancements.

Some manufacturers of software often provide the consumer with a set of requirements that are different from those that are needed to run usual software. These requirements are generally known as the recommended requirements. They are always at a level above that of the minimum requirements. They show an ideal situation which is required to run the software.

It is also recommended that a field technician, prior to a client visit, checks the site conditions. This will help in the analysis and identification of the actual conditions at a customer's site.

4.1.3 Setting up the System

There are certain steps involved in complete setting up of a new system or new networking device. The following figure lists the main steps involved in a system set up:

Open the packaging of the new product

Take out the hardware/modules carefully

Check the modules inside the package

Connect all the hardware devices such as the central processing unit (CPU), monitor, keyboard, mouse, modem/ router or LAN cable

In case of a laptop, connect the battery, plug in and switch on the system
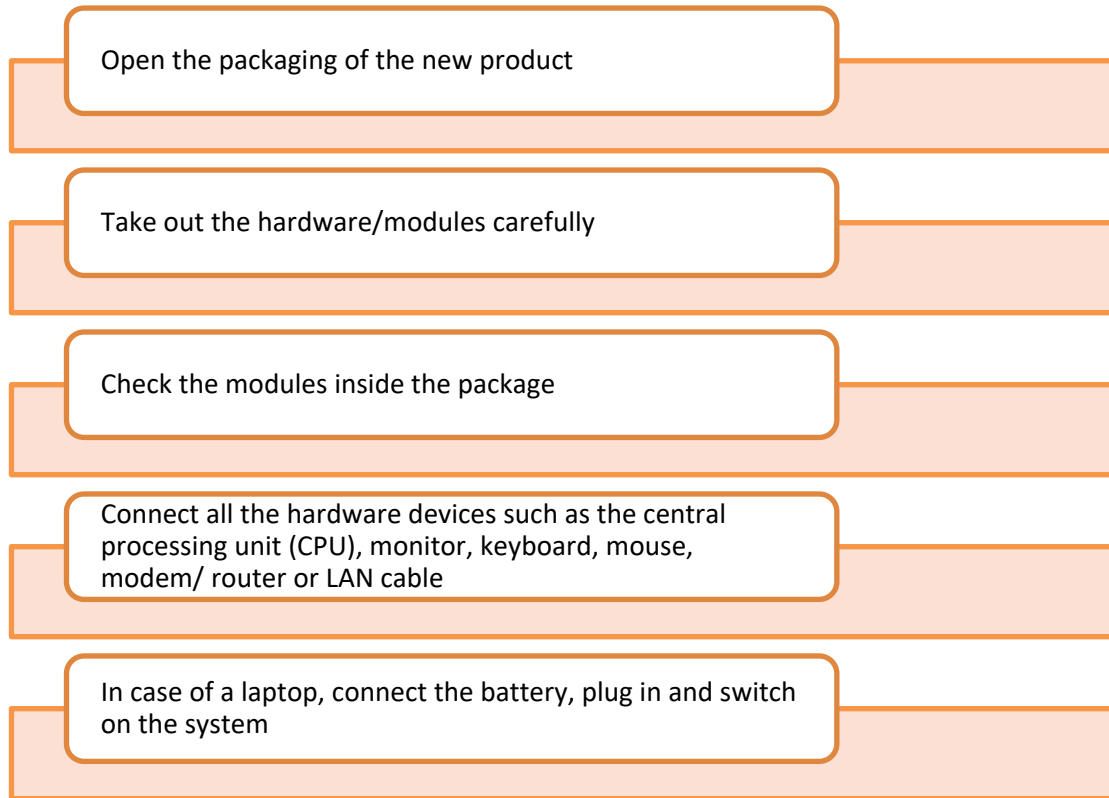
Fig.4.1.2: Steps involved in setting up a system

Open the Packaging

After getting the system to the site, remove the package carefully and check the modules inside it. They should match the checklist.

For example, the following figure represents the steps involved for unpacking the system to ensure proper installation of a new desktop computer:

Inspect outer packaging for any damage	→	Move the package to a convenient place to unpack
Ensure proper levelled space for the product's removal from the package	→	Cut bands around the cardboard covering the cabinet
Remove the cardboard covering from the cabinet, using scissors or a knife	→	Remove plastic bag and the foam packing material
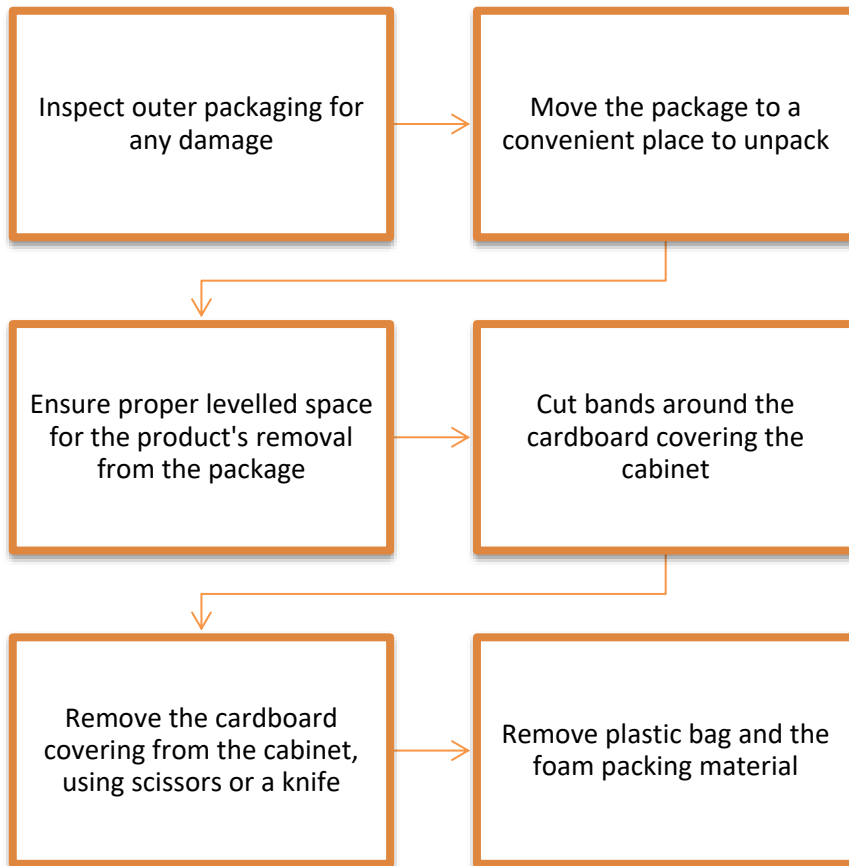
Fig. 4.1.3: Steps for unpacking a system

The tools used for handling and unpacking the system are shown in the following figure:

Utility knife   Cutter

Fig. 4.1.4: Tools used in handling and unpacking a system

Take out the Hardware/Modules

Take out all the hardware/modules carefully from the package. Check and understand the symbols on the package to know about the cautions and warnings related to the installation.

The following figure depicts some common warning symbols along with their meanings:

	A triangle with an exclamation mark within it represents a warning or a notice that is important. .
	A triangle with a hand that is crossed out is the symbol used to represent a product that is sensitive to electroStatic discharge (ESD).
	A triangle with a lightning bolt is a symbol used to represent a warning for the potential of an electrical shock.
	An F with two C's represents the FCC and is a symbol found on a package that meets the FCC (Federal Communications Commission) guidelines.
	An umbrella icon on a package warns that the contents of the package are sensitive to water and should be protected.
	A wine glass with a crack is a symbol used to indicate that the contents of a package are fragile.
	One or two arrows with a line underneath them indicate the direction in which the box should be positioned. The line shows the bottom and the arrows point upwards.

Fig. 4.1.5: Common warning symbols on a package

Check the Modules

To ensure smooth installation, the modules inside the package must be checked so that if any module is missing or any damage is found, it can be informed to the company as early as possible. In addition, do the following things:

- Check all the modules for any damage that may be caused during shipping. If any damage is found, it should be reported to the carrier and the dealer
- Check for any cracks or depressions on the monitor screen
- Match the accessories against the delivery checklist

Connect all the Hardware Devices

After checking all the modules, the next step is to connect all the hardware devices such as mouse, keyboard, Ethernet and so on to their respective ports. Computer ports are connecting points which act as an interface with peripheral devices, which work to communicate with the computer. For making the connection, correct identification of these ports is necessary. These ports are usually located at the backside of the CPU (in case of desktop computers). The following image shows the different connection ports for connecting mouse, keyboard, USB and so on:
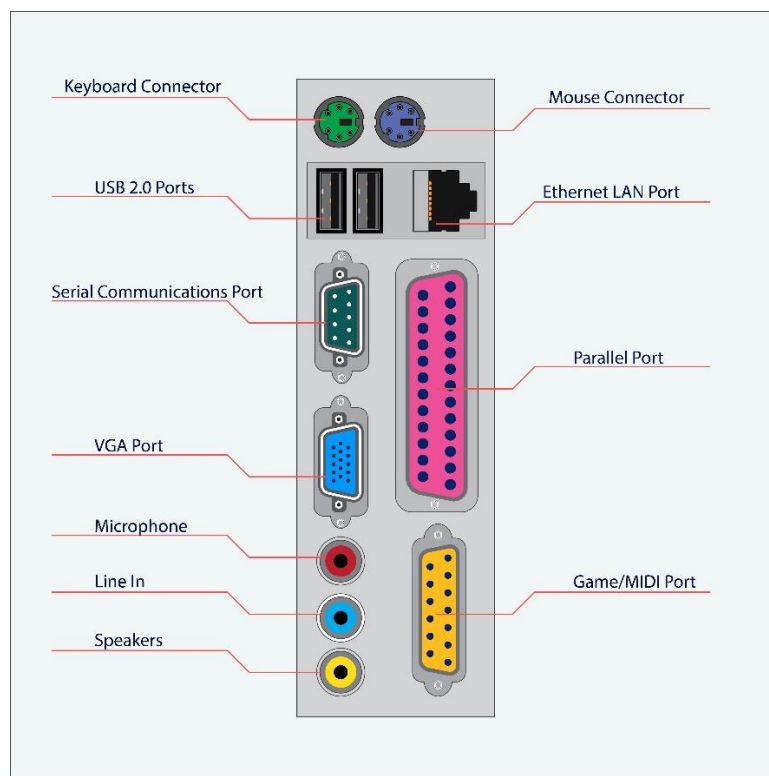
Fig. 4.1.6: Different connection ports in a desktop computer

In the case of laptop computers, the keyboard is attached to the monitor and other connection ports are located on the side of the laptop as shown in the following image:

Fig. 4.1.7: Different connection ports in a laptop computer

Provide Power Source

The last step of the assembling process is to provide power to the computer. In case of a desktop computer, the power can be provided by simply inserting the power plug into the socket and turning it on. In case of laptops, first the battery should be placed into its correct location. It needs to be charged after getting drained. For this purpose, an adapter is used, which generally comes along with the laptop.

4.1.4 Standard Operating Procedures

Standard operating procedures provide a stable platform for performance measurements. All companies, be it small or large, have documented work standards to ensure consistent progress. It is the responsibility of the field technician to follow these standards. The technician should adhere to work standards to meet the targets and achieve sustainability in the workplace. The technician should also follow the safety standards to stay safe while working with electrical and electronic components.

The following figure lists a few standard operating procedures for a field technician:

Fig. 4.1.8: Standard operating procedures for a field technician

ESD

ESD is the sudden build-up of static electricity when two differently charged objects are brought together. While installing and repairing electronic products, ESD is one of the issues that arise, as it can cause damage to the electronic devices and components.

The following figure represents some causes of ESD:
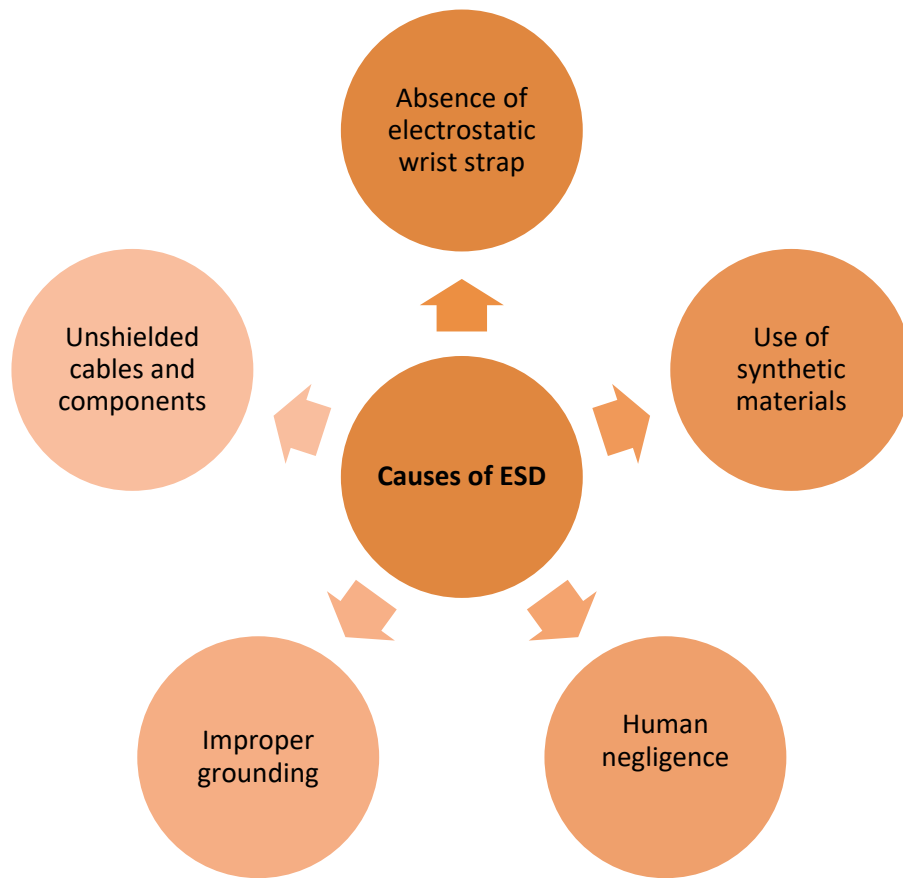
Fig. 4.1.9: Causes of ESD

Activity

Match the following:

1.	⚠	a.	The contents of the package are sensitive to water and should be protected.
2.	⚡	b.	A package that meets the FCC guidelines
3.	☂	c.	A product that is sensitive to ESD.
4.	FC	d.	A warning for the potential of an electrical shock.
5.	⚠	e.	A warning or a notice that is important.

Practical

A customer has recently purchased a new hard disk for his computer since the old one had crashed. Perform a task of installation of new hard disk to the computer.

Component:

Hardware:

1. Phillips and flat blade screwdrivers (small and medium size)
2. A 3-claw part grabber
3. A chip inserter and chip extractor
4. A TORX head screwdriver
5. A 1/4" and 3/16" nut driver
6. A container to hold small parts and screws

Software:

1. Operating system
2. Bootable disk with FDISK.EXE and FORMAT.COM copied onto disk
3. Disk Manager

Practical

Perform the task of Installation of a Network Interface card in a new desktop system in the network.

Hardware:

1. Phillips and flat blade screwdrivers (small and medium size)
2. A 3-claw part grabber
3. A chip inserter and chip extractor
4. A TORX head screwdriver
5. A 1/4" and 3/16" nut driver
6. A container to hold small parts and screws
7. A computer system

UNIT 4.2: Configuring and Setting up Peripherals

Unit Objectives ◎

At the end of this unit, you will be able to:

• Identify the customer's peripheral requirements and their placement
• Connect all the peripherals
• Install the peripherals

4.2.1 Customer Requirements

Understanding the needs of a customer is one of the foremost responsibilities of a technician's job role. This includes the following practices:

• Greet the customer and talk politely
• Understand the customer's requirement
• Provide the best possible and cost effective solution to the customer
• Ensure that the customer is satisfied with the service

When work is allocated, it is important for the field technicians to understand and analyse the requirement before going ahead with the plan of action or visiting the customer's site. This means that they should be able to understand what their customers want and also know how to satisfy their needs. They need to know how to deal effectively with the customers.

Requirement of some customers is such that they ask for additional peripherals apart from those which are provided by the manufacturer. A few of the peripherals which they want are printers, scanners, webcams, microphones, tape drives and speakers. It is important to understand which peripherals should be carried while visiting the customer's site. This can be achieved by talking to the customer prior to the visit.

Further, the technician should place all the peripherals as per the customer's need. Primarily, the field technician must listen to the customer, even if the viewpoint is the same – let the customer vent it off. After the customer has finished, express feeling and then respond accordingly.

Provide immediate response to the problem reported by the customer, if possible. At times, it may mean bending the rules, but customer satisfaction is the key to success and going out of the way can hit the nail on its head.

4.2.2. Connecting and Installing the Peripherals

After the correct placement of the peripherals, the next step is to connect them with the computer. Most printers, scanners, speakers and other peripheral devices are connected to

the system via USB ports. The following figure shows how to connect various peripheral devices to the system:

Locate the monitor cable.

Use the second cable to connect the monitor to the surge protector.

Connect one end of the cable to the monitor port and the other end to the monitor.

Plug the other end to a surge protector.

Plug the keyboard PS/2 connector into the purple port behind the computer.

Plug one end of the first power supply cable into the port behind the computer case.

Plug the mouse PS/2 connector into the green port behind the computer.

Locate the two power supply cables.

Connect the speakers to the computer's audio port.

Fig. 4.2.1: Connection of peripherals

Installing a Printer

A typical printer includes components such as a cord, cable, ribbon and cartridges. Papers placed in the printer's tray are a part of the printing stationary and not of the printer.

The following figure lists the steps to install a printer:

| Install the cartridges in the printer and place paper on its tray | → | Insert installation CD. Run the set up application. | → | Connect the printer to the PC using the USB cable. |

| Turn it on. | → | Print a test page |
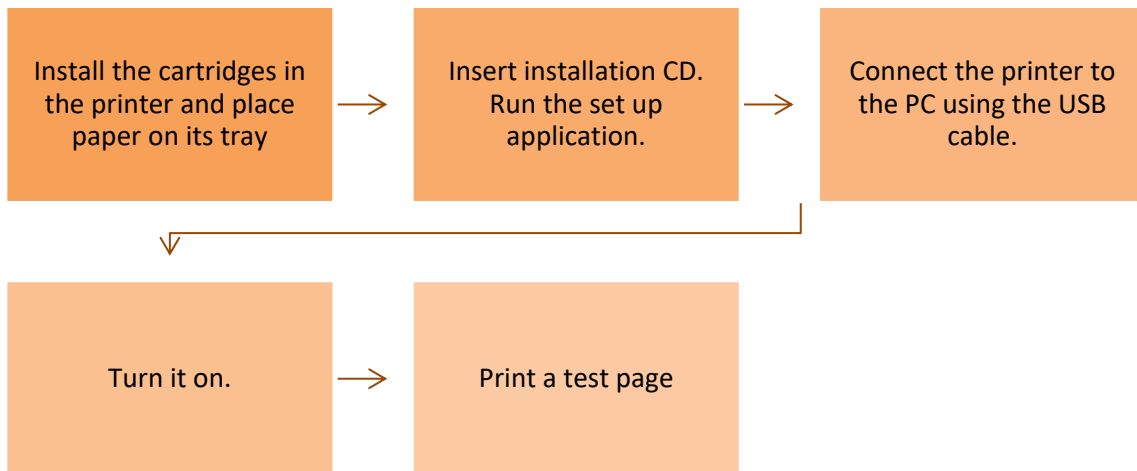
Fig. 4.2.2: Steps to install a printer

Installing a Scanner

The following figure lists the steps to install a scanner:

Turn the scanner on

↓

Click on Found New Hardware pop-up and then click Next.

↓

If scanner CD is avalaible, insert the CD and then click Next.

↓

Click on Start then select Control Panel and type scanners in the Search box.

↓

Click on View Scanners and Cameras link.

↓

Click on Add Device button and then click Next.

↓

Click on Manufacuter list and then click on the model name.

↓

Click on Finish.

↓

Scan a test document to check its functionality.

Fig. 4.2.3: Steps to install a scanner

Installing a Webcam

A very small amount of user input is required to install the modern webcams. Most of the webcams automatically get installed after being plugged in. If they do not get installed automatically, then the driver file from the manufacturer's website needs to be downloaded. The following figure lists the steps to install a webcam:

Plug the webcam into any USB port on the computer.	→	Let the webcam be installed automatically.	→	Insert the CD. (packaged along with the webcam).

Install the software and click on Next.	→	Agree to terms and conditions and then click on Next. Then click on Finish.	→	Run the application and click a photograph to check if it is working.
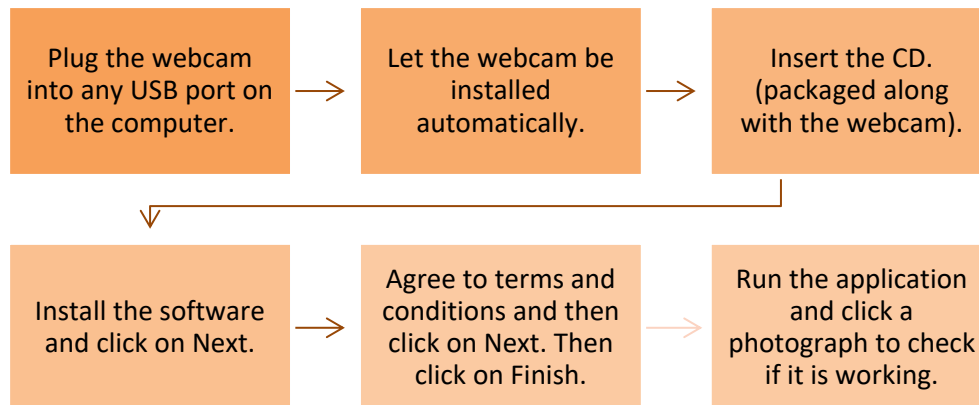
Fig. 4.2.4: Steps to install a webcam

Installing Speakers

There are two types of speakers that can be installed in a system, USB speakers and headphone jack speakers. The following figures list the steps to install both the types of speakers:

Locate the USB slot.	⇒	Plug the USB connector into that slot.	⇒	Set the speakers volume to a desired level.

Play a song to ensure the working of the speakers.
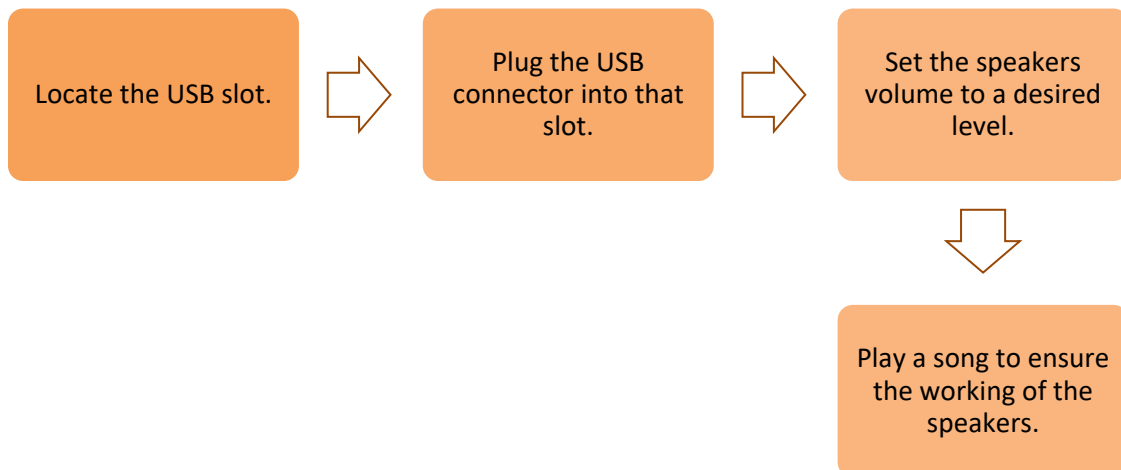
Fig. 4.2.6(i): Steps to install USB speakers

| Locate the headphone jack. | → | Plug the connector into the headphone slot. | ⇒ | Set the volume to the desired level. |

Play a song to ensure the working of the speakers.

Fig. 4.2.6(ii): Steps to install headphone jack speakers
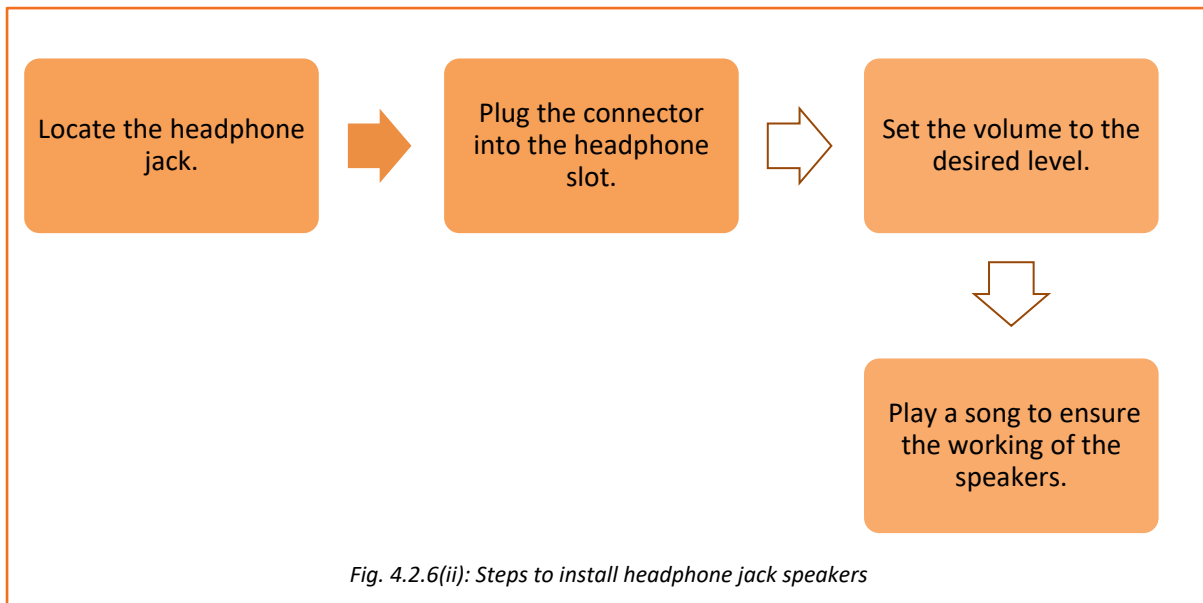
4.2.3. Installing Software

Software is a part of a computer which helps the hardware to function properly. It also helps the input/output devices to communicate with the CPU. It comprises of the operating system along with various programs of the computer.

A field technician is responsible for installing the operating system software on the customer's system. Prior to the installation process, it is mandatory to check the system requirements which include the storage capacity of the hard disk and random access memory (RAM). In addition, he/she should be able to install additional software as per standard customer requirement.

Installing the Anti-Virus Software

Antivirus software, also referred to as anti-malware software, is a software that helps to prevent, detect and remove unwanted, malicious software from a computer. Malicious software or malware is used to harm the computer and disrupt its functioning with the intention of gathering personal information from it. In the absence of good antivirus software, hackers can infect the computers with malware and steal sensitive data such as passwords, personal data and identity.

The following figure shows the steps for standard antivirus installation:

Download the antivirus from its parent website. In case of a CD/DVD, insert it into the computer's CD tray.	Click Install.
Read the license agreement, and accept the terms and conditions.	Wait until the installation is completed, and then click Finish.
After the antivirus is installed, activate it. The computer may now request a 'restart.'	Restart the computer and the antivirus is ready to clean the computer.

Fig. 4.2.7: Steps for standard antivirus installation

4.2.4. Safety Procedures

The field technician must adhere to the safety procedures. There are certain guidelines that must be followed to ensure own safety and that of the co-workers. These guidelines provide a sound, safe and flexible environment to work.

The following figure explains the general safety guidelines that must be followed by a field technician:

Check if the tools and equipment are in a good working condition

Wear personal protective equipment

Keep the work area clean and free from clutter

Maintain proper body posture at work

Follow safety rules and guidelines

Report any breach of safety

Fig. 4.2.8: Safety procedures

Practical ⚒

Perform the steps to install a printer and connect it to a desktop. Test its functioning after installation.

Equipment:
- Working system/Desktop
- Printer and cartridges
- Paper

Hint:

The participant must be able to perform the following steps:

- Install the cartridges in the printer and place paper on its tray
- Insert installation CD. Run the set up application.
- Connect the printer to the PC using the USB cable.
- Turn it on.
- Print a test page

Practical

Perform the steps to install Microsoft Office (MS Office) 2016 on Windows 10.

The participant must be able to perform the following steps:

1. Start the system.
2. Insert the MS Office media disc into the DVD drive.
3. The Windows will launch setup automatically.
4. Enter the product key when prompted and click "Continue." Read the license terms and then check "I Accept the Terms of This Agreement."
5. Click "Continue."
6. If there is a need to install some of the products, click "Customize."
7. Select the first program or tool from the list.
8. Repeat the previous steps for each application or feature.
9. Click "Install Now" to install MS Office on the laptop.

Activity

While testing the laptop you realize that it is not giving audio output. How would you troubleshoot the problem?

Components:

- System with faulty sound card
- Flat/Phillips screwdrivers
- Screws
- Sound card
- Correct drive cables [Integrated Drive Electronics (IDE) or Small Computer System Interface (SCSI)]
- Audio cable to attach CD-ROM drive to sound card
- Installation disk for the new sound card

UNIT 4.3: Completing the Installation Process

Unit Objectives ⊚

At the end of this unit, you will be able to:

- Check the functioning of the system
- Check the functioning of the installed software such as antivirus
- Ensure product functions are tested
- Provide demo to the customer
- Resolve customer queries
- Take feedback from the customer

4.3. 1 Check the System's Functioning

After installing all the required peripherals and software, it is mandatory to check the working of the system, to identify problems (if any) and to ensure its smooth functioning. For computing and display systems, keeping a check on problems at the initial stage ensures the longevity of hardware and software applications. The following figure lists some basics questions that must be answered to ensure the proper functioning of a system:

Is the computer switching on?

Are there any error messages?

Has any new hardware or software been added?

Has the computer been shifted?

Have there been any power outages or electrical storms?

Have all the power cords been reconnected and checked?

Is it a hardware/software issue?

Is there any malware or virus in the computer?

Fig. 4.3.1: Basic questions to answer to ensure the system's proper functioning

In addition, testing should also be performed to check the performance of a system as shown in the following figure:

Hardware Testing

Software Testing

Functional Testing
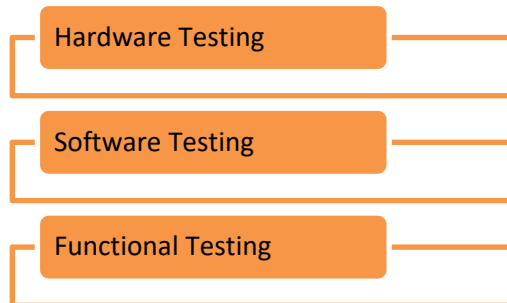
Fig. 4.3.2: Testing required for checking the system's functioning

Hardware Testing

Hardware failures are responsible for problems, such as the computer not getting switched on by the user, getting overheated or appearance of a blue screen. A computer can function only when all the components work well together. Consider a scenario; there is a broken hard drive due to some physical damage, which implies that it does not work. Alternatively, the computer is slow or gives an error message on the screen informing that one of the hardware components is having an issue.

As compared to software issues, hardware issues are harder to tackle, as a process is needed to find out exactly which component is not working properly. Hardware diagnostics is run on most computers. It is used to check the health of the system and detect faults in normal operations of computers.

Software Testing

When testing the software of a computer, the field technician should ensure that correct drivers are installed on that system. The technician should know how to use hardware troubleshooter, how to configure a device and how to download as well as install and update device drivers.

To run the Hardware and Devices Troubleshooter in Windows 7:

1. Select the Start button and click on Control Panel
2. Type 'troubleshooter' in the search box and click on Troubleshooting
3. Select Configure a device under Hardware and Sound tab

To download and install a driver:

1. Select the Start button, enter "device manager" in the search box, and then click on Device Manager.
2. Find the device that needs to be updated.
3. Double-click on the device name.
4. Click the Driver tab and select Update Driver.

To update a device driver using windows update:

1. Select the Start button, type "Windows Update" in the search box
2. Select Windows Update
3. In the left pane, click on Check for updates
4. Select the updates that need to be installed. Then select the check box for the driver that needs to be installed, and then select OK.
5. On the Windows Update page, select Install updates.

Functional Testing

Functional testing can be done at the end. This implies that the computer should be used as desired and then checked to see if its performance is up to expectations. For example, boot up the computer and browse the internet after connecting it to a network through a wireless fidelity (Wi-Fi). This action will check the working of the browser, the functionality of the Wi-Fi hardware and the configuration of the network connection.

4.3.2 Check the Functioning of the Installed Software

After installing the software, it is mandatory to check its functioning. If there is any software problem, it will manifest itself into various issues: freezing of the computer, pages not getting loaded, glitches during playing games or movies from the computer. A computer needs device drivers to perform these functions. If the correct drivers are not installed, it will lead to software issues. The only way to resolve such a situation is to install correct drivers followed by re-installing the software or upgrading the Windows program.

Check the Functioning of an Anti-Virus Software

The typical steps to run an antivirus are shown in the following figure:
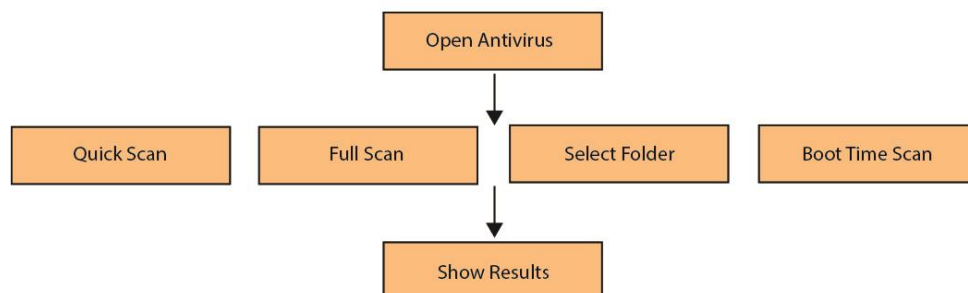
Fig. 4.3.3: Steps to run antivirus software

Open the antivirus user interface by double-clicking the icon on the computer and select any of the following options:

*   Quick scan - This will guide the antivirus to perform a scan on an area on the computer most susceptible to malware infection.

- Full scan – This performs an in-depth scan of the computer. All the files are scanned. It can take time to complete as it is a detailed scan.
- Select folder scan – If malicious files are only in a particular folder, select the folder(s) and perform the scan either on the specific folder or multiple folders.
- Boot-time scan – Some viruses are in the system but they do not show up after the computer is started. Perform a boot-time scan to detect and remove such viruses while booting.

After the scanning is complete (irrespective of the option), a notification will appear with the scan result. If threat(s) is detected, click 'show result' to view the automatic action taken by the software. Action on a threat(s) can also be taken manually.

Providing Guidance to the Customer

Demonstrating a product is a way of promoting or showing the operation of equipment to the users. The goal of demonstrating the workability of equipment, such as a newly installed desktop, peripheral device, software or hardware, to the customer is to make them aware of the operation of that equipment and answer their queries related to its operation.

There is nothing better than a good demonstration session. It is only after a demonstration (demo) that the users understand the operation of particular equipment.

There are a few rules which must be considered while preparing for the demo. The following figure lists these rules:
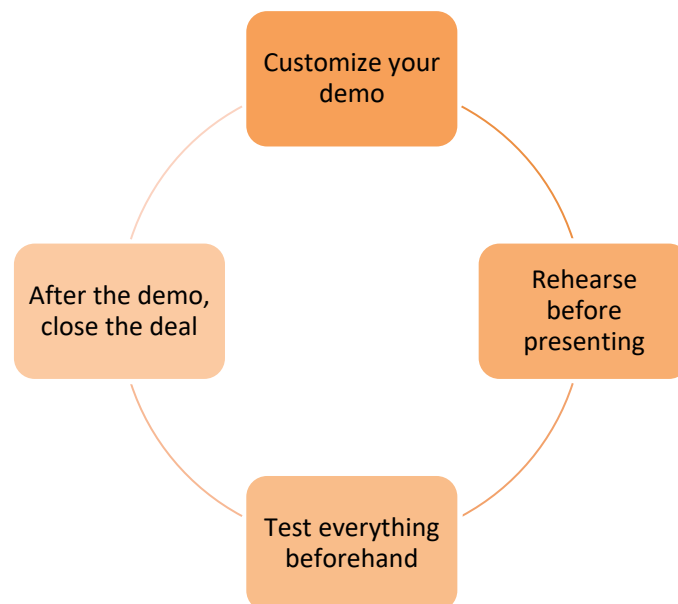
Fig. 4.3.4: Rules to be followed to prepare for an effective demo

In addition, it is the responsibility of a field technician to make the customers aware of the user manual and tell them how to read it.

It can be a user manual which contains instructions for the installation of a software/hardware or it may be a help book giving solutions to common problems that may arise with some equipment. The following figure lists the steps for reading a manual:

Step 1: Determine information	One must be able to determine and read the specified requirement rather than reading the entire document.
Step 2: Scan the document	Scan the document to determine its layout style and get a better idea about the manner in which the content is presented.
Step 3: Find information	Look up for the required information using headings, index or the table of contents.
Step 4: Take notes	It is essential to take notes for any important topic that one may come accross while reading the document. Tips and warnings mentioned in the manual should also be noted.
Step 5: Use glossary	A person may come across technical terms while reading the document. Meanings of such terms can be looked up in the glossary section at the end of the manual.

Fig. 4.3.5: Steps to read a manual

Customers can have varied queries and issues. It the core responsibility of the field technician to respond to them.

Take Feedback from Customer

Just like it is essential to address issues within the facility, it is also important to get feedback of the customer. The customer is always special and the customer's feedback is the most important thing for an organization.

The procedure as shown in the following figure should be followed:

Fig. 4.3.6: Procedure to be followed for taking customer feedback

The time taken to resolve an issue and the difficulties that a customer encountered while communicating the problem should be understood. The misunderstandings observed during the interaction should be clearly documented.

The methods of interaction and behavioural aspects also need to be considered in drawing conclusions after each task or problem handling routine. Getting honest feedback from the clients helps to improve the organizational functioning.

The field technician can get a feedback form filled by the customer at the facility.

The following figure shows a typical template for a customer feedback form:

Customer Feedback Form

Please fill the form. We value your feedback.

Date: _____   Location: _____

Service: Complaint   ☐   New Connection   ☐

1. How would you rate our service?

☐   Very Good

☐   Good

☐   Poor

2. Did the technician come with all the necessary tools and equipment to do the job?

          Yes   ☐   No

3. Did the technician behave politely with you?

          Yes   ☐   No

4. Did the wireman have knowledge of the work to be done?

          Yes   ☐   No

5. Any suggestion which you would like to share.

_____

_____

Fig. 4.3.7: A sample customer feedback form

Practical

Perform the steps to set automatic updates of an antivirus.

Components:

- Desktop/laptop
- An older version of an installed antivirus

5. Installation and Configuration of Storage and Networking Devices

Unit 5.1 – Installation and Configuration of Networking Devices

Unit 5.2 – Installation and Configuration of Storage Devices

Key Learning Outcomes

At the end of this module, you will be able to:

- Install and configure networking devices
- Install and configure storage devices

UNIT 5.1: Installation and Configuration of Networking Devices

Unit Objectives ⊚

At the end of this unit, you will be able to:

- Define networking devices
- Identify networking components
- Define internet, intranet and extranet
- Install networking devices
- Configure networking devices

5.1.1 Networking Devices

Network devices are components which are used to connect computers in a network and other electronic devices to be shared within the network. These shared devices or resources can be printers, fax machines, database servers, and so on. For proper functioning of such devices, it is important to configure and install them properly before their use.

Components of the Network

The passage taken by the data packets (message) from its source to destination can be simple as connecting two computers by a single cable or could be complex as a network that stretches to the globe. The platform that supports the network is known as network infrastructure. The main advantage of network infrastructure is that it keeps the communication channel stable and reliable.

The following figure enlists the three categories of network components that network infrastructure contains:

End Devices

- It act as an interface between communication network and users.
- It is also known as host device.
- It can be a source or destination of the information(message) sent over a network.
- Example of end devices are: Network printers, laptop, workstation, mobile devices (tablet, scannner, PDAs).
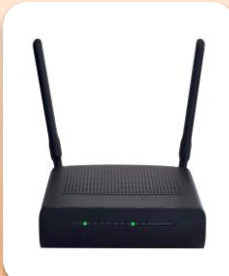
Intermediate Devices

- It is responsible to interconnect end devices and maintain the flow of data over the network.
- It can connect a host to the network or form a internetwork by connecting a group of networks.
- It uses host address along with the information about interconnection of networks, to sent the message on the correct path.
- Example of intermdiate devices are: firewall, router, switch and bridge.
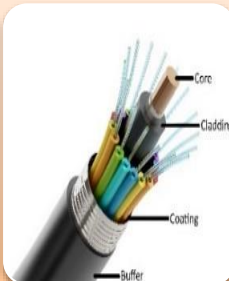
Media Devices

- It provides a path or channel to transmit information over the network.
- It encodes information into electrical signals, electromagnetic waves or visible light depending upon the media through which it is transmitted over.
- Example of media devices are: fiber optic cables and copper cables.

Fig. 5.1.1: Components of networking devices

The physical components of the network are the devices and the media. Whereas, the hardware of the network constitutes of the components such as system (desktop or laptop), wireless access point (WAP), switch router, cables and so on. At times, many components of the network are hidden for example in case of wireless media, the data packets are travelled through the air (using invisible infrared waves or RF frequency).

In addition, components of the network are utilized to provide services and processes. These services and processes are nothing but the communication programs which is commonly known as software, which runs on the networking devices. An example of the services can be common network applications such as email and web hosting services.

Representation of the Network

Network representation can be defined as a visual representation of devices, which are used to interconnect networks. It is helpful in understanding the complex connections of internetwork.

It can also be defined as a language of networking that uses sets of symbols to represent the networking devices as mentioned above in a large operational area.

The following image represents symbols used for networking devices:

End Devices

Intermediate Devices

Media Devices

Fig. 5.1.2: Symbols used for networking devices

5.1.2 Internet

Internet is a network that is available globally. Billions of computers and various electronic devices interconnected together, establish the global system of network. It is possible to

communicate with anyone anywhere in the world and get access to any information. The following image shows Internet connectivity around the world:

Fig. 5.1.3: Internet connectivity around the world

Internet can also be described as the wired or wireless communication network with the help of which one can transmit and receive information for single or multiple operations. By using Internet one can browse different websites, download files, pictures and videos, upload files, listen to music, connect with people and do lots of other things.

Working of Internet

Various devices can be connected to a network with the help of physical cables or via wireless connection such as Wi-Fi and 3G/4G. The following image shows how two computers are connected to the Internet:
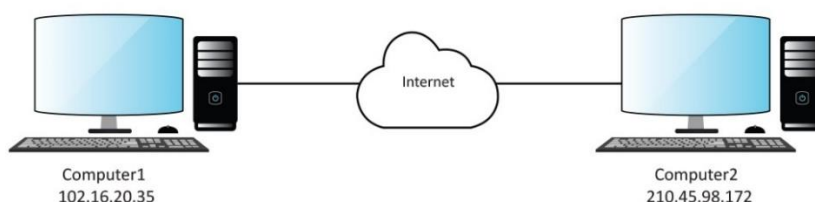
Fig. 5.1.4: Two computers connected through Internet

One computer having IP address 102.16.20.35 is connected to the other computer having IP address 210.45.98.172 via Internet. Internet here can be represented as an abstract object between the two computers. Generally, a cloud symbol is used for depicting Internet.

The following image shows the working of Internet:
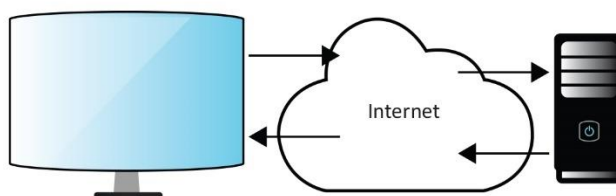
Fig. 5.1.5: Working of Internet

When a website is visited by the user, the browser sends a request to the server over internet. A web server is a computer program which listens to the requests from browsers and executes them. The server after getting the request, locates the required document and returns that to the browser.

Intranet

Intranet is a network of computers that is designed for a group of users. It serves as a private Internet for an organization. The authorized users or the employees of an organization can access intranet from Internet but the number of users is less. For example, intranet is used in an organization to share information with its employees only.

Extranet

Extranet refers to an intranet which can be accessed by authorized users outside the intranet but partially. It enables business to share information in a secure way over the Internet. For example, when an organization wants to exchange some information with another organization such as their customers or vendors, it may provide access to its intranet to the employees of the other organization.

The following image shows the intranet, extranet and the Internet:
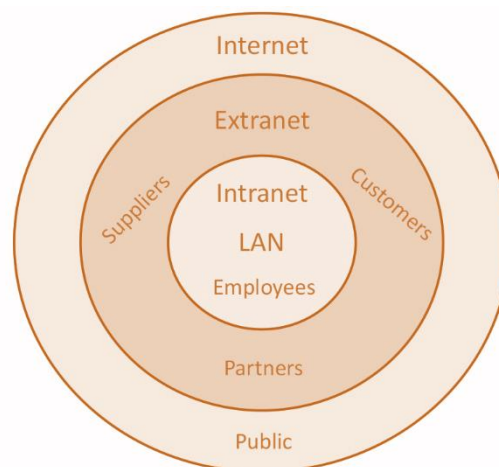
Fig 5.1.6: Intranet, Extranet and Internet

Types of Internet Connection

The Internet access using different types of connections is shown in the following figure:

```
┌─────────────────────────────────┐        ┌─────────────────────────────────┐
│ Hardwired broadband connection  │        │  Wireless broadband connection  │
└─────────────────────────────────┘        └─────────────────────────────────┘
        │                                           │
        ├──┌──────────────────────┐                 ├──┌──────────────────────┐
        │  │       Dial-up        │                 │  │  Satellite broadband │
        │  └──────────────────────┘                 │  └──────────────────────┘
        │                                           │
        ├──┌──────────────────────┐                 ├──┌──────────────────────┐
        │  │ Integrated Services  │                 │  │  Mobile broadband    │
        │  │  Digital Network     │                 │  │        •3G           │
        │  │      (ISDN)          │                 │  │        •4G           │
        │  └──────────────────────┘                 │  └──────────────────────┘
        │                                           │
        ├──┌──────────────────────┐                 └──┌──────────────────────┐
        │  │     Leased line      │                    │        Wifi          │
        │  └──────────────────────┘                    └──────────────────────┘
        │
        ├──┌──────────────────────┐
        │  │        Cable         │
        │  └──────────────────────┘
        │
        └──┌──────────────────────┐
           │ Digital subscriber   │
           │     line(DSL)        │
           └──────────────────────┘
```
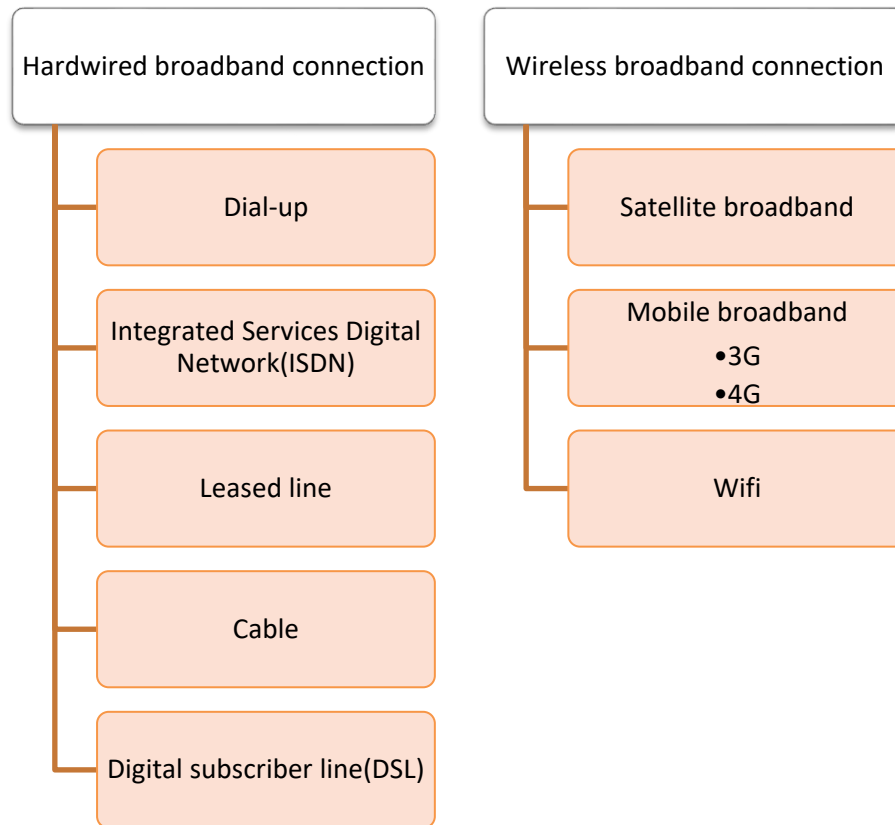
Fig. 5.1.7: Types of Internet connection

Hardwired Broadband Connection

Hardwired broadband connection is set up by connecting the devices with cables. This type of connection is further categorized into:

Dial-up

A dial-up connection is made through modem connected to an active telephone line which is not in use. The phone line is connected to the modem and the other end is inserted into the phone jack. The computer must be configured for the dial-up connection. The user has to dial a specific number that is provided by the ISP to access Internet on the computer.

The following figure shows the dial-up connection:
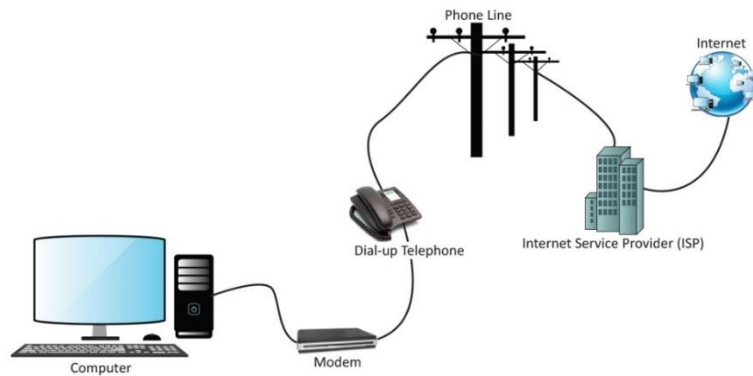
Fig. 5.1.8: Dial-up Internet connection

ISDN

ISDN is a network technology which can transport voice and digital data. Transmission of digital data is carried out over standard phone lines. There are two types of channels in ISDN connection:

- Bearer (B) channel: *B channels* are used for data
- Data (D) channel: *D channels* are mainly used for signalling and control

Various communication services such as voice calls, fax transmissions and so on can be transmitted over ISDN network. The basic ISDN line allows multiple communication devices, having different numbers to simultaneously operate and use parallel connections. End users require special phones or faxes which are capable of making ISDN connections. The following figure shows the ISDN connection:
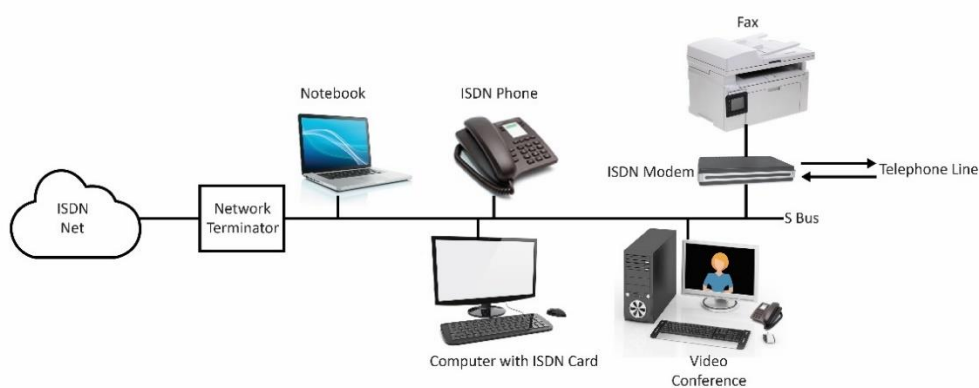
Fig. 5.1.9: ISDN connection

Leased line

Leased line provides a dedicated connection to the network for all time. It offers symmetric data connection having fixed-bandwidth.

The following figure shows the use of leased line:
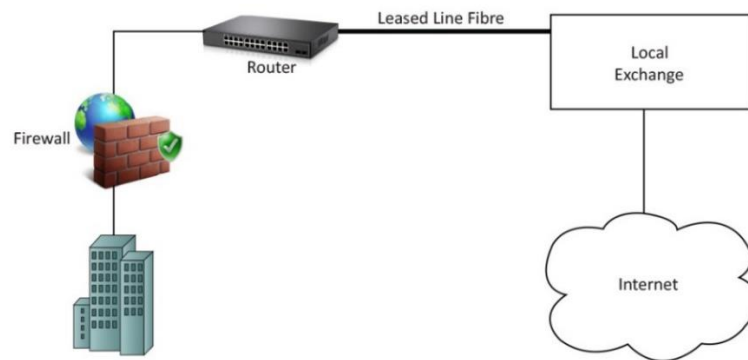
Fig. 5.1.10: Leased line connection

Cable Connection

Cable Internet connection provides access to Internet using a cable modem. Hybrid fiber coaxial cables are used for wiring. It provides network connectivity from the ISP to the end user. The following figure shows the cable connection:
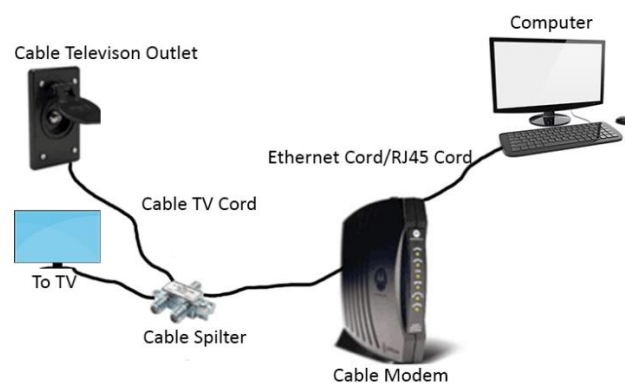
Fig. 5.1.11: Cable Connection

Digital Subscriber Line (DSL)

DSL can be operated using a single telephone line but normal use of the telephone is not affected during the use of Internet.

The following figure shows the use of DSL line for making a connection:
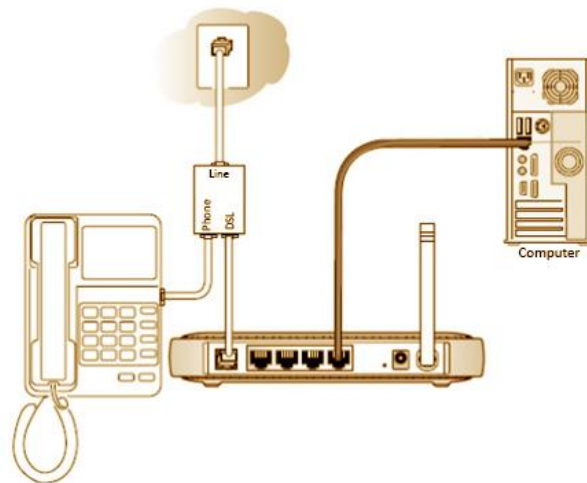
Fig. 5.1.12: DSL connection

Wireless Broadband Connection

Wireless broadband access is further categorized into:

Satellite Broadband

Satellite Internet connection provides Internet access of the following types:

* fixed,
* portable and
* mobile

Satellite connection uses the orbiting satellites for transmitting and receiving data. It is used in those areas where wired broadband technologies such as DSL and cable are unavailable. The following image shows satellite broadband which is used for remote area:

Fig. 5.1.13: Satellite broadband

Mobile Broadband

Mobile broadband provides a wireless Internet access using a USB wireless modem, portable modem, mobile phone and other mobile devices. New mobile technology and infrastructure lead to a change in fundamental nature of the service, peak data rates and new frequency bands every ten years. These changes are known as generations.

Wi-Fi

The full form of Wi-Fi is Wireless Fidelity. Wi-Fi is a communication protocol that facilitates data transfer through wireless connection. The following figure shows Wi-Fi connection:
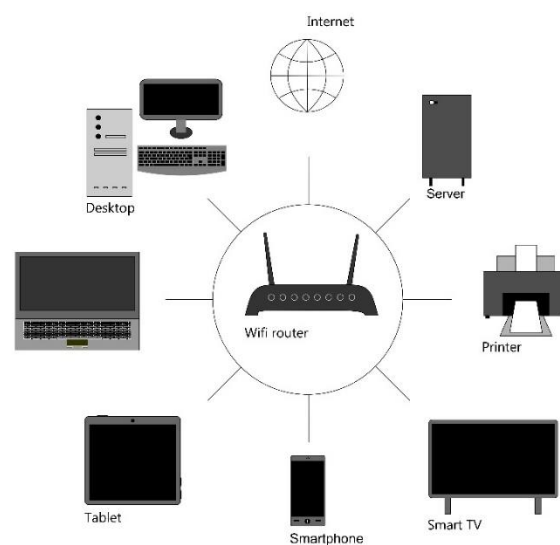
Fig. 5.1.14: Wi-Fi connection

A device within the range of Wi-Fi modem connection can be connected wirelessly to the Internet. The frequencies emitted from the connectivity ranges from 2.4GHz to 5GHz depending on the amount of data over the network.

5.1.3 Installation and Configuration of Networking Devices

Network configuration and installation is defined as the process that allows system administrator to set up network's flow, control and connection to support internetwork communication.

Some common networking devices that are installed and configured in mostly all LANs and MANs are:
- Switch
- Router
- Modem
- Firewall
- Bridge

Configuration/Installation of a Switch

Before installation process, it is necessary to check that all the components must be there which are used to connect switch with other devices.

A package of switch contains following components:

- Console cable
- Network switch
- Power cord
- Installation guide booklet

The steps that should be performed in order to install the switch are shown in the following figure:

| Take a console cable and connect its one end in the console port of the switch. | → | If console port is not there, configure IP address to the swich. | → | Connect other end of the console cable to the COM port of computer. |

| Verify the configuration by checking its functioning. | ← | Install hyperterminal software in computer to make the switch compaitable with it. |
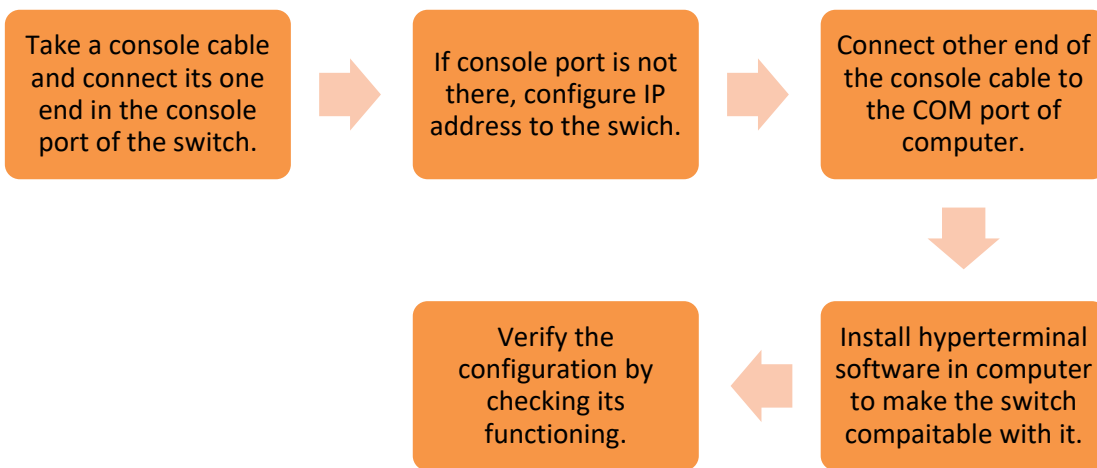
Fig. 5.1.15: Steps to install a switch

Configuration/Installation of a Router

A package of router contains following components:

- Ethernet cable
- Network router
- Power cord
- Installation guide booklet
- Drivers CD

The steps that should be performed in order to install a router are shown in the following figure:
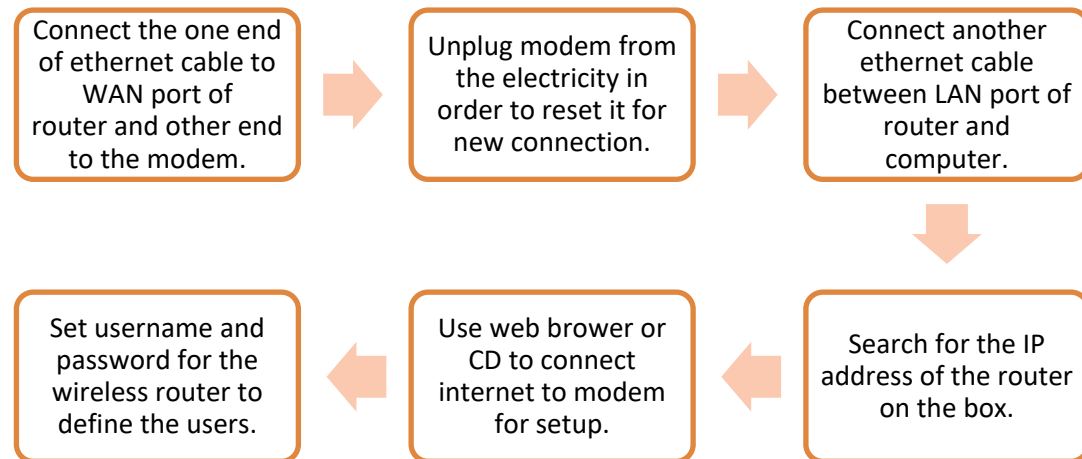
Fig. 5.1.16: Steps to install a router

Configuration/Installation of a Modem

A package of router contains following components:

- Ethernet cable
- Modem
- Power cord
- Filters
- Phone cable

The steps that should be performed in order to install a modem are shown in the following figure:

Set up a connection between filter and phone line to seperate phone signals and modem signals. → Switch on the modem and connect one port of modem to filter with cable. → Connect modem to the computer using ethernet cable.

Check for the signals to verify the configurtaion. ← Set up the internet connection with the help of driver CD or web browser.
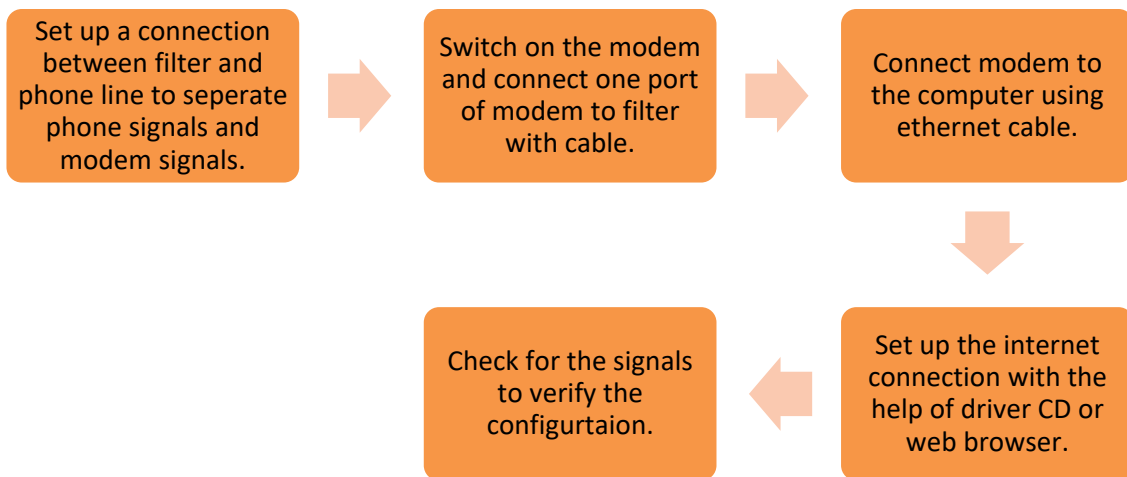
Fig. 5.1.17: Steps to install a modem

Configuration/Installation of a Bridge

The steps that should be performed in order to configure a bridge connection between devices in Windows XP are shown in the following figure:

Turn the computer on

Click on my network places and then right click on network connection to select bridge connections

To select multiple network connection, click to select first network

Now hold ctrl key and select second network connection with a single click

From pop up menu, click on bridge connections.

Windows will create network bridge

Now in the proprties of network adapter, click on bridge properties.

Configure the properties of TCP/IP and assign IP address manually of the bridge.

Fig. 5.1.17: Steps to configure a bridge connection between devices in Windows XP

Configuration/Installation of Firewall

A package of firewall contains following components:

- LAN cable
- Firewall hardware
- Power adapter

The steps that should be performed in order to install and configure firewall are shown in the following figure:

Connect ISP line to the WAN port of firewall.	→	With the help of LAN cable, connect one LAN port of firewall to the switch port.	→	Connect power cord to the firewall and turn it on.

Assign username and password to the firewall.	←	Set up the internet connection and browse IP address of firewall (IP address is available in the LAN properties of firewall)

In the network option on the left side, select maual configuration and assign IP address to it.	→	In the trusted network, assign MAC address which you want to restrict.

Fig. 5.1.18: Steps to install and configure firewall

Activity

Match the following.

1.	Hardwired Broadband Connection	a.	is a network technology which can transport voice and digital data.
2.	Dial-up	b.	provides a dedicated connection to the network for all time.
3.	ISDN	c.	is made through modem connected to an active telephone line which is not in use.
4.	Leased lines	d.	is set up by connecting the devices with cables

Practical

Perform the task of installing and configuring of CSF (Config Server Firewall) on CentOS 7.

Hardware/Software:

1. System
2. CentOS 7
3. Root privileges

The participant must be able to perform the following steps:

1. Install the dependencies for CSF.
2. Install CSF.
3. Configure CSF.
4. Basic CSF commands.
5. Advanced Configuration.

Practical

Perform the setup of a home network router and then configure the network security features.

Hardware/Software:

1. System
2. Router
3. Ethernet cables
4. Browser

The participant must be able to perform the following steps:

1. Choose a suitable location for placing the router
2. Connect the computer to the router.
3. Open the administration console of the router.
4. Update the MAC address of the router.
5. Configure addition network security features.

UNIT 5.2: Installation and Configuration of Storage Devices

Unit Objectives ⊚

At the end of this unit, you will be able to:

- Install storage devices
- Configure storage devices

5.2.1 Storage Devices

Storage devices, also called storage media, are hardware devices which are used to store data or information. It can store information temporarily or permanently. These devices can be added to computers externally or internally.

Network Attached Storage (NAS)

NAS is a file storage device which acts as a server and is linked to a computer network facilitating data access to different group of users. The following image shows NAS:

Fig 5.2.1 Network attached storage drive

NAS functions as a self-sufficient computer which is linked to a network. It provides data storage facility to the devices connected on the network. NAS utilizes its OS and other software programs to allow the users to access the data and files.

The following figure lists some advantages of NAS devices:

Easy to operate

Low on cost

Simple to use for data back-up

Good at centralizing data storage in a safe, reliable way
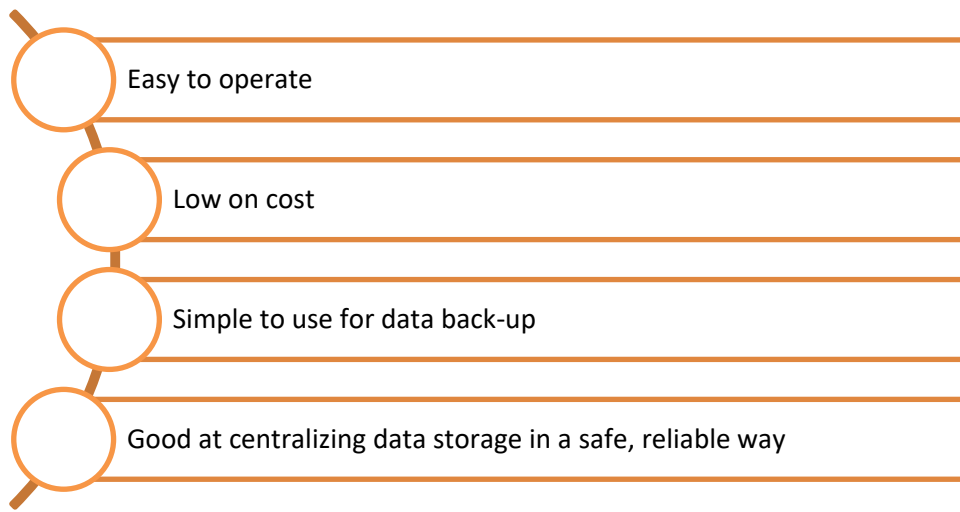
Fig. 5.2.2: Advantages of NAS devices

5.2.2 Installation and Configuration of Storage devices

The configuration and installation process of some storage devices are as shown:

Configuration/Installation of CD/DVD Drive

After the setting up of software and other hardware, it is essential to install storage devices.

The steps that should be performed in order to install CD/DVD are shown in the following figure:

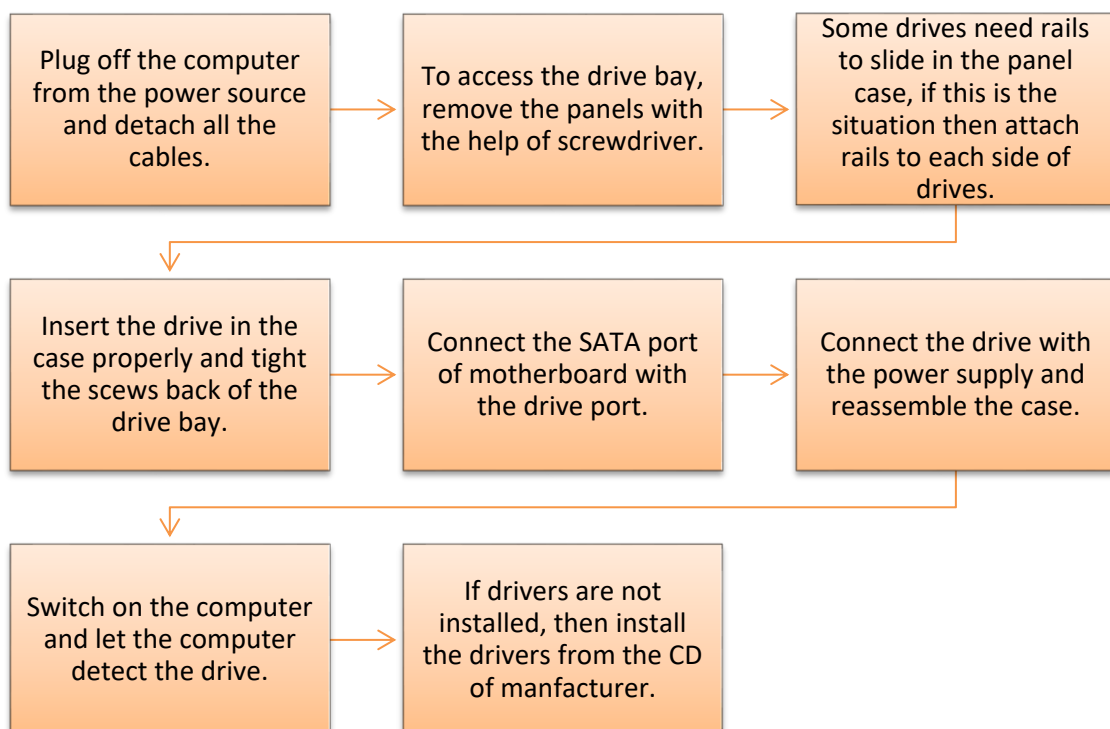| Plug off the computer from the power source and detach all the cables. | → | To access the drive bay, remove the panels with the help of screwdriver. | → | Some drives need rails to slide in the panel case, if this is the situation then attach rails to each side of drives. |
| Insert the drive in the case properly and tight the scews back of the drive bay. | → | Connect the SATA port of motherboard with the drive port. | → | Connect the drive with the power supply and reassemble the case. |
| Switch on the computer and let the computer detect the drive. | → | If drivers are not installed, then install the drivers from the CD of manfacturer. | | |

Fig. 5.2.3: Steps to install a CD/DVD Drive

Configuration/Installation of Hard Drive

The steps that should be performed in order to install hard disk in the computer are shown in the following figure:

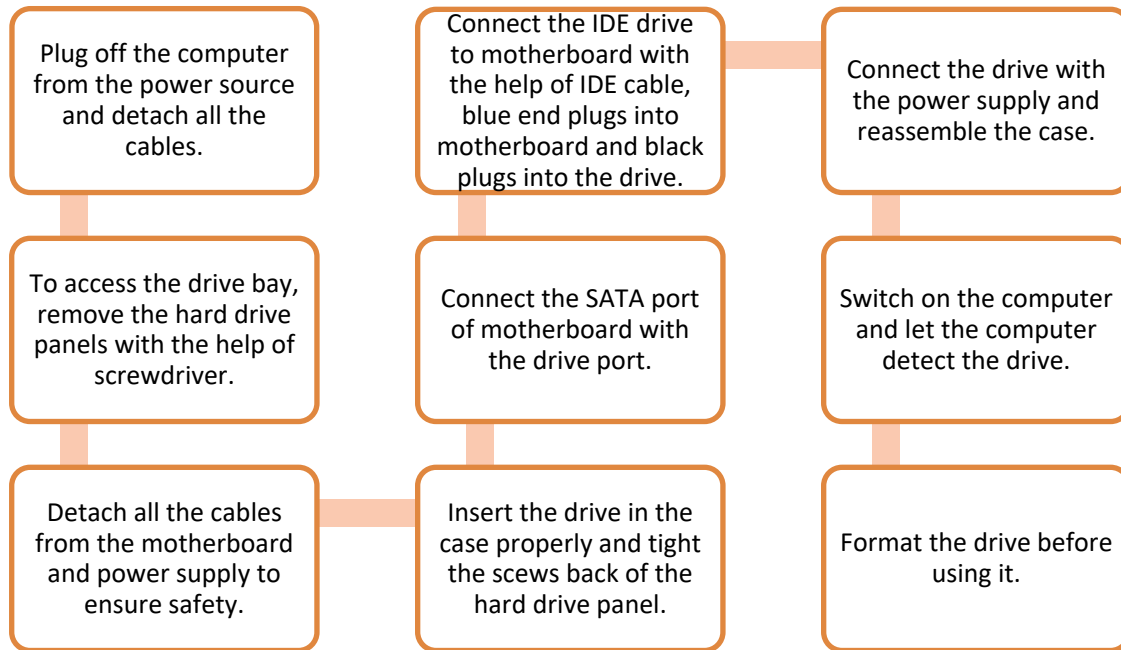|		
Plug off the computer from the power source and detach all the cables.	Connect the IDE drive to motherboard with the help of IDE cable, blue end plugs into motherboard and black plugs into the drive.	Connect the drive with the power supply and reassemble the case.
To access the drive bay, remove the hard drive panels with the help of screwdriver.	Connect the SATA port of motherboard with the drive port.	Switch on the computer and let the computer detect the drive.
Detach all the cables from the motherboard and power supply to ensure safety.	Insert the drive in the case properly and tight the scews back of the hard drive panel.	Format the drive before using it.

Fig. 5.2.4: Steps to install a hard drive

Practical

A customer has recently purchased a new hard disk for a computer since the old one had crashed. Perform a task of installation of the new hard disk on the computer.

Components:

Hardware:

1. Phillips and flat blade screwdrivers (small and medium size)
2. A 3-claw part grabber
3. A chip inserter and chip extractor
4. A TORX head screwdriver
5. A 1/4" and 3/16" nut driver
6. A container to hold small parts and screws

Software:

1. Operating system
2. Bootable disk with FDISK.EXE and FORMAT.COM copied onto the disk
3. Disk Manager

6. Troubleshooting of Networking Devices, Storage and Other Components

Unit 6.1 – Understanding Customer Complaints

Unit 6.2 – Troubleshooting Process

Unit 6.3 – Completing Repairs

Unit 6.4 – Reporting to Superior

Key Learning Outcomes

At the end of this module, you will be able to:

- Classify customer complaints
- Identify system level problem on field
- Troubleshoot storage and other devices
- Complete the repairs
- Report to superior
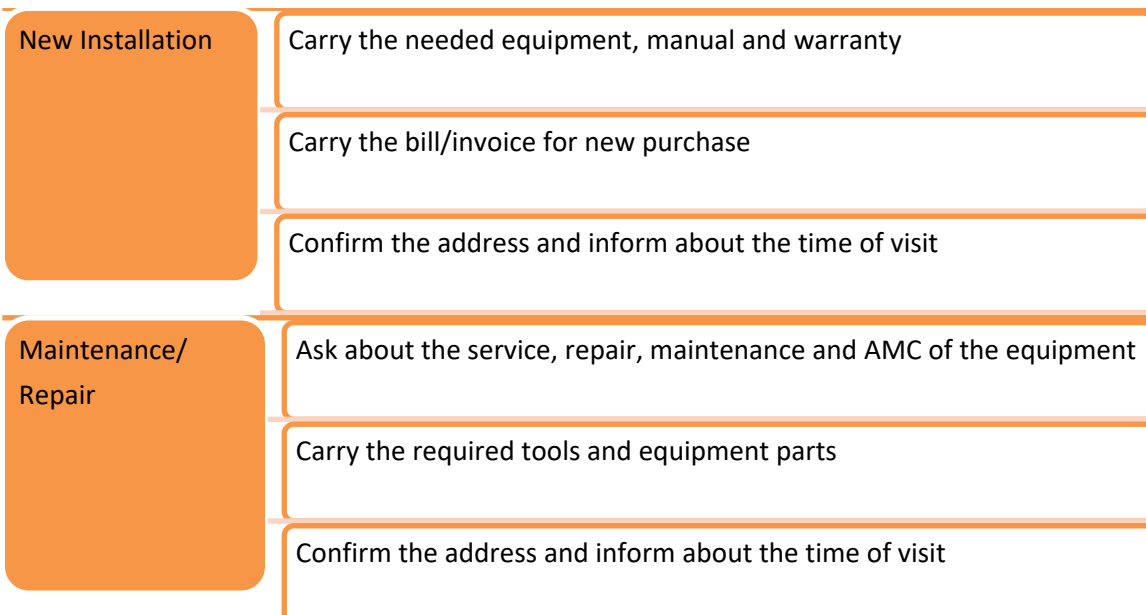
UNIT 6.1: Classify Customer Complaints

Unit Objectives ⌖

At the end of this unit, you will be able to:
- Identify the concerns of the customers
- Interact with the customer on phone
- Commence field trip based on the type of complaint
- Explain product warranty, terms and conditions
- Identify the type of problem and carry relevant tools and equipments
- Assess to do replacement or repair
- Carry approved and verified replaceable parts

6.1.1. Identify the Concerns of Customers

A field technician is responsible for the installation or repair/maintenance of the computer and its peripherals. When work is allocated, it is important to understand and analyse the requirement before going ahead with the plan of action or visiting the customer's site. The following figure shows the main tasks involved in the role of a field technician:

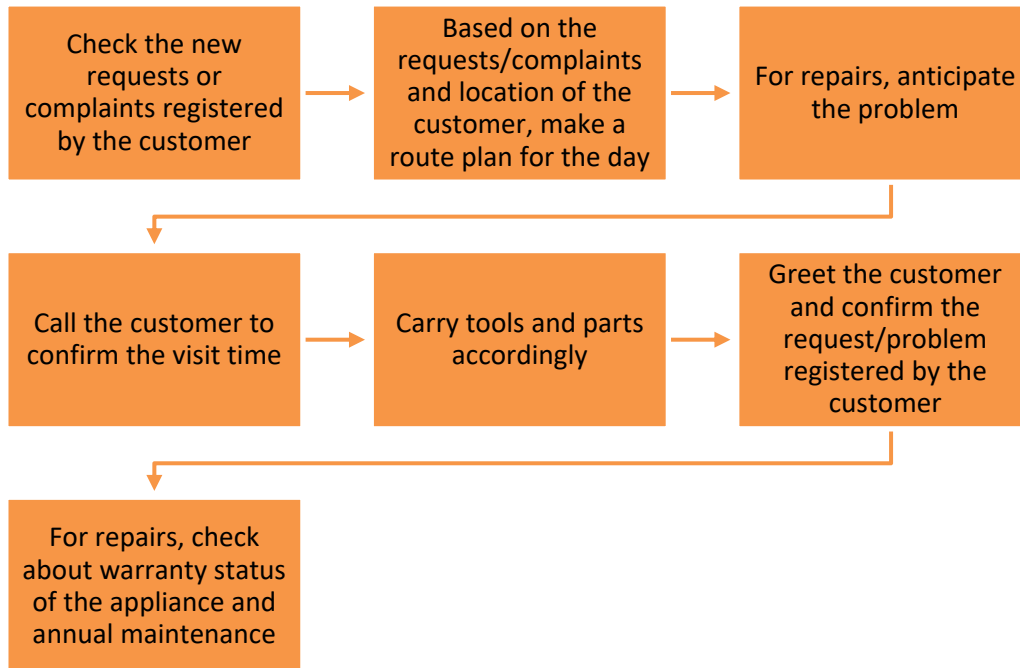| New Installation | Carry the needed equipment, manual and warranty |
	Carry the bill/invoice for new purchase
	Confirm the address and inform about the time of visit
Maintenance/ Repair	Ask about the service, repair, maintenance and AMC of the equipment
	Carry the required tools and equipment parts
	Confirm the address and inform about the time of visit

Fig. 6.1.1: Workflow for installation and repair

Before visiting the customer for installation or repair, it is important to understand the requirement of the customer.

The following figure represents the various activities which should be done before a visit to the customer's site is scheduled:
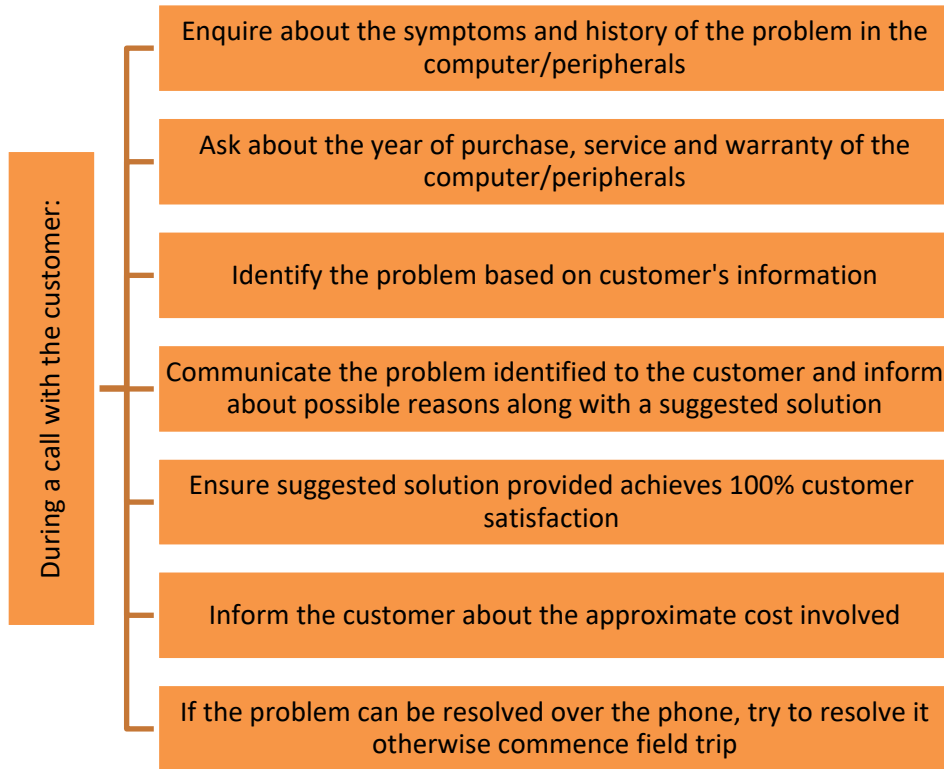
| Check the new requests or complaints registered by the customer | → | Based on the requests/complaints and location of the customer, make a route plan for the day | → | For repairs, anticipate the problem |

| Call the customer to confirm the visit time | → | Carry tools and parts accordingly | → | Greet the customer and confirm the request/problem registered by the customer |

| For repairs, check about warranty status of the appliance and annual maintenance |

Fig. 6.1.2: To-do list for a technician

6.1.2. Interact with Customer on Phone

Prior to visiting the customer premises for repairing/servicing of the computer, it is important to know the details of the problem and accordingly suggest a corrective measure. This can be achieved by calling the customer and asking them about the problem in detail and then suggesting them a possible solution. It is also important that the customer should be satisfied with the suggested solution.

The following figure highlights the to-do list to be followed on a call with the customer before visiting the customer's premises:

During a call with the customer:

- Enquire about the symptoms and history of the problem in the computer/peripherals
- Ask about the year of purchase, service and warranty of the computer/peripherals
- Identify the problem based on customer's information
- Communicate the problem identified to the customer and inform about possible reasons along with a suggested solution
- Ensure suggested solution provided achieves 100% customer satisfaction
- Inform the customer about the approximate cost involved
- If the problem can be resolved over the phone, try to resolve it otherwise commence field trip

Fig 6.1.3: To-do list to be followed on a call with the customer

6.1.3. Troubleshooting

Troubleshooting refers to the repair of faulty products or processes. Troubleshooting begins with searching the source of a problem and ends with finding the solution to that problem to ensure that the product or process functions properly. Good troubleshooting consists of the following four steps:

- Identification of the symptoms of a problem
- Elimination of the causes of a problem
- Verification of the solution
- Restoration of the product or process

In other words, the first thing to do is to identify the symptoms that are causing a failure in the system. The next step is to diagnose the cause of that malfunction, till a solution is reached. This is followed by returning the product to its original state.

Proper knowledge and understanding of the behaviour of each of the components that make up a computer system is necessary.

The field technician should follow some simple steps for troubleshooting as shown in the following figure:

Identify the exact nature of the problem by observing symptoms ▸ Isolate the cause of the problem by testing the likely causes ▸ Resolve the problem
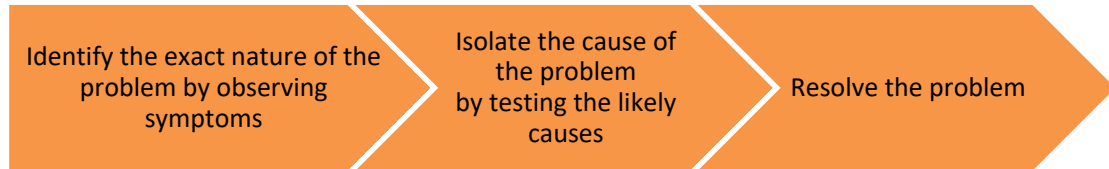
Fig. 6.1.4: Steps for troubleshooting

6.1.4. Understanding Product Warranty and ID

A field technician should know the terms and conditions of buying a product and should be able to read and understand the warranty provided. The field technician should search for information such as shown in the following figure:

Tenure of the warranty

Time of beginning and expiring of the warranty

The conditions that may void the coverage

The contact details to get warranty service

What the company will do if the product fails–replace the product or refund the cost

Parts and issues covered

Coverage of consequential damage

Conditions or limitations of the warranty (some warranties provide coverage only if you maintain or use the product as directed)

Fig. 6.1.5: Required warranty information

In addition, the field technician should be able to make the customer understand about the warranty details.

Reading Serial Number and Product ID

The field technician should have the knowledge of the product labelling of any software or hardware component. Serial number and product id uniquely identify the component. The format of serial number varies with the type of product and its manufacturers. The series of letters and numbers in a serial number may specify the manufacturer information, country of origin, year of production and number of unit. The following image shows serial number of a product:

Fig. 6.1.6: Serial number of a product

The following figure lists some examples of serial number and product id of different products:

Fig. 6.1.7: Serial number and product id of different products

The field technician should be able to find the product identification label for different products. For a notebook, the identification label may be in a different location as shown in the following figure:

| At the back | Inside battery compartment | Under a cover on the back |

Fig. 6.1.8: Identification label at different location

Software serial numbers, also known as product keys, are included on the CD with its packaging.

Reading Manufacturing and Warranty Date

A field technician should know how to read the manufacturing and warranty date as per the product whether it is hardware or software. It helps in educating the customer about the life time of the products and how to maintain them for longer use. These dates are available on the back side of the product box and in the documents also.

The following figure shows the manufacturing date on different products:

Fig 6.1.9: Manufacturing date on different products

6.1.5. Problem Identification

The most important step of identifying the problem is to determine whether the problem is caused by a failure of hardware or software.

Software Problems

Software problem manifests itself as freezing of computer, pages not getting loaded or glitches during playing games or movies from the computer. A computer needs device drivers to perform   these functions. If the correct drivers are not installed, it will lead to software issues. The only way to resolve such a situation is to install correct drivers followed by re-installing the software or upgrading the Windows program.

Hardware Problems

Hardware failures are responsible for problems such as when the user is not able to switch on the computer or is faced with a blue screen or overheating of the computer. A computer can function only when all the components work well together. Consider a scenario, where there is a broken hard drive, which implies that it doesn't work. Alternatively, the computer can also mean that it is slow or gives an error message on the screen informing that one of the hardware components is having an issue.

As compared to software issues, hardware issues are harder to tackle as a process is needed to find out exactly which component is not working properly.

After identifying the type of problem, the field technician must decide whether to replace or repair the faulty part. It is also important to carry approved and verified replaceable parts.

Practical

A customer has recently purchased a new hard disk for their computer since the old one had crashed. Perform a task of installation of new hard disk to the computer.

Component:

Hardware:

1. Phillips and flat blade screwdrivers (small and medium size)
2. A 3-claw part grabber
3. A chip inserter and chip extractor
4. A TORX head screwdriver
5. A 1/4" and 3/16" nut driver
6. A container to hold small parts and screws

Software:

1. Operating system
2. Bootable disk with FDISK.EXE and FORMAT.COM copied onto disk
3. Disk Manager

UNIT 6.2: Troubleshooting Process

Unit Objectives ⊚

At the end of this unit, you will be able to:

- Identify the customer's problems at their premises
- Use appropriate tools and equipment
- Perform root-cause analysis
- Disassemble and check each part of the computing system
- Follow standard operating procedures
- Identify the solution design and troubleshoot the storage devices
- Perform soldering
- Identify and fix the errors

6.2.1. Identify the Customer Problems

Within an organization, a customer's issues are reported to the field technician either through an email or through a telephone call. These issues are logged into the system by the field technician or by the reporting person. Depending on the severity of the issue, the issues are resolved by the field technician.

There are many cases where the issues cannot be resolved remotely and need the field technician to visit the customer's facility for resolution. When the field technician visits a customer's facility, then there are certain work processes that they need to follow.

There are some common work processes at the customer's facility that a field technician needs to adhere to.

The following figure lists these work processes:

Read and understand the service request to know the problem of the customer.

Be aware of the policy and restrictions to be followed at the customer's facility.

Seek details of the problem/issue.

Understand the configuration of different systems, architecture and layout.

Check for the IT hardwares such as storage, network devices, computers and server systems.

Resolve the issue by replacing the faulty module. If any external support is required, contact the appropriate person.

Fill the required documents such as service bill, service report, log book and so on.

Take feedback from the customer in the organization's feedback form.

Fig.6.2.1: Common work processes at the customer's facility

6.2.2. Assess Applications and Equipment in Use

The field technician should be aware of the types of applications that run on the systems of customers and the importance of these applications to the customer. Furthermore, they also need to be aware of the critical hardware used at the customer's facility. Typically, server systems and network configurations are the most critical equipments and hardware in any organisation.

To analyse and identify the critical applications and hardware at customer's site, the field technician should follow some key points, as shown in the following figure:

Acquire knowledge about the work processes and support service policies of the organisation

Identify the type of applications that are generally run on the computers by the customer

Identify the hardware and peripheral devices used

Identify and assess the criticality of the issue that the customer is facing

Assess the impact of the faulty module on other hardware

Assess the probable loss that may happen if there is a system breakdown

Fig. 6.2.2: Key points for assessing critical issues

Also, the field technician should check the call log database to be aware of similar problems faced by other customers. This helps in faster resolution of issues and thus saves time and effort. Therefore, it is imperative that based on the log database, the field technician stocks the replacement spares for regularly occurring problems.

For example, a customer reports that the router is not working properly. The customer has also tried switching the modem on/off and unplugging the router. The field technician has tried to resolve the issue remotely by suggesting the customer to check the router connection and its software setting. But the problem is not resolved. The light on the router is on but it's not able to access the internet.

Now, the field technician would typically check the log database and from there come to know that the primary issue in such cases is that the cable is not connected to the WAN port of the router or there is a problem from Internet service provider (ISP). Therefore, when he visits the customer site to resolve this issue, it is ideal for him to carry a new router and cables along with the invoice.

6.2.3. Perform Root Cause Analysis

Field technician needs to identify whether the root cause of the problem lies in the hardware of networking devices or software. Hence, they need to troubleshoot the related components to look into the details of the problem.

For example, the client's modem is not working properly. To resolve the problem, the field technician should check:

- Whether there is a problem in the connection
- Or in the modem
- Or in the driver installation

In addition, a field technician should be aware of fault tolerance and fault handling techniques. Fault tolerance means the ability of a system to continue working in the event of a fault that may be due to hardware or software. It becomes easy to troubleshoot a device when the system is equipped with these techniques.

Fault handling means that once the fault has been identified, the field technician should be aware of all possible causes and their corresponding resolutions.

The overall action plan for handling software faults is shown in the following figure:
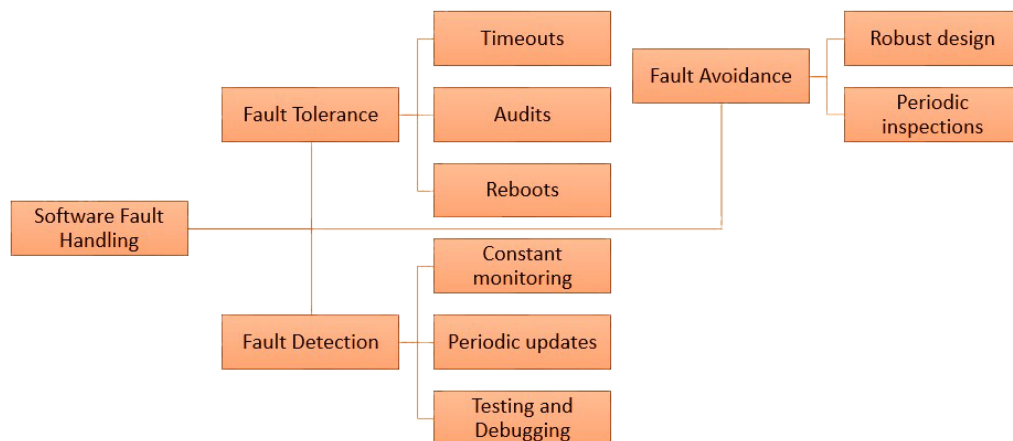
Fig. 6.2.3: Action plan for handling software faults

The overall action plan for handling hardware faults is shown in the following figure:
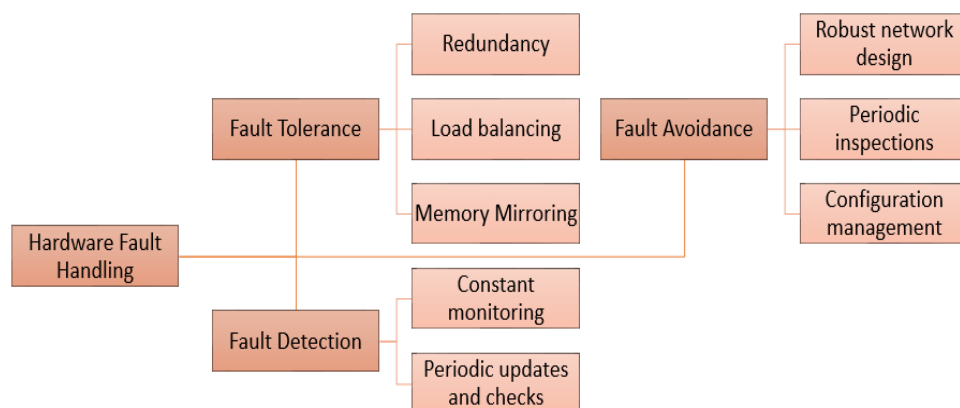
Fig.6.2.4: Action plan for handling hardware faults

6.2.4. Disassembling the System

The desktop or laptop needs to be disassembled and then again assembled if the components inside a laptop or a desktop need to be repaired or cleaned. The steps to disassemble a desktop are shown in the following figure:

Shut down the system.	Remove the power cable, then remove the cable from SMPS (switch mode power supply) from the back of the CPU cabinet.	Remove the external devices such as keyboard, mouse, monitor, printer or scanner from the back of CPU cabinet.

Remove the adapter cards (video and sound cards) and unscrew the card screw. Hold the card (front and back edges) and gently rock it lengthwise to release it.	Pull data cables off from the Hard disk drive, CD/DVD/Blue-ray drives, floppy disk drive as well as motherboard connector.	

Remove the screws and slide the drive out of the back of the bay	Memory modules are mounted on the motherboard. Handle the chip only by the edges	The power supply is attached into tower cabinet at the top back end of the tower. Detach it from the switchboard

Remove the motherboard's power connector, including CPU fan power connector, cabinet fan and the front panel of cabinet power buttons.	Remove the screws of SMPS from the back of the cabinet and detach the SMPS from the tower cabinet	

Remove the screws from the back of the motherboard and detach it from the cabinet	Remove the CPU fan from the motherboard. Remove the heat sink by pulling the tab upward	Finally, remove the processor by pulling back the plastic tab and stretching it side ways.

Fig. 6.2.5: Steps for disassembling a desktop

The steps to disassemble a laptop are shown in the following figure:

Remove the battery and power adapter	Undo the screws and remove the back cover	Remove the hard drive by pulling it in the opposite direction to its data pins
Lift the RAM to an approximately 30-degree angle from the bottom surface of the laptop. Gently slide the RAM out of its connector and out of the slot	Lift the Wireless card to an approximately 30-degree angle and gently slide the card out of its connector and out of the slot	Remove the 'Hinge Cover Plate' and keyboard
Remove any other cable under the keyboard	Remove the display unit	Remove the motherboard and motherboard peripherals

Fig. 6.2.6: Steps for disassembling a laptop

6.2.5. Identifying and Fixing Errors/Issues

A networking system consists of networking devices and peripherals to maintain the flow of data from one computer to another through the networking devices. Usually, networking hardware is reliable but it may get damaged over a period of time. It is essential to maintain the hardware system to keep the system functional. In addition, the software also needs to be maintained periodically. For example, a modem helps the computer system to access internet. A proper set up and installation of driver files is important to run the modem properly.

There may be certain circumstances when networking devices are not maintained properly and various issues are faced by the operator. When a field technician is called up for the repair, then he/she should be efficient enough to find the issue and fix them accurately.

Software Issues on Windows

A field technician should ensure that correct drivers are installed on the system, while searching for software issues in it. The individual should know how to use the hardware troubleshoot options, how to configure a device and how to download as well as install and update device drivers.

Using Windows 7 Troubleshoot Option:

- Select the Start button and click on Control Panel.
- Type"troubleshoot" in the search box and click on Troubleshooting.
- Select configure a device under Hardware and Sound tab.

Download and Install a Driver:

- Select the **Start** button, enter "device manager" in the search box and then click on **Device Manager**.
- Find the device that needs to be updated.
- Double-click on the device name.
- Click the **Driver** tab and select Update Driver**.**

Update a Device Driver Using Windows Update:

- Select the **Start** button, type "Windows Update" in the search box.
- Select **Windows Update.**
- In the left pane, click on **Check for updates.**
- On the **Select the updates you want to install** page, select the check box for the driver that needs to be installed, and then select **OK.**
- On the **Windows Update** page, select **Install updates**.

Soldering

Soldering is the process of joining two or more objects that are usually made of metal by melting and pouring a filler metal, called solder, into the joint. The solder component has a lower melting point than the other two metals that are to be joined.

While replacing the faulty parts, soldering of some components may be required. So, a field technician should have a basic knowledge of how to use the manual hand soldering iron unit to solder the components or parts. The following figure shows a typical soldering process:
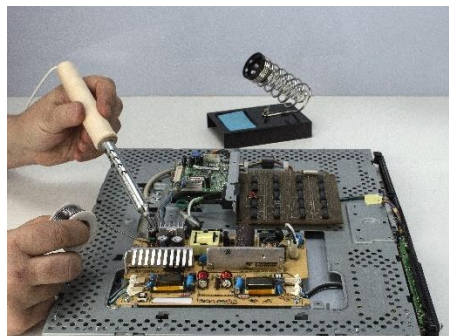
Fig. 6.2.7: Soldering process

Soldering Procedure

The steps of soldering technique are as follows:

Step 1: Heat up the soldering iron sufficiently.

Step 2: Clean the soldering iron with a damp sponge, if it is dirty. If a soldering station is used, adjust its temperature.

Step 3: Apply suitable flux to remove any type of oxide when soldering.

Step 4: Coat the soldering iron's tip with a thin layer of solder. This process of tinning helps in transferring heat between tip and the component to be soldered.

Step 5: Use pliers for bending the lead of the component being soldered so that it can easily be embedded

Step 6: Hold the soldering iron and place the iron tip in such a way that it touches both the surface and the lead of the component on the board.

Step 7: Touch the solder to the iron tip and move that around the joint by keeping the iron tip fixed. Let the solder melt and flow till the joint is covered.

Step 8: Remove the iron after removing the solder and make sure that the joint is kept stationary till it cools down.

Handling Issues Not within Scope

There may be certain circumstances when a field technician is unable to resolve the software or hardware problems at customer sites. Some of the typical examples of such cases are:

- Some systems, such as ERP or data management systems, where a lot of customization has been done for the client by the service provider or the implementation partner, the customization is like a black box for an IT service engineer. This is because its code/program may not be shared. Also, there might be a separate team to support these systems.
- There are some hardware servers or systems which are under the control and support of an external vendor. Thus, the service engineer may not have any role to play in this scenario.

In both the scenarios, one may take external support or escalate the issue. However, if one is not sure under whose purview the issue lies, a senior person should be consulted before approaching the problem.

Escalate Problems to the Vendor

Software developers write code to meet the client's requirements in such a way that only they can understand the system's behaviour. So, it is difficult to troubleshoot such a system and also time consuming. It is always recommended to take external support of the developer to solve such issues.

Escalate Problems to a Senior

If the field technician is not aware of the developer of a particular system, then it becomes difficult to contact and resolve the issue. In most of the organizations, there is a list of all software and systems that are being used. This list also contains a point of contact for each software or system. To refer to this list, a senior person should be consulted.

6.2.6. Identify the Faulty Module and Perform Troubleshooting

The table lists some basic troubleshooting tips of networking, storage devices and other components:

New Component	Issue	Actions
Router	No connection message id displayed on the computer	• Switch off the router • Unplug from the adapter and wait for a few minutes. • Reset the connection and configure it.
	Access Denied to internet	• Reboot the computer and plug off the system. • Check the cable connections. • Check network drivers are properly installed. • Check whether the adapter is working properly.
		• Check the temperature of the router. • Sometimes overheating causes blockage of vents. • Put the router in an airy place for proper airflow.

		• Reposition the router
		  o Sometimes signals get blocked due to large metallic objects like microwave or cordless phones.
		  o Ensure that the router's antenna is placed vertically rather than horizontally.

		• Change configuration settings of the router
		  o Reset the router to its default factory settings
		  o Reconfigure the router and change the name of the wireless network including passphrase.

		• MAC address restriction
		    o Some router allows MAC address filtering.
		    o Make sure that the MAC address of the router should be included in the connection list of computers.
		    o Either MAC address filtering can be disabled.

Modem	Link light doesn't come on	• Disable all the connections.
		    o Check whether the ethernet cable is connected to the port of the computer.
		    o Check the cable type.

	Poor connectivity	• Plug off the modem from the adapter. • Change the location of the modem. • Reconfigure all the settings of the modem.
	No connection	• Turn off the modem and unplug all the devices from the phone socket including modem, filters and other devices. • Connect the telephone into the socket without filter and check whether the dial tone is free from any noise interference. • If handset is working fine, then plug modem directly into the phone socket. • Connect computer with the modem and try to visit a website. • If site is not opening, check the cable connections or try connecting the modem with the help of new ethernet cable.
		• Connect the modem directly with the phone socket. • Connect the filter and other equipments one by one. • If modem gets disconnected while connecting filters and other equipments, there is a problem with the other devices. • Check for the faulty part and replace it with the new module.

	Modem light is continuously blinking	• Check the connectivity of the telephone line, receiver, fax machines and other equipments. • They should be connected with the filters except modem. • Connect phone cable directly to the wall outlet. • Check whether any interference is there in phone line. • Reboot the computer and reconfigure the modem settings.
		• Check the connection of router with the modem • Connect modem directly to the computer • Change the IP address in case it is a static IP address.
	Ethernet light is not lit	• Check the connection of ethernet cable with the modem. • Remove and re-insert the cable in the modem. • Bypass the router and connect the modem directly with the computer. • Check the cable that connects the modem with the computer.
Switch	No connectivity between switches	• Check the connection between all the switches by passing signals. • Check that there is proper neighbour ship formed between them. • Check for the MTU mismatch between router and switch.

		• Ping the device
		  o Ping the device to check the connectivity between console and switch.
		  o Check the connection of switch by using show interface command
		  o Check the cable connections.
		  o Check the duplex and speed of the switches.
		  o Make sure that all switches are running on same IOS version.

	Duplex and speed mismatching	• Enable auto negotiation on network ports and at the user ends. • Manually change the duplex and speed settings on both sides of the switch.
Firewall	Setup problem	• Check all the cable connections for the link light. • Cable should be cross over. • Ping the appliance IP address. • Set the computer IP address as per the appliance IP address for proper communication.
	Internet connection is absent	• Set the user name and password for the appliance as required by ISPs • Set the host name, domain name and MAC address on the set-up page of appliance. • Set the static IP address on the static IP and DNS page of appliance.
	Cannot receive mail from the server	• Check the domain name of the server. • It should be fully qualified domain name.

	Problem in network connectivity	• Check the connectivity by performing connectivity test from source server to receiver server.
		  o Open command prompt on server and check connectivity of telnet.
		  o If the command prompt hangs, try to ping the router.
		  o Use proper domain name and IP address.
		• Check for the proper domain name, IP address and the ports of server.

Bridge	Slow transfer speed	• Turn off the bridge for a few minutes. • Pair the bridges manually. • Do factory reset on the bridge manually. • Again, pair the bridges. • Unplug the client unit and connect it to the computer or laptop. • Make sure that the Wi-Fi is off. • Now check the connection between the client and the computer. • Ping the computer

	No connection	• Ping the computer.
		  o Check the cable connection between the switch and the router to which it is connected.
		  o Check the IP address of the system.
		  o Check the network interface card drivers.
		• Ping the bridge
		  o An error in reply indicates improper connection.
		  o Check cabling between the switch and the bridge.
		  o Change the duplex settings of bridge. Set the speed and duplex settings manually.
		• Ping the server
		  o In case of error, check the hub, cabling and the network card.
		• Check the IP properties of server.

Hard Drive	Computer does not boot and no error message appears on the screen	• Check whether the BIOS supports drives.
		  o Turn off the computer and remove the new drive
		  o Shift the jumper onto the alternate-capacity jumper.
		  o Remount the drive in the computer
		  o Insert a bootable system diskette into drive A and turn on the computer.
		  o Insert the Disc Wizard diskette into drive A
		  o Type A: XDM and press ENTER.
		  o Follow the Disk Manager instructions
		  o Install the dynamic drive overlay and partition and format the new drive
		  o Reboot the system

	Blank screen when the system is powered up	• Plug-in the monitor. • Ensure the video card is in its slot • Secure it with mounting screws. • Turn off the computer • Remove the drive host adapter • If the screen turns on after the reboot, the host adapter may be incompatible or defective.

	The system does not recognize the drive	• Check all the cables • Check the power supply • Reboot the computer • Check whether the drive motor starts up • If the drive motor does not start up, recheck all the drive cables. • Check the drive-type listed in the system setup program for each drive • Press the CTRL+ALT and DELETE keys simultaneously to reboot the computer • If the computer has a turbo switch, set it to slow speed before turning the computer on. • If there is no turbo switch, use keyboard commands. • Return the processor to the fast speed after the computer is running, • Or warm-boot the computer after every power-on. • Check for I/O address conflicts. • Ensure that the drive and host adapter are compatible with the computer. • Turn off the computer • Take out the peripheral adapter cards except for the video card and host adapter. • If the computer recognizes the drive after rebooting, turn off the computer. • Reinstall the other peripheral cards, one at a time, until the conflict reoccurs. • Isolate the source of the address conflict • Resolve the conflict by changing the I/O address of the peripheral that appears to cause the conflict. • Check that there is no diskette in drive A and reboot.

	The system hangs in FDISK or fails to create/save the partition record	• Check all the cables • Ensure that the setup system diskette is not corrupted. • Use a backup diskette • Make smaller partitions • Change the interrupt jumper setting on the host adapter. • Disable the Track 0 protection feature in the system setup program before using FDISK. • Re-enable this feature when FDISK is done.
	The DOS message "Disk Boot Failure," "Non-System Disk" or "No ROM Basic - SYSTEM HALTED" appears	• Use the DOS SYS utility to reinstall the DOS system files. • Check all the cables. • Use FDISK to verify that the primary partition is active. • Check for viruses.
	The system error message, "HDD controller failure" appears	• Confirm the jumper settings on the drive. • Verify the drive-type settings in the system setup program

	System in-operative. Keyboard lights are on, power indicator lights are lit and hard drive is spinning.	• Expansion card is partially dislodged from expansion slot on the motherboard.
		  ○ Turn off the computer.
		  ○ Ensure all expansion cards are securely seated in slots
		  ○ Press down firmly on expansion card, using even pressure on both ends of the expansion card.
		• Defective floppy disk drive or tape drive.
		  ○ Turn the system off.
		  ○ Disconnect the cables from one of the floppy drives. Turn on the system and check to see if the keyboard operates normally.
		  ○ Repeat until the defective unit has been located.

	System does not boot from hard disk drive but can be booted from floppy disk drive	• Check the connector between hard drive and system board
		  o Check the cable running from the disk to the disk controller on the board.
		  o Check that both ends are securely plugged in
		  o Check the drive type in the Standard CMOS Setup
		• Damaged Hard Disk or Disk Controller.
		  o Format the hard disk
		  o If unable to do so, the hard disk may be defective.
		• Hard Disk directory or FAT is scrambled.
		  o Run the FDISK program
		  o Format the hard drive.
		  o Copy the backup data back onto the hard drive.

	System only boots from Floppy Disk. Hard Disk can be read and applications can be used, but booting from Hard Disk is impossible	• Hard Disk boot program has been damaged.
		  o Create back up of data and applications files.
		  o Reformat the Hard Drive.
		  o Re-install the applications and data using backup disks.
		  o Check the cable running from the disk to the disk controller on the board.
		  o Make sure both ends are securely plugged in.
		  o Check the drive type in the Standard CMOS Setup

	Screen message says, "Invalid Configuration" or "CMOS Failure"	• Check the configuration program. • Replace any incorrect information.
	Cannot boot system after installing second hard drive.	• Ensure that the master /Slave jumpers are set correctly. • Run SETUP program and select correct drive types.

New Network Card	Unable to connect to a server	• Load the driver and ensure that the protocols are bound. • Check the Device Properties list • Use the diagnostic utilities to test the NIC adapter • Check if additional networking software needs to be installed.
Monitor	Picture is not visible	• Check the signal cable connections • Ensure that the computer is switched on • Check the brightness control
	Screen not in the center position	• Adjust the H-Size, H-Phase or V-Size, V-Center controls. • Check the signal timing of the computer
	Too bright or too dark screen	• Check the Brightness or contrast control • Check the specified voltage • Check the signal timing of the computer system • Check the horizontal frequency.
	The screen is shaking	• Move all the objects such as a motor or transformer, which emit magnetic field, away from the monitor. • Check the specified voltage • Check the signal timing of the computer system

The following table lists some common system problems and their solutions

Issue	Diagnosis	Solution
A Program is Not Responding.	The Computer is Frozen	• Press the Ctrl +Alt and Delete keys simultaneously. • Open the Task Manager and highlight the program's name. Then press the End Task button. • Manually turn off the computer by pressing the on/off button. • Once the computer responds again, run a virus check.

New Hardware or Software is Working Incorrectly.	Incompatibility Issue with System Configuration	• Check that the computer meets the requirements of the program or utility. • Uninstall the program and then reinstall it.
PC Not Connecting to the Network through LAN	Problem in Network Configuration	• Go to network setting and check that the Ethernet is enabled. • Check the working of the modem. • Check all the wires and connections. • Check the LAN card. • Check the IP Address and DNS settings.
No Power	Improper Connection Faulty PSU or SMPS Unit	• Ensure that the power cord is plugged into the supply. • Check whether PSU is putting out enough voltage. • Switch off the computer and detach all the devices. • Reinstall each device one by one. • Switch on the computer after each device. • If the system does not come on after installing a particular component, replace it. • Check the SMPS unit. • If the system doesn't come on after reinstalling all the devices, it may be a motherboard or CPU problem.
Computer Doesn't Power Up		• Ensure that the power cable is connected to the CPU and to the monitor. • Check the power socket. • Replace the power socket with a different one, or if power extension board is used, plug the power directly into the socket. • Replace the power cable. • Check if the LED at front of the monitor is in On position. If yes, then CPU must be at fault. • If LED at CPU is in On position then it might be a monitor issue. • If none of the LEDs are in On position, then it may be a local power issue.

| Blank Screen, Nothing Appears on the Screen | Improper Connection or Display Settings | Check if monitor and CPU power is in On position. Check if monitor is plugged into the CPU. Ensure that the power cable is plugged into the monitor and is not loose. Some CPU has multiple ports for display, check each port by plugging in securely. When the power button is pressed on the monitor and some status is displayed, it means the power to the monitor is in On position and the screen display is okay. Check the cable running from the CPU to the monitor. Check the brightness level using the menu button on the monitor. It may have been set to dark. Check that the computer is not in the screensaver or sleep mode. |

Some Common problems and their Solutions

Problem/ Symptoms	Action
No Operating System Found or Similar Message	- Ensure that the system is set to boot from the right device. - Ensure that the proper boot order is listed under the Boot menu. - Remove any non-bootable DVD from the drive. - Ensure that the boot drive is the first option. - Once boot drive is found, the OS begins to load it.
Non-Working Devices/Device Not Recognized	- Ensure that cables are plugged in. - Ensure that the cables are firmly connected to the device - Check that the add-on cards are seated in their slots. - Check the device drivers. - Try to reinstall the device driver or download the latest version. - Try to uninstall and reinstall the device.

Problems After Installing New Software or Device Driver	• Uninstall the software or driver • Return the system to a previous working state by using System Restore. • Try to boot to Safe Mode and then perform a restore. • Restart the system • Press the F8 key continuously. • Select Safe Mode from the menu displayed and press enter. • Start system restore.
Nothing Happens when Power Button is hit	• Check the power connection. • Ensure that the wire from the case power button is connected to the right connector on the motherboard. • Check the power connections to the motherboard. • Check the floppy power cable. • Unplug everything from the motherboard except power cable, power button wire, video card, memory and processor. • If it does not power up, that means the motherboard or the case power supply is defective.
System Freezes Intermittently while Installing the OS	• Verify that the heat sink fan is spinning • Ensure that the heat sink is firmly mounted • Check that the heat sink is parallel to the surface of the processor.

6.2.7. Replacing Faulty Modules

A field technician also provides hardware and related software service and maintenance which may include installation or repair of hardware equipment or associated software by monitoring, troubleshooting and replacing faulty modules. While replacing faulty modules, it's the responsibility of the field technician to check the warranty on the faulty module while replacing it and also ensure that no damage is done to the other hardware.

The following figure lists the steps to be followed in order to replace a faulty module:

Disassemble the system

Remove the faulty module

Replace it with the new one

Re-assemble the system
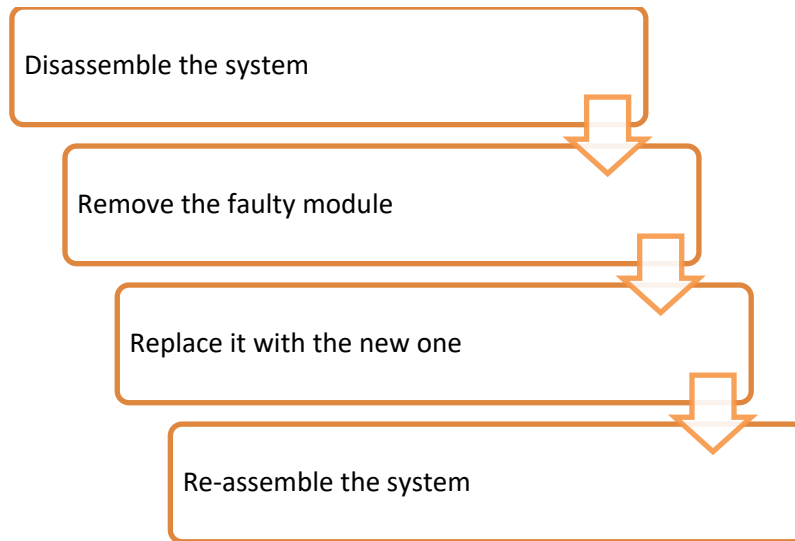
Fig. 6.2.8: Steps for replacing a faulty module

New Product Models

Since IT industry evolves at a very fast pace, the field technicians need to be updated with the latest products, their software ecosystem and methods to operate the technologically advanced machines. New tech savvy hardware comes with a specific set of rules and operating methods. Therefore, field technicians need to acquire complete knowledge about their functioning. A field technician should do the following when working with a new product:

- Keep in mind the constraints related to the use of the new product to avoid any hardware or software failure.
- Comply with the codes put in place for the use of any machine or software.

Practical

Perform the task of replacement of hard disk drive for desktop.

Hardware:

1. SATA and IDE drives

UNIT 6.3: Completing Repairs

Unit Objectives

At the end of this unit, you will be able to:

- Report percentage of call closure in multiple visits against the benchmark
- Ensure no sub-standard or unverified parts are used in replacing
- Complete the function within the agreed Turn Around Time (TAT)
- Meet monthly or daily targets given

6.3.1. Report Percentage of Call Closure

The job of a field technician does not end with just examining or maintaining the equipment. Once an equipment, for example a computer is worked upon, the technician is required to create a detailed report on the changes made, specify the next supposed date when the hardware or the software on the system may require repair or update and in how many days the assigned task was completed. For example, a task was to be completed in two visits but the technician took three visits to complete it then they need to report why they took more time to complete the task. In addition, they also need to specify the reason of delay such as appropriate tools missing, spare part unavailable at store and so on.

6.3.2. Use Only Verified Parts

As the cost of verified parts/modules is greater than that of sub-standard and unverified ones, so many people prefer the unverified parts. The unverified parts can stop working at any time. In addition, they can cause damage to the system's performance. So, it is the responsibility of the field technician to make use of only verified parts while replacing the parts and also make the customers aware of its advantages.

6.3.3. Complete the Work in Turnaround Time (TAT)

In most organizations, conflicts between co-workers occur due to tight schedules and deadlines. Employees working on deadlines are required to work on short turnaround times, resulting in frustration and stress. Strategic planning in advance is the best way to avoid such circumstances. Irrespective of the team size, this can be achieved by deploying tools to communicate deadlines.

The following figure shows key points which will help in timely completion of work:

Complete the call closure in single visit

Complete the task with the quality benchmark of the company
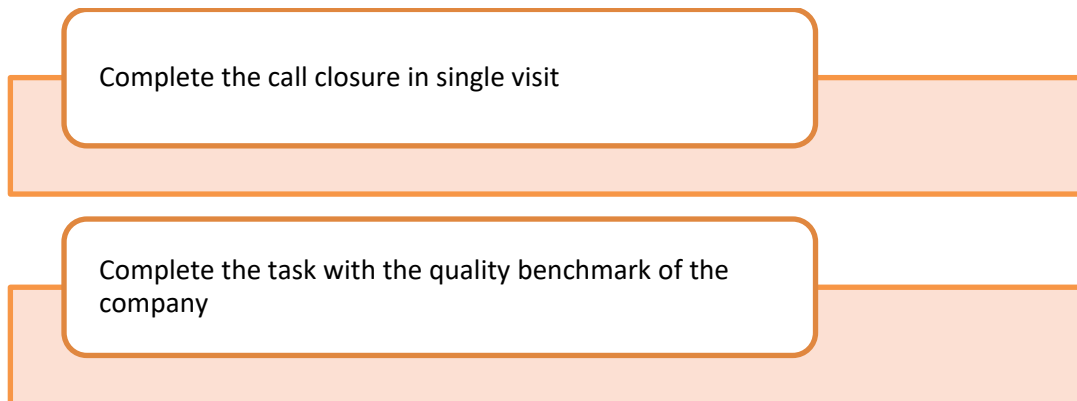
Fig. 6.3.1: Key points for timely completion of work

6.3.4. Meet the Targets

Just like any other job profile in an organization, meeting the targets set down by the management is very important. A field technician needs to be clear about the goals and visions of the organization to achieve all the designated targets. The following figure shows the key points which will help a field technician to meet the expected targets:

Maintain the quality of work

Ensure availability of machinery and software

Field Technician

Manage the team

Scrutinize the procedures on site
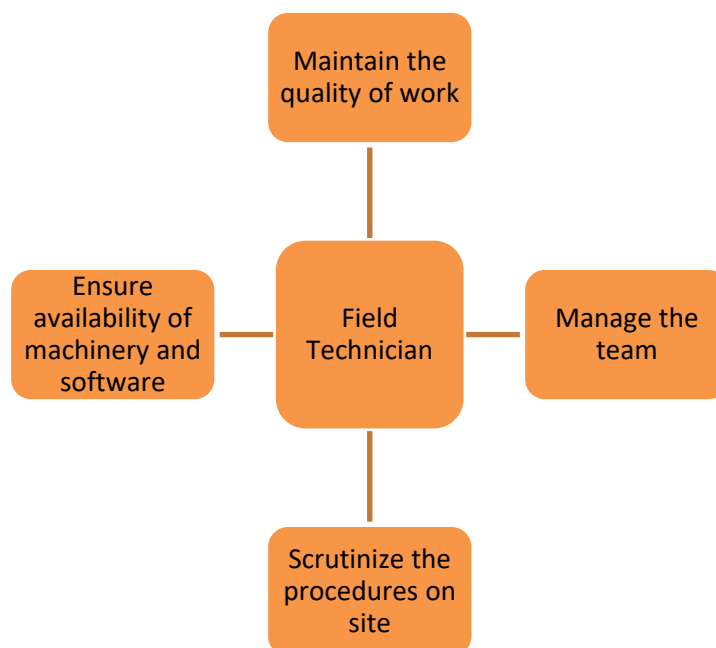
Fig.6.3.2: Key points to remember for meeting targets

The quality of work needs to be maintained at all times in compliance with the referral handbook of the company. Making sure that individual roles and responsibilities are understood by the personnel is vital. Timely check of the machinery and software systems needs to be done to avoid any bottlenecks in achieving weekly or monthly targets.

UNIT 6.4: Reporting to Superior

Unit Objectives

At the end of this unit, you will be able to:

- Take work order from the Supervisor
- Report 100% on time completion
- Submit the feedback form
- Report work status accurately
- Create knowledge bank

6.4.1. Understand the Work Requirement

For a person to work, it is important to understand the work requirements. The work requirements for a field technician include certain responsibilities as shown in the following figure:

Take work order from the supervisor or customer care about the complaint registered

Understand the work requirements

Follow the line of authority

Issue on time the tools and the equipments

Keep upto date with new products and developments

Plan, organize and control work for efficiency

Report on the work load and completion status

Find solutions to customer complaints and queries that are unresolved in the field or escalate issues of concern to the supervisor

Fig. 6.4.1: Meaning of work requirement

Work requirement is also a document which has the date, location and the details of a particular task which has to be done. It is the record of the task which is to be performed. The technician should be able to understand the task assigned and its requirements.

6.4.2. Quality and Timely Completion of Work

A few simple principles, if adhered to, can ensure quality work. As a field technician, maintenance of quality and timely completion of work can be done in the following ways:

- Ensure that work is done is as per the guidelines and standard of the company.
- Plan and organize the allocated work for the day.
- Follow the proposed plan of action.
- Inform the supervisor in case of any deviation or emergency.
- Work to ensure 100% customer satisfaction.

The field technician would get a job sheet or work allocation from the supervisor. The supervisor will also share a plan of action with field technician to ensure adherence to timeliness and quality for the work assigned and should specify the reason for not meeting the target. For example, a field technician should repair or replace hardware with reference to an agreed target and time or specify the reasons for not meeting target. The following figure highlights the points which will help a field technician in understanding the plan to achieve 100% quality and timely completion of work:

Establish a compliance plan

Build a communication strategy

Develop an effective work schedule

Create a review plan

Test the product

Fig. 6.4.2: Achieving quality and timely completion of work

6.4.3. Submit the Feedback Form

Once the issue/problem is solved, feedback from the customer is very important. Feedback helps to create a reference guide for the field technician in an organization if the same problem creeps up again. Having discussions with the supervisor in relation to the problem and its solution solves a lot of intangible problems in the organization.

The customer is always special for an organization and therefore, customer's feedback is the most important aspect of providing service for an organization. A technician should take

customer feedback in a feedback form provided by the company. The following figure represents a procedure to take feedback form the customer:

Take feedback from the customer in a feedback form

Don't be defensive during the feedback

Share the feedback form with the supervisor
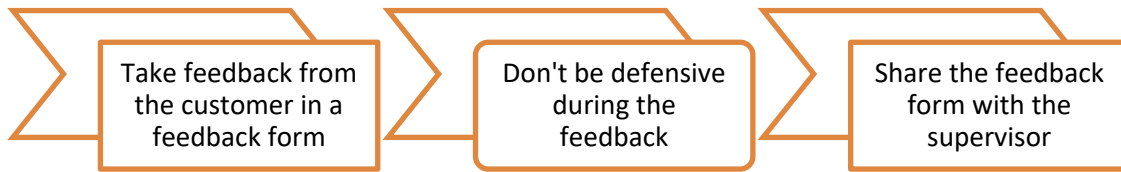
Fig. 6.4.3: Procedure for taking the feedback

6.4.4. Documentation

After completing the installation at the site, the technician should complete the documentation to record the details related to installation. They should also create knowledge bank on the complex repairs made through documentation. Along with completing the documentation, the field technician should tell the customer about some dos and don'ts for using the computer and its peripherals. A field technician should know how to use MS-Word, MS-Excel to properly insert the information about the work done at the customer's site.

The field technician will also tell the customer about important pages to be referred to from the product manual such as the webcam switch and its functionality. The documents may include the following:

- Work status report
- Customer hand over slip
- Customer feedback form
- Servicing date or period
- Warranty documents

Tests performed on the networking/storage with results, in case there is a complaint or an issue in the already installed networking/storage.

7. Interacting with Customers

Unit 7.1 – Identify Customers' Requirements

Unit 7.2 – Interacting with Customers Prior to Site Visit

Unit 7.3 – Suggesting Solutions to Customers' Problems

Unit 7.4 – Maintaining Schedules and Records

Unit 7.5 – Achieving Productivity and Quality

Key Learning Outcomes

At the end of this module, you will be able to:

- Identify customers' requirements
- Learn how to interact with customers
- Suggest resolutions to the problems of customers
- Learn how to maintain records of customers' complaints and resolutions
- Describe the importance of productivity and quality

UNIT 7.1: Identify Customers' Requirements

Unit Objectives

At the end of this unit, you will be able to:

- Identify a customer's requirement
- Educate customers about different aspects of installing and repairing hardware

7.1.1 Understand a Customer's Requirement

Understanding the needs of a customer is one of the foremost parts of a technician's job role. This includes the following practices:

- Call the customer as per the complaint registered to understand the issues
- Check the time of visiting the location
- Greet the customer and talk politely
- Understand the customer's requirement
- Provide the best possible and cost effective solution to the customer
- Ensure that the customer is satisfied with the service
- Address the queries and issues raised by the customer about the hardware devices

7.1.2 Educate and Inform the Customer

Educating the customer about the products and their operation is an important aspect of a field technician's job. For the satisfaction of the customer, a field technician should inform him/her about the operational behaviour of the hardware installed at the site or premises and also give other information related to it.

The following figure shows a list of information about the hardware which is to be used by the customer:
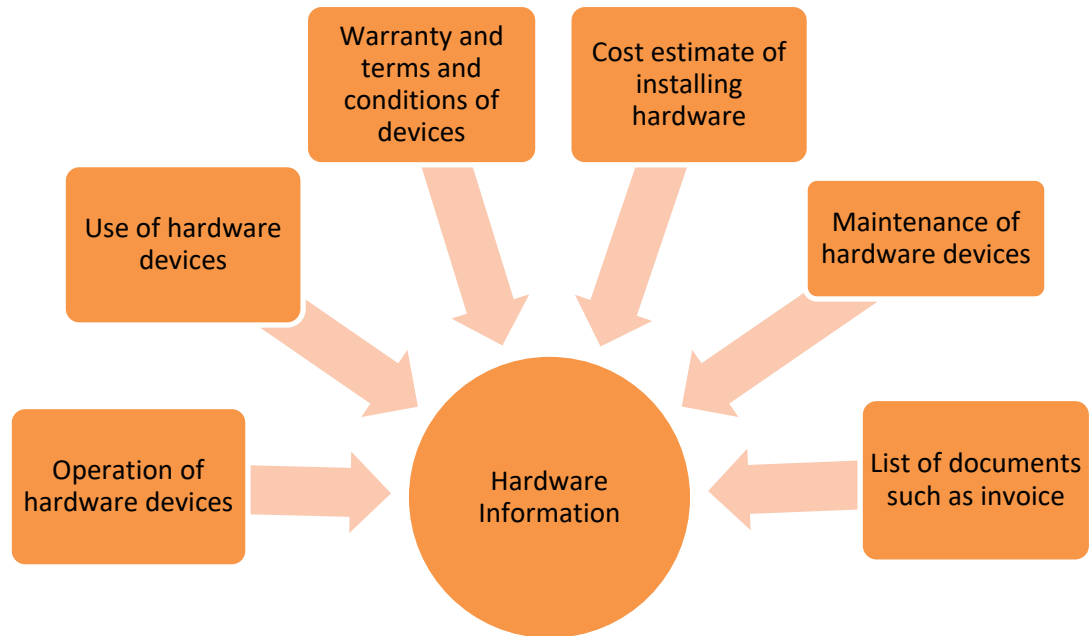
Fig 7.1.1: List of information about hardware

UNIT 7.2: Interacting with Customers Prior to Site Visit

Unit Objectives ⊚

At the end of this unit, you will be able to:

- Analyse location requirements for the hardware devices
- Ask customers about their issues
- Inform customers about the repair procedure and warranty coverage of devices
- Educate customers about the annual maintenance contract

7.2.1 Analyse Location Requirements

For a field technician, it is important to analyse the location before installing the hardware components and other peripherals, for their proper handling and to prevent them from any damage.

While analysing the location, the customer's requirements should be understood such as where the hardware should be installed and whether it can be installed at that location or should be taken to the service centre for any changes.

Some points that should be kept in mind while analysing the location requirements for hardware installation are as shown in the following figure:

Location should be dirt free.

It should be away from wet area.
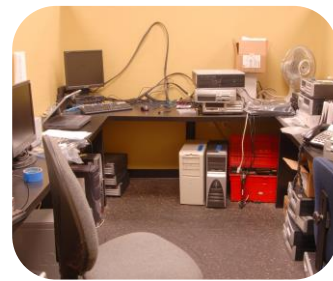
It should be spacious.

It should not be in a high tempertaure or high humidity zone.

Fig. 7.2.1: Analysing the location requirements for hardware installation

7.2.2 Ask Questions

Asking Questions is also a skill. They may be asked to get more details or to be sure of something. A field technician should ask the customer questions to analyse the problems being faced and seek inputs to understand the symptoms.

The following figure enlists the points to be asked or ensured at a customer's premises:

At customer's premises	Enquire about the symptoms and history of the problem in the hardware
	Ask about the year of purchase, service and warranty of the hardware and other peripherals
	Identify the problem based on the customer's information and examination of the hardware and other peripherals
	Communicate the problem identified to the customer and inform about possible reasons
	Inform the customer regarding the costs involved and hand over the invoice after the task is completed
	Ensure service is provided to achieve 100% customer satisfaction

Fig. 7.2.2: Points to be asked or ensured at a customer's premises

Depending upon the intention of asking a question, it can be:

- Close ended questions – are mainly yes, no answer type questions. The purpose of asking such questions is to get specific details. The following table shows close ended questions:

Example	Question Tag
Did you come yesterday?	Do, Did, Is, Can, Could, Will, Would, Shall, Should and so on
Can you finish this task in 2 hours?	
Shall I do it now?	

- Open ended questions – are mainly questions which do not demand a specific answer but are probing for details. The following table shows pattern of open ended questions:

Example	
What do you think about the meeting yesterday?	
How was your day?	
Where have you been all afternoon?	

7.2.3 Warranty Coverage and Annual Maintenance Contract

A warranty coverage is an agreement between the manufacturer and the buyer which assures the customer of a free repair service till the mentioned date of warranty. A field technician should enquire about the warranty coverage after inspecting the device which is to be replaced or repaired.

If the device is out of warranty coverage, the customer should be informed about the initial charges of replacing the damaged part.

The following figure shows a warranty card template:

Fig.7.2.3: A warranty card template

Inform Customer about Replacement or Repair Process

A technician is responsible for informing a customer about the replacement or repair procedure of a defective hardware. The customer has to be told whether the repairing would take place at the premises or at the service centre and about the estimated cost of repairing.

Annual Maintenance Contract

It is defined as a contract between two parties about the maintenance of a product owned by one of the parties, on some terms and conditions, which are negotiated in the beginning and are maintained in the form of a legal contract.

A technician should educate the customer about this contract and its benefits regarding product maintenance and legal terms and conditions, so that in future the customer would be able to use this contract to repair the damaged products.

The following image shows template for annual maintenance contract of hardware and peripherals:

Fig 7.2.4: Template for annual maintenance contract of hardware and peripherals

UNIT 7.3: Suggesting Solutions to Customers' Problems

Unit Objectives ⌖

At the end of this unit, you will be able to:

- Provide solutions to the customers' problems
- Inform the customer about the estimated cost of repairing under warranty and time required to repair the faulty equipment
- Explain to the customer the reasons for replacement, if the module requires it

7.3.1 Suggest a Solution to the Customer

After identifying the issue, a field technician needs to offer solutions to the customer. All the possible solutions should be explained along with their associated cost. The technician should then propose the best solution and let the customer decide whether to go ahead with it or not.

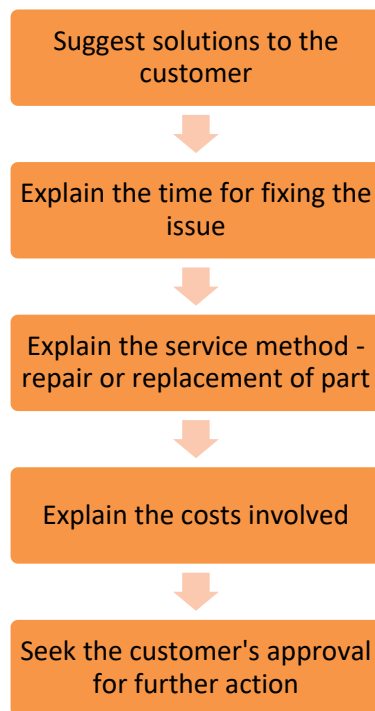The following figure shows the steps involved in offering solutions to a customer:

```
┌─────────────────────────────────┐
│   Suggest solutions to the      │
│          customer               │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│  Explain the time for fixing the │
│             issue               │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│   Explain the service method -  │
│  repair or replacement of part  │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│     Explain the costs involved  │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│   Seek the customer's approval  │
│        for further action       │
└─────────────────────────────────┘
```

Fig 7.3.1: Suggesting a solution to the customer for an issue

7.3.2 Inform and Explain to the Customer about Modules Replacement

A technician is required to inform the customer whether the faulty module has to be replaced or repaired along with reasons. For instance, if the product is under warranty coverage then the customer has to be told about the estimated cost of repairing and the time required to repair it.

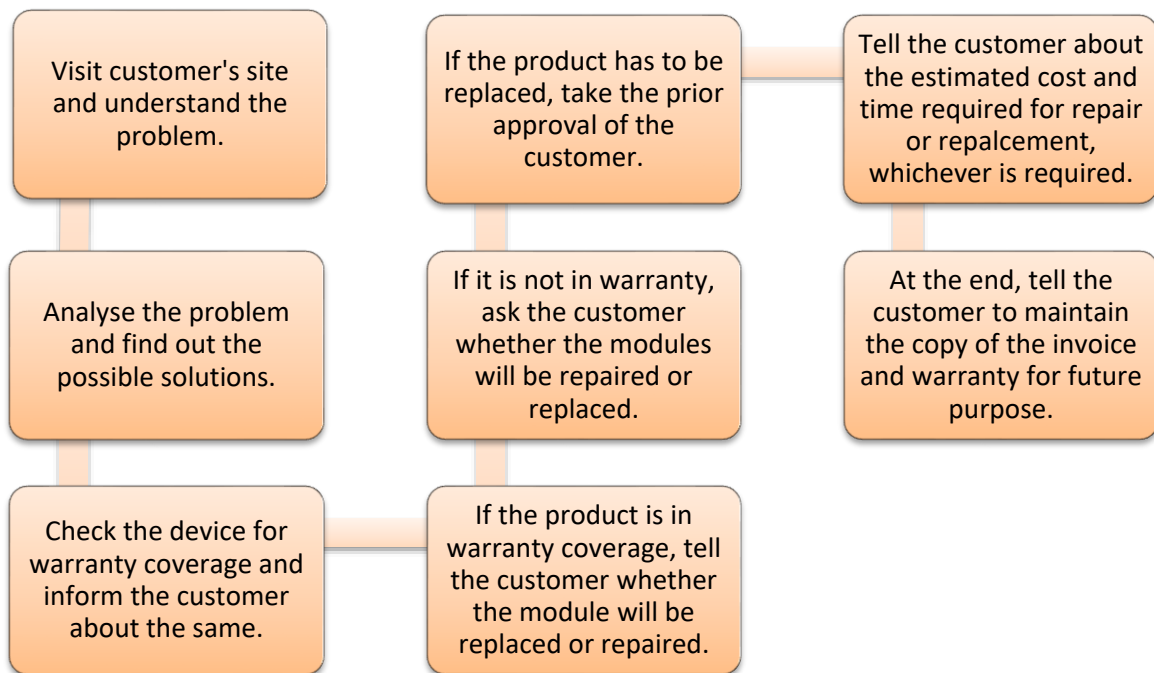The following figure shows the steps required to inform the customer about modules replacement:

Visit customer's site and understand the problem.	If the product has to be replaced, take the prior approval of the customer.	Tell the customer about the estimated cost and time required for repair or repalcement, whichever is required.
Analyse the problem and find out the possible solutions.	If it is not in warranty, ask the customer whether the modules will be repaired or replaced.	At the end, tell the customer to maintain the copy of the invoice and warranty for future purpose.
Check the device for warranty coverage and inform the customer about the same.	If the product is in warranty coverage, tell the customer whether the module will be replaced or repaired.	

Fig 7.3.2: Steps required to inform the customer about modules replacement

UNIT 7.4: Maintaining Schedules and Records

Unit Objectives 🎯
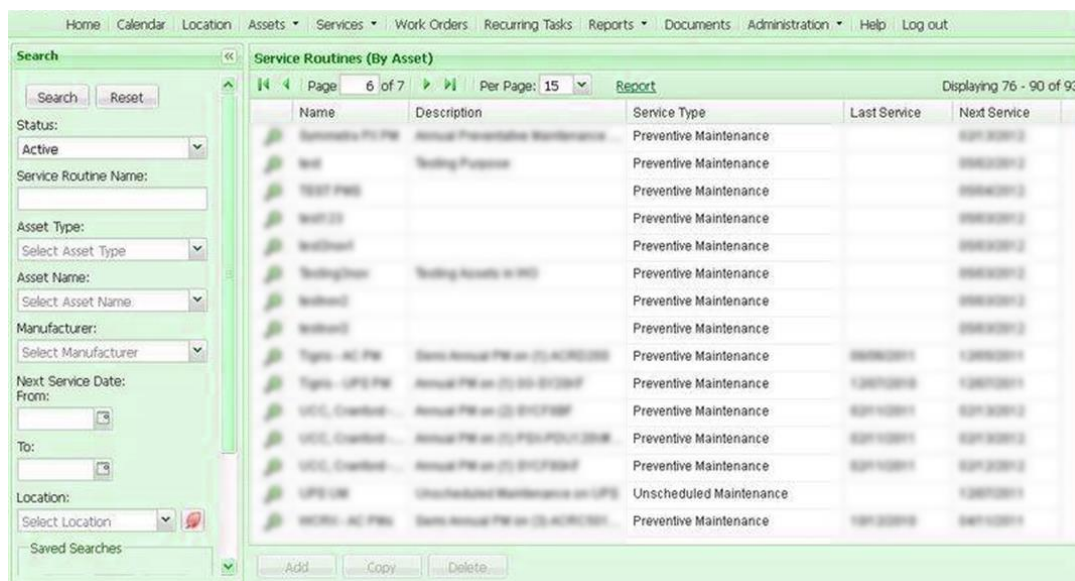
At the end of this unit, you will be able to:

- Explain maintenance schedules
- Tell the customer to retain the copy of the invoice and provide the same

7.4.1 Maintenance Schedule

A maintenance schedule is vital for keeping records of servicing, repairing and performing preventive maintenance. A field technician should maintain service records and next servicing schedules to be able to inform the customer about the maintenance of the components at the facility. The technician needs to perform hardware and software maintenance.

The following screenshot shows a sample maintenance schedule report:

Fig. 7.4.1: Sample maintenance schedule report

Hardware Maintenance

The field technician should assess the condition of the hardware components and upgrade them if required. He/she should be aware of the compatibility issue. The technician also needs to maintain the warranty details of the components. If the warranty period is going to expire, the person should communicate that with the customer and ask if any extended warranty is required.

In this case, there are two ways:

- The customer can ask for extension of the warranty period.
- The customer doesn't want to extend it. If there is any problem, he will buy a new one.

The field technician needs to communicate about the above two ways and then tell the details of further procedure.

The following image shows a sample maintenance requirement form:

Fig. 7.4.2: Sample maintenance requirement form

The technician should maintain a checklist for scheduling the maintenance. The following figure shows a maintenance checklist:

Activity	Frequency	Auto?
Check power supply fan for ventilation and dirt build-up and clean if necessary	Quarterly	No
Back up CMOS information	Quarterly	No
Check processor temperature, inspect heat sink and fan to ensure they are working	Annually or Whenever case is open	No
Check hard disk for temperature and vibration	Annually (or whenever case is opened)	No
Clean exterior of case	Annually	No
Clean exterior of monitor	Annually	No
Check and clean interior, motherboard and expansion cards if necessary	Annually	No
Check internal connections and cables	Annually	No

Fig. 7.4.3: A maintenance checklist

7.4.2 Maintain the Copy of Invoice

Invoice is defined as a non-negotiable instrument given by the seller to the customer after purchases of the goods and services. It acts as the bill of sale or contract of sale.

Invoice template consists of the following content:

- Trading parties (seller and customer)
- Quantity of items sold
- Date of shipment
- Mode of transport
- Rate and discount
- Delivery and payment terms

The field technician should provide a copy of invoice to the customer and tell him/her to retain a copy of it for future purpose.

The following image shows sample of an invoice template:

UNIT 7.5: Achieving Productivity and Quality

Unit Objectives 🎯

At the end of this unit, you will be able to:

- Deliver service within the service level agreement (SLA) time
- Identify customers' requirements and put them at ease by providing appropriate solutions
- Achieve customers' satisfaction
- Maintain no repeat or second escalation from a customer

7.5.1 Deliver Service within SLA time

To achieve a customer's satisfaction, it is necessary to deliver the service within the time as mentioned in the SLA. Managing the expectation of a customer is not easy for a field technician. The expectations can turn into a grave problem if the responsibilities and the roles of both the parties are not clearly defined on paper and agreed upon by both the customer and the service provider.

An agreement of a sort is therefore important to understand that both the parties – customer and organisation– have duties and responsibilities to each other and these must be properly detailed. This is where an SLA comes in. An SLA is a formal contract between the service provider and the customer, defining services, responsibilities, scope and duties of both the parties. For instance, an IT hardware company may offer routine inspection and maintenance service for a certain period of time as part of one time cost at the time of purchase of an equipment.

The following image shows an SLA:

Fig. 7.5.1: Writing out an SLA

It is important for the field technician to read and understand the SLA before visiting a customer, so that all the queries, support and service can be addressed according to the terms specified. This will minimize all the issues related to service expectations of a customer.

The following figure enlists practices required to be followed to achieve a customer's satisfaction:
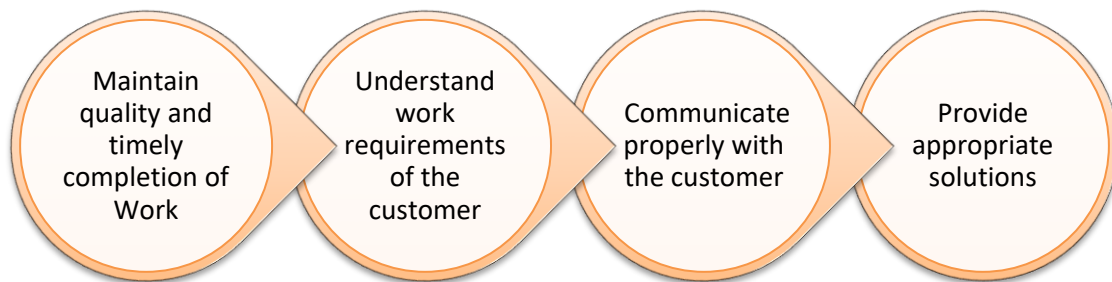
*Fig 7.5.2: Practices to be followed to achieve a customer's satisfaction*

Maintain Records of Activity

One of the most important parts of good customer service is maintaining accurate records, containing details of dealings with the customers. Customers' records can help to gather information about how best to market a company's services and also help to ensure that the organisation runs smoothly. Most records are stored electronically on a database.

Objectives of Documentation

- To record all the problems reported by users
- To record the timing of the corrective action
- To record the issues that are escalated and to whom
- To record what action has been taken and by whom
- To record when the outstanding requests got cleared.

7.5.2 Maintain No Repeat or Second Escalation from a Customer

Zero defect in work can be achieved in the following ways:
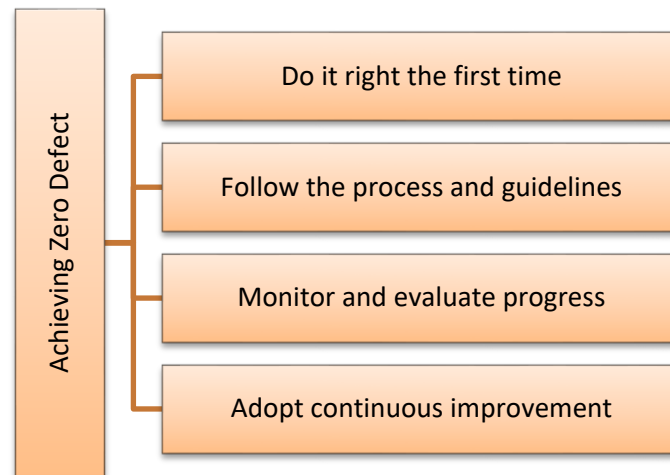
Fig. 5.5.3: Measures to achieve zero defect in work

Escalation Process

There may be a case where a customer's request is not closed within the agreed SLA time frame. In such a situation, the technician should escalate the matter to the superior/ back line support and the escalation manager. The supervisor is responsible for ensuring that all escalated enquiries are dealt with and resolved promptly. However, the technician should try to exhaust all the options at his level before escalating any enquiry to the supervisor.

A customer enquiry should reach the supervisor only if there is a need to oversee the issue from a holistic viewpoint. They will evaluate the situation, facilitate the issue resolution and act as an advocate on behalf of the customer.

Complaints escalation process

The technician should do everything to resolve an issue at the first instance. To facilitate the fast and efficient resolution of the issues at the first point of contact, a complaint process needs to be designed and followed.

If an issue is unresolved and needs expert guidance, the technician should clearly explain the escalation options to the customer before proceeding further.

The following figure illustrates the steps of a complaint resolution process:

Step 1
• First contact

Step 2
• Escalation to the supervisor or manager

Step 3
• Referred to the Solutions team

Step 4
• Further options
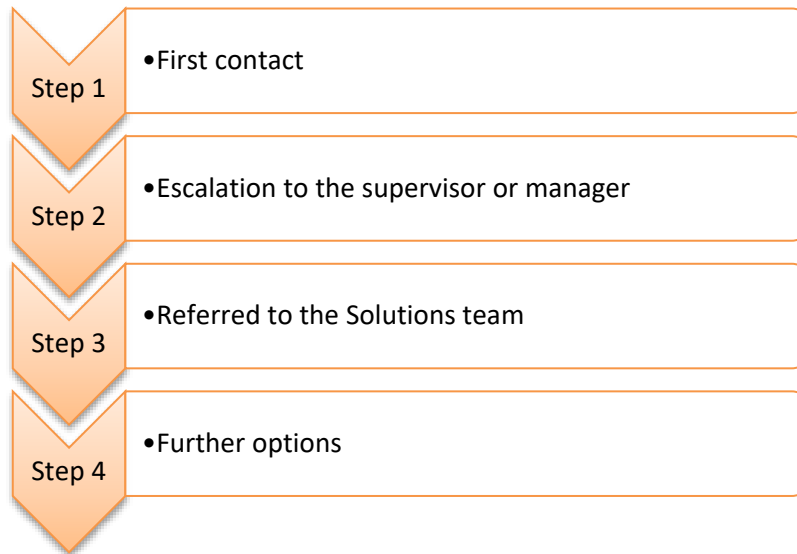
Fig. 7.5.4: A complaint resolution process

Step 1: First contact

A field technician needs to be suitably empowered to resolve first level complaints as well as complex issues and make rational customer service decisions.

Step 2: Escalation to the supervisor or manager

If the technician is unable to resolve a complaint, it can be escalated to the supervisor or manager. The manager will review the problem, respond to the complainant and attempt to resolve the issue to the customer's satisfaction.

In circumstances where the manager is unable to resolve the complaint to the customer's satisfaction, it will be referred to the Solutions team.

Step 3: Referred to the Solutions team

The Solutions team will review and try to resolve the issue to the customer's satisfaction in accordance with the industry code and regulation.

Step 4: Further options

Most of the complaints can be handled internally by utilizing all the possible avenues available for resolving it. However, if the customer is still not satisfied with the handling of the complaint, then as a last resort the technician may seek complaint mediation or further assistance from the supervisor.

8. Understanding Organizational Policies and Standards

Unit 8.1 – Explain Company's Policies

Unit 8.2 – Identify Company's Product/Quality Standards

Unit 8.3 – Describe Company's Safety Policies and Standards

Unit 8.4 – Interact with Supervisor

Unit 8.5 – Interact with Colleagues

Key Learning Outcomes 💡

At the end of this module, you will be able to:

- Explain company's policies
- Identify company's product/quality standards
- Describe company's safety policies and standards
- Interact with supervisor
- Interact with colleagues

UNIT 8.1: Company's Policies

Unit Objectives

At the end of this unit, you will be able to:

- Identify the company's customer care policies
- Identify the company's code of conduct policies
- Describe the organisation culture and typical customer profile
- Explain the company's reporting structure
- Define company's policy on product's warranty
- Identify the company's line of business, product portfolio and competitors

8.1.1. Customer Care Policies

A technician needs to meet the requirements, needs and expectations of the customers. This can be done by providing timely resolutions to queries and complaints. The goal is to minimize the system's downtime and improve the customer's overall experience of getting a device installed or serviced.

Therefore, a technician needs to follow certain policies laid down by the organization for ensuring that the maximum customer satisfaction is achieved. The following figure lists some features of the customer care policies that a technician needs to adhere to:
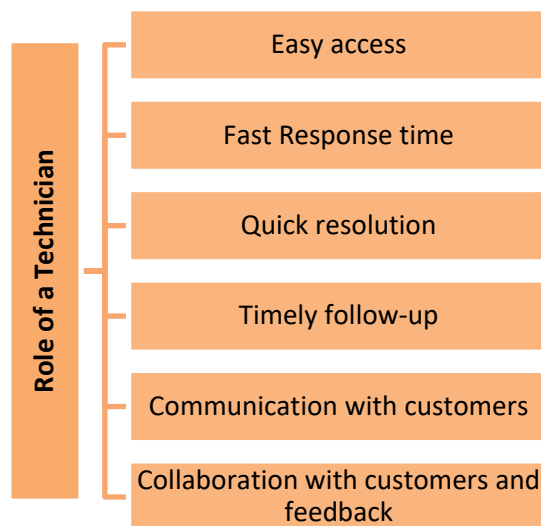
Fig. 8.1.1: Role of a technician

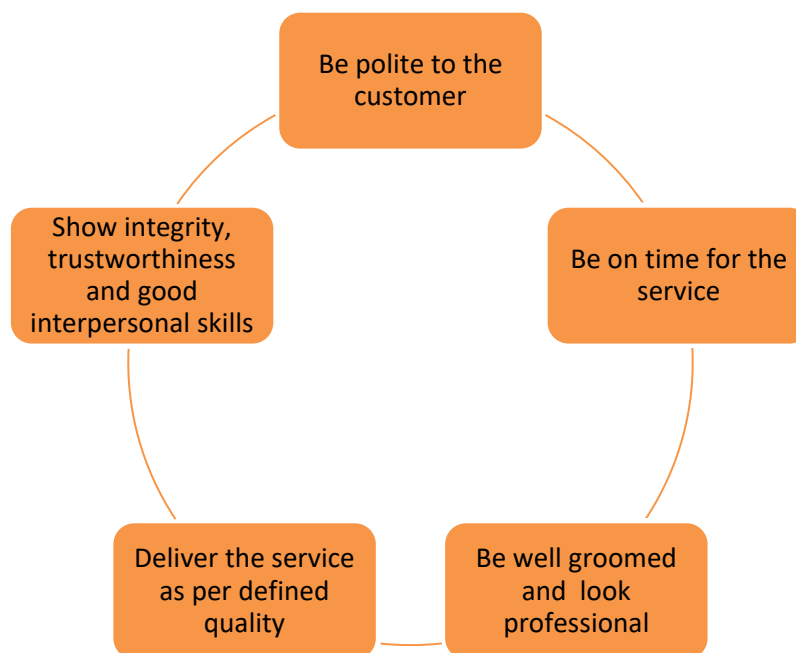### 8.1.2. Code of Conduct Policies

In an organization, the code of conduct means the core values, ethics, responsibilities, commitments and virtues that every employee of that organization needs to comply with. It

lays down the general guidelines that the organization expects from its employees in specific situations. Thus, it is necessary to follow a proper code of conduct in terms of behaviour and work output delivered.

8.1.3. Organisational Culture

Organizational culture is defined as the shared values, beliefs and norms within an organization and the demands of a job role. A field technician represents the organization in front of the customers and has direct interaction with them. The following figure represents the characteristics of organizational culture which a technician should reflect:

Be polite to the customer

Show integrity, trustworthiness and good interpersonal skills

Be on time for the service

Deliver the service as per defined quality

Be well groomed and look professional

Fig. 8.1.2: Characteristics of organizational culture

As a field technician, the individual may need to cater to different sets of customers, from different backgrounds.

The following figure represents the broad classification of customer profiles:

Domestic

- Local language
- Region/area-wise code of conduct
- Technical know-how of the product

Industry/Factory

- Scale
- Point of contact
- Number of avaiable systems and their peripherals

Small Enterprises

- Point of contact
- Number of avaiable systems and their peripherals
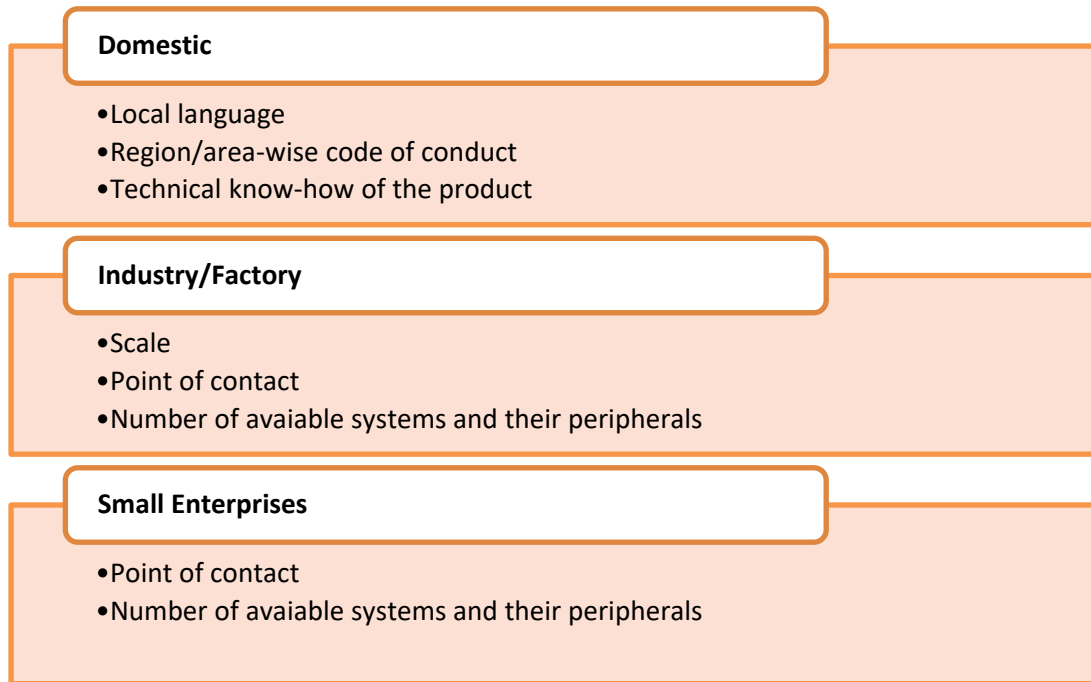
Fig. 8.1.3: Classification of customer profiles

Company's Policies and Rules

If a company's policies and rules are not defined clearly, then the employees may not comply with the disciplinary standards wholeheartedly. The following figure lists a few examples of a company's policies:

Conduct of an Employee

Equal rights of employees

Attendance/Time off

Product's warranty and other terms and conditions

Line of business, product portfolio and competitors
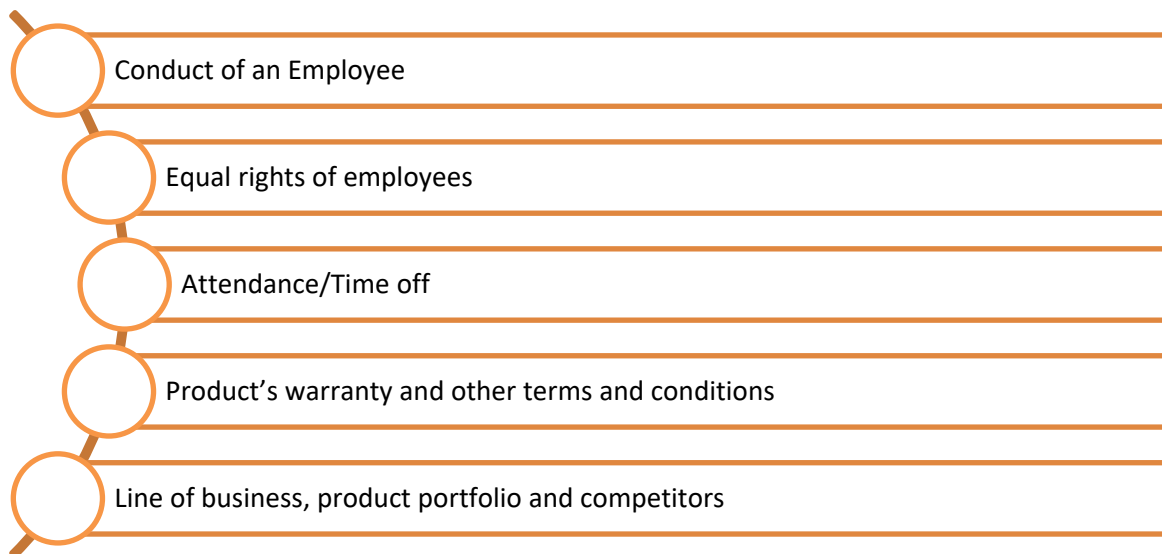
Fig. 8.1.4: A company's common policies

Reporting Structure

There are set rules and regulations within an organization which an employee needs to follow. These outline responsibilities of both the employers and the employees.
The following figure lists the key points of the reporting and documentation process a field technician needs to ensure while working in an organization:

Follow the company's policies and rules

Follow the reporting hierarchy

Follow role as defined in the workflow

Follow the documentation process

Follow the sales and after sales support policy

Fig. 8.1.5: Reporting and documentation process

Documentation

Right documentation can make a lot of the difference in getting quick resolutions. To achieve this, certain steps need to be taken as shown in the following figure:

Document every complaint

Document common problems

Document ticket escalation process

Make documentation an on-going process
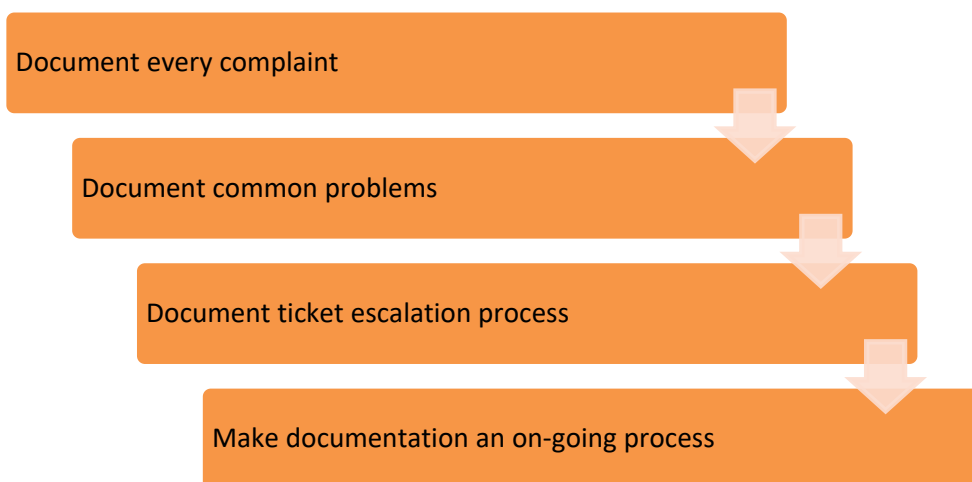
Fig. 8.1.6: Steps for right documentation

Document Every Complaint

The field technicians need to document issues as they come in. In addition to recording the symptoms described by the customers, they should probe for the right symptoms. For example, if a customer says that his computer is running slow, the technician needs to

differentiate whether the problem is caused by a virus or a malfunctioning hardware or an unpatched system.

The field technician should know how to ask the right questions to try and resolve an issue within the first call.

Document Common Problems

Majority of the issues can be reduced to a handful of common problems. If there is a good documentation process that has resolution paths for all common problems, then the field technician does not have to reinvent the wheel for every ticket. He can use the internal help desk knowledge base and time tested processes to resolve the issues quickly.
A well organised process enables the field technician to respond to a ticket quickly and resolve most of the customers' problems immediately.

Document Ticket Escalation Process

A good escalation process makes sure that when the field technician is not able to resolve a problem, he/she addresses ticket escalation promptly. The ticket gets send to the next level of customer support and the customer does not have to wait for days for it to get resolved.

Documentation should be an on-going effort

Documentation is not a onetime effort; it needs to be an on-going process. The field technicians should regularly optimize the issue resolution procedures and processes. This ensures that the customers' issues are resolved promptly.

UNIT 8.2: Company's Product/Quality Standards

Unit Objectives 🎯

At the end of this unit, you will be able to:

• Identify the company's products and the reporting of recurring problems

Company's Products and Recurring Problems Reported

The Computer and Peripherals industry produces a wide range of products for sale to just about all businesses and consumers. It can consist of products like printer, scanner, mouse, moniter and other devices as mentioned in the above modules.

An overview of a company's product is as shown in the following image:

Fig. 8.2.1 An overview of a company's product

Occurrence of Recurring Problems

When a field technician visits a customer's site for repairing or replacing faulty modules, the person should keep a record of the visit and educate the customer about the procedure of repairing, so that if in future the problem persists, it can be tackled.
But, sometimes, these problems occur frequently.

In this case, a field technician should perform the following steps to troubleshoot the recurring problems in the device as shown in the following figure:

Visit the customer's site and understand the problem.

Document the reason for the recurring problem and consult the superior to find out better solutions.

Educate the customer about the reasons behind the recurring problems, so that in future, it can be avoided.

Analyse the reason behind the frequently occuring problem in the device.

If it is the same problem, ask the customer whether to replace the device or repair it.

Check the report of the previous repairing session.

First, perform the repeated procedure of finding faults as mentioned in the report.

Fig 8.2.2 Steps to troubleshoot the recurring problems in a device

UNIT 8.3: Company's Safety Policies and Standards

Unit Objectives ⊙

At the end of this unit, you will be able to:

- Identify the safety procedures to follow
- Identify the quality standards to be followed
- Explain electrostatic discharge(ESD)

8.3.1. Safety Procedures

As a field technician, there are certain guidelines that must be followed to ensure own safety and that of the co-workers. These guidelines provide a sound, safe and flexible environment to work. The following figure represents the general safety guidelines to be followed at workplace:

Always follow the correct procedures to ensure zero accidents at work.

Always use an appropriate tool for the respective task.

Always read labels and instructions given on the components.

Always wear appropriate clothing and remove metal objects before working.

Use prescribed protective safety equipment only.

Always follow electrical safety rules when working with electrical machinery or equipment.

Report all unsafe acts or unsafe conditions to the supervisor.

Fig 8.3.1. Safety guidelines

8.3.2. Quality Standards

A few simple principles, if adhered to, can ensure production of quality work. As a field technician, maintenance of quality and timely completion of work can be done in the following ways:

- Ensure that work is done as per the guidelines and standard of the company.
- Plan and organize the allocated work for the day.
- Follow the proposed plan of action.
- Inform the supervisor in case of any deviation or emergency.
- Work to ensure 100% customer satisfaction.

The field technician would get a job sheet or a work allocation from the supervisor. The supervisor would also share a plan of action with the field technician to ensure adherence to timelines and quality for the work assigned. The following figure highlights the points which help a field technician in understanding the plan to achieve 100% quality and timely completion of work:
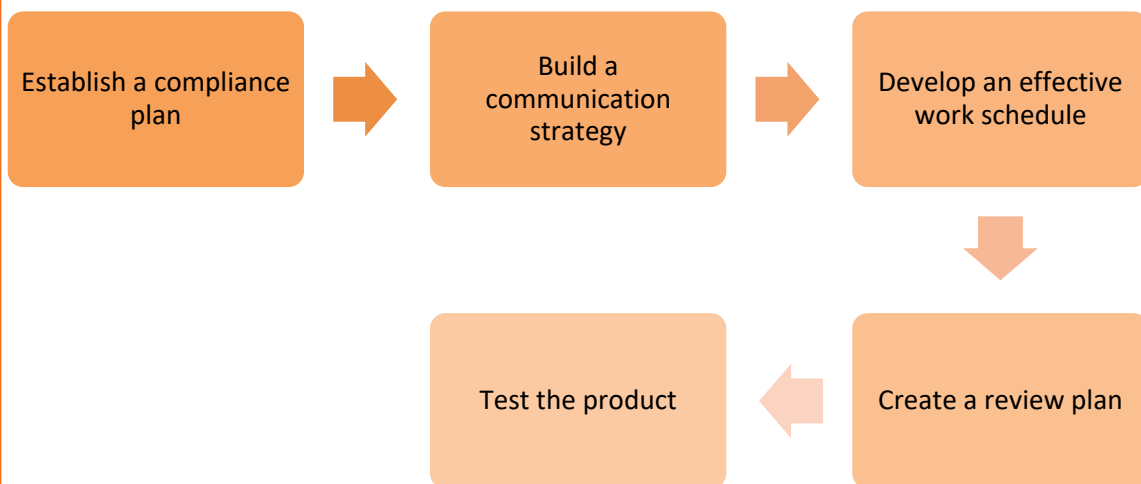
Fig. 8.3.2: Achieving quality and timely completion of work

8.3.3. ESD Protection

ESD protection is essential for sensitive components, during and after production, while shipping, during assembly of the device and in the finished device. ESD can cause severe damage to components such as microchips. Grounding is imperative for ESD prevention. An ESD simulator having special output circuit called human body model (HBM) is generally utilized to test the vulnerability of electronic devices to ESD from human contact.

The following protective gears should be used while handling components that are prone to ESD:

Wire strap	Gloves	Safety Clothes

Fig. 8.3.3: Safety gears for prevention of ESD

Activity

Tick the actions which can prove to be a threat to the health and safety of a field technician.

Smoking near combustible substances ☐

Oil spill near customer interaction area ☐

Tools lying on a table of a field technician ☐

Tools lying on the floor ☐

Entering a 'No Entry' zone at customer site ☐

Touching a live wire hanging out of a panel ☐

Working in dim light ☐

Walking on a wet floor ☐

UNIT 8.4: Interacting with Supervisor

Unit Objectives 🎯

At the end of this unit, you will be able to:

- Describe and assess work requirements
- Identify the targets and incentives
- Explain documentation of work on enterprise resource planning (ERP) software
- Resolve personnel issues
- Communicate potential hazards at a particular location
- Deliver work of expected quality despite constraints

8.4.1. Work Requirement

As a field technician, one of the major roles and responsibilities is to understand the work requirements. The major roles of a field technician are as follows:

- If there are any issues in the hardware and software, a field technician needs to come-up with solutions as soon as possible to eliminate any bottlenecks in terms of productivity. It is an integral part of maintaining a smoothly running working environment having zero tolerance for even major delays.
- Coordinating with customers, co-workers, subordinates and superiors is also defined as one of the major roles of a field technician.
- A field technician needs to have a clear picture of the work requirements as it determines the smooth functioning of an organization.

Understand Work Requirements and Targets

The targets and short term goals set by the organization determine the targets for the personnel. The field technician needs to understand the goals set by the superiors. These may be set with respect to timespan as listed in the following figure:
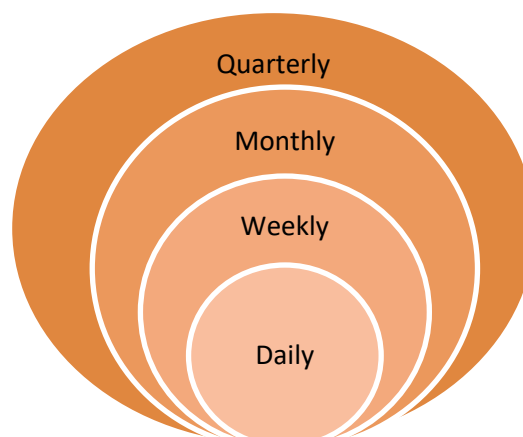
Fig. 8.4.1: Goals set by superiors

These goals then further define the targets to be assigned to the team responsible for all hardware related personnel. The incentive policy should be clear so that the employees can understand it well. It will motivate them to put maximum effort in maintaining hardware facility of an organization.

Any ambiguity in understanding the work requirements defined by the supervisor results in time delays and confusions. A field technician needs to avoid such instances at all costs. For example, failing to understand the priority of jobs or tasks assigned by the supervisor for the day. Understanding the technical requirement is also equally important. So, while replacing faulty modules, a field technician should check the warranty on the faulty module and also ensure that the other hardware is undamaged.

8.4.2 Documentation of Work on Enterprise Resource Planning (ERP) Software

One of the most important parts of good customer service is maintaining accurate records, which contain details of dealings with the customers. Customer records can help gather information about how best to market a company's services and also help to ensure that the organisation runs smoothly. Most records are stored electronically on a database.

ERP software is used in a company to maintain the records of work performed by the field technician. It is defined as a business management software that consists of integrated applications required to manage the documentation process and control back office related functions such as human resources and other technologies.

The following screenshots show samples of ERP software used in an organisation:

Fig 8.4.2: Samples of ERP software used in an organisation

8.4.3 Work Ethics

Work ethics mean differentiating between the right and the wrong way of doing a job and adopting the right conduct. They involve certain principles as shown in the following figure:

Fig 8.4.3: Work ethics

Consider an example: Pawan finished the task assigned to him. He has done the work on time and in an efficient manner. He also informed his supervisor regarding a major safety breach which helped in preventing an accident situation. Pawan was awarded an incentive for the best work done in that month. Later on, for his alertness and proactive stance he was also awarded by the MD of the company.

Resolve Personnel Issues

Resolving personnel issues involves the followings:

- Communicating effectively with the personnel ensures positive feedback in the organization. Two-way communication within and beyond the facility is also advised for a field technician in any organization.
- All conflicts of interest, misunderstandings and personnel grievances need to be understood and then reported to the higher authority.
- Suggestions on resolving the problems is important as it helps the facility staff to concentrate on the job at hand.

Any personal issue or grievance also needs to be attended to by the field technician himself before pushing the issue through to the supervisors. Managing the personnel is the most important part of team effort towards a unified goal.

Delivery of Work of Expected Quality

Delivery of work as per expected quality should be maintained in the following ways:

- Ensure the work done is as per the guidelines and standard of the company.
- Plan and organize work for the day.
- Follow the plan.
- Inform supervisor in case of any deviation or emergency.

The following figure highlights the points which help the employers in developing a plan to achieve 100% quality and timely work completion:
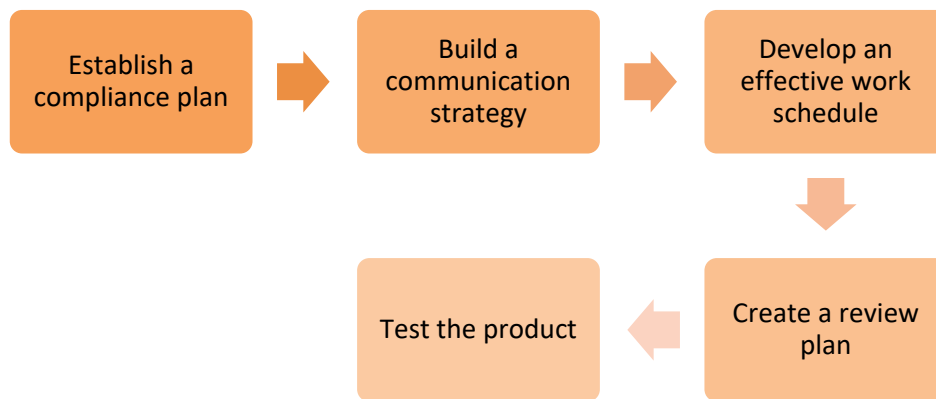
Fig. 8.4.4: Achieving quality and timely work completion

Inform Superior about Potential Hazards

Understanding all possible hazards that can happen in a facility is the responsibility of a field technician. One possible cause of hazard could be the lack of clear understanding about the company's code of conduct or the reference handbook which puts constraints on the use of equipment for purpose that is against the code of conduct. A field technician can handle the hazards by following these practices:

- Communicating any such hazard to the supervisor to prevent unaffordable downtimes which could otherwise hamper critical functioning of the organization.
- Having clear communication with the other staff members and getting in place early warning systems for potential threats in another dimension.
- Making risk assessment is an integral part of a field technician job description. Potential hazards should be assessed with precision and supported with practical evidence.
- Adopting a systematic approach is another dimension of communicating potential hazards.

The following figure shows a systematic approach for handling hazards:
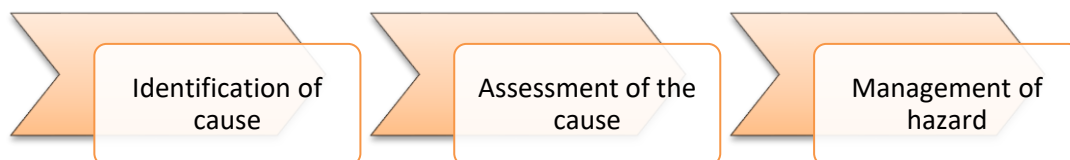
Fig. 8.4.5: Systematic approach for handling hazards

Role Play

Ravi is new at the workplace and he has to be briefed about the work, line of communication, safety measures to be adopted and so on. The supervisor has assigned this task to one of Ravi's colleague. Perform the role play.

Hints:

- One participant can act as the supervisor.
- Another participant acts a colleague, while a third one acts as Ravi.
- The Supervisor briefs the field technicians about work and shows the line of hierarchy chart, and tells about safety and tools.
- The Supervisor also asks the colleague to provide details about work, safety tools and equipment that will be used and the work completion report format to be used.

UNIT 8.5: Interacting with Colleagues

Unit Objectives

At the end of this unit, you will be able to:

- Receive spares from tool room or stores or deposit faulty modules and tools to stores
- Pass on customer complaints to colleagues
- Assist colleagues in resolving field problems
- Resolve conflicts and achieve smooth workflow

8.5.1 Interpersonal Relationship

Every worker works towards a common goal in an organization, still all of them are divided by certain roles and activities and the way they accomplish that objective. Inter-personal communication – whether formal or informal - is the most common and important key to accomplish productivity and perform social functions in an organization.

The primary objective of a field technician is to understand the process and the health of the communication taking place among the co-workers in order to improve its quality. To maintain a healthy interpersonal relationship, it is important to adhere to the points shown in the following figure:

Interpersonal Relationship

- Resolve interpersonal conflict and ensure smooth flow of work
- Receive equipment/tools from stores
- Pass on customer complaints to colleagues in respective geographical locations
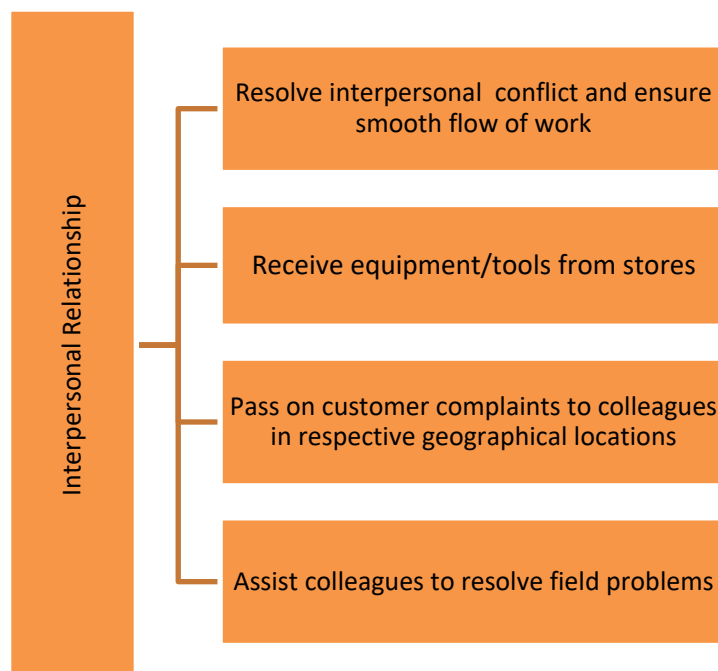- Assist colleagues to resolve field problems

Fig 8.5.1: Managing interpersonal relationship

Resolve Conflicts

As discussed earlier, individuals are divided by roles and responsibilities in an organization despite working towards a common goal. Hence possibility of conflicts is nearly unavoidable.

A few tips to reinstate better communication among co-workers in such quandary are as follows:

- **Clarify of roles and responsibilities**

  Going to the basics is the best way to resolve a problem. The role of a field technician is to ensure a glitch-free workflow in an organization. The technician and his team will participate in addressing IT issues, whether small or big. Providing a more rounded perspective of job roles and responsibilities offers inculcation of a positive and resolute approach for problems among co-workers. Also, this enables people with less job experience to take up things in a more constructive manner.

- **Plan strategically**

  In most organizations, conflicts between co-workers occur due to tight schedules and deadlines. Employees working on deadlines are required to work on short turnaround times, resulting in frustration and stress. Strategic planning in advance is the best way to avoid such circumstances. Irrespective of the team size, this can be achieved by deploying tools like Calendar to communicate deadlines. The following image shows planning using a calendar:

Fig. 8.5.2: Planning using a calendar

Receive Equipment/Tools from Stores

Getting the job done in a process depends on information communication. Furthermore, accuracy of the end result entirely depends on effective inter-personal communication. For example, the IT department of an organization wants to replace old computers with the new ones, accurately and smoothly. The entire exchange process depends on how effectively the IT department communicated the requirement for infrastructure upgrade to the person in charge at the store.

Customer Complaints in the Respective Geographical Area

Serving customers at an organization with a wide spectrum of consumer base poses additional challenges. Maintaining service quality in such cases can be a challenging task, owing to cultural and social diversity. However, such barriers can be overcome in a better way by giving the opportunity to a worker hailing from the respective geographical area. Addressing such problems in this way can improve the ability of an organization to

implement strategies aimed at improving the service quality. The following images show the segmentation of the customer base to collect their complaints accordingly:
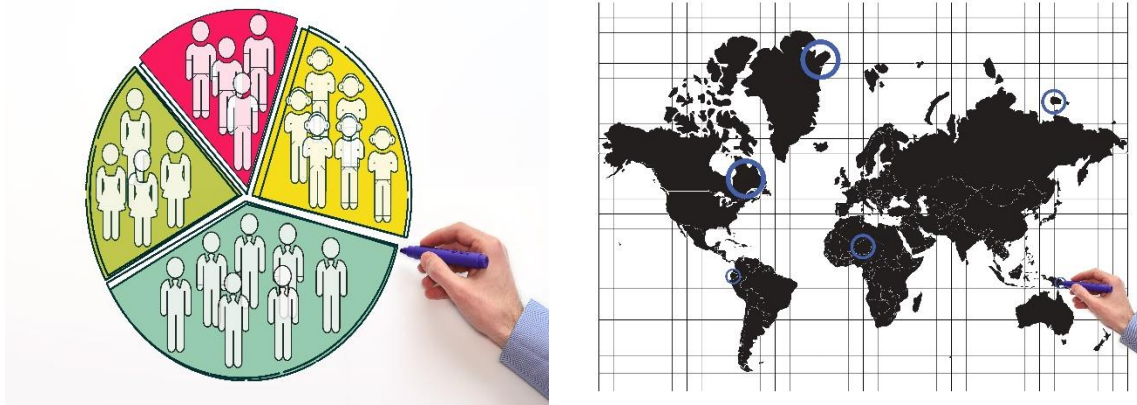
Fig. 8.5.3: Segmentation of customer base

Assist Colleagues

Be it work allocation, manpower distribution or identification of areas of high responsiveness, healthy communication is the key to improve service quality. Informal communication is what is usually seen to be dominant in most workplaces. People asking for help from the person sitting at the adjacent desk to troubleshoot a hardware issue, rather than consulting a field technician, is one of the most common examples of informal communication. The communication is spontaneous and successful in achieving the goal, paving the way to formal inter-personal communication. Despite having established communication procedures, informal communications occur in every organization and help in resolving problems and conflicts in real time. Hence, the role of a field technician is to understand potential of this form of communication and further it with the help of modern-day technologies.

The following image shows colleagues assisting each other:

Fig. 8.5.4: Colleagues assisting each other

Activity: Role Play

You are assigned the task to install a hardware at a customer's site. You reach the customer's site along with your colleague. Your colleague starts arguing and shouting at you in front of the customer. What will you do?

Perform the role play.

Hints:

Ask one participant to play the role of the technician and the other to play the role of the colleague who is shouting. Ask a third participant to be the customer.

After the role play, discuss with other participants/viewers about what the players could have done better or if they missed a step/process.

9. Soft Skills

Unit 9.1 – Writing skills

Unit 9.2 – Interacting with People

Unit 9.3 – Decision Making

Unit 9.4 – Team Work and Multitasking

Unit 9.5 – Relative and Critical Thinking

Unit 9.6 – Personal Grooming

Key Learning Outcomes

At the end of this module, you will be able to:

- Write reports and fill forms as needed for the role
- Interact with people
- Make decisions
- Work in a team and perform multitasking
- Identify how to enable relative and critical thinking while performing tasks
- Identify various aspects of personal grooming

UNIT 9.1: Writing Skills

Unit Objectives

At the end of this unit, you will be able to:

- Write down the problems and details of the work done on the job sheet.
- Make reports and fill forms

9.1.1. Writing Information in a Job Sheet

A job sheet is a document prepared by a senior at a workplace, typically a supervisor, for the technicians to fill each time they undertake a task (a job, such as fixing a hardware or installing a new device). It serves the purpose of storing records for later reference as well as acts as a proof of the job completed along with the effectiveness and efficiency with which it was completed.

A job sheet has various fields/columns that correspond to the description of the job such as when was the job assigned; what is the customer's name, address and phone number; is the product under warranty; was the job completed on time; who was assigned the job; the customer's signature and other such fields.

A technician needs to, therefore, possess certain writing skills to ensure that the documents are filled correctly and legitimately. The handwriting needs to be clear and easily readable to the customers as well as the supervisors. Moreover, the technician should be able to read and then fill the right information in the specific fields.

The following figure shows a sample of a job sheet that the field technicians are required to fill for every job assigned to them:

Work Job Sheet

Name of the employee: _____
Employee ID: _____
Department: _____
Assigned job date: _____
Completed on: _____
Job assigned by: _____

Customer Information

Name:
Address:
City:
State:
Pin Code:

Phone:
Email:
Source of Contact:
☐ Email   ☐ Phone

Complaint Details

Type of Complaint:
Description:
In warranty:

For Office Use Only

Total cost involved:
Mode of payment:

Sign of the customer   Sign of the employee

Fig. 9.1.1: A sample of a job sheet

9.1.2. Filling Information in an Invoice

Though an invoice is generally system generated after the sale of a product, but sometimes, a technician may be required to fill a few fields in the invoice at a customer's site, depending on the circumstances. For example, in case of a faulty part in a printer, a field technician may have to carry a new part to replace it and the invoice sheet for that part. But, the invoice will be filled with the details only if the faulty part is beyond repair and the customer agrees to pay for the new part.

The following figure shows a sample of an invoice that a field technician may be required to fill for a specific job assigned to him/her:

Fig. 9.1.2: A sample of an invoice

9.1.3. Filling a Checklist

In addition to other forms, a field technician may also need to fill a checklist for a specific job/task. To be able to fill it, the technician should know how to read it correctly and then fill the right responses based on the task completed. Typically, a checklist has a Yes or No format where the columns/fields have to be simply ticked. But sometimes, there may be a few fields for which the small sentences or statements may have to be written.

The following figure shows a sample of a checklist that a field technician is required, sometimes, to fill for a job; for example, fixing a faulty hard drive:

Task	Daily	Weekly	Monthly	Quarterly	Half - Yearly	Yearly
Run Microsoft Update (critical update)						
Update antivirus scanner signature						
Run antivirus scan						
Run malware scanner						
Vacuum the system exterior						
Scan/clean/compact registry						
Defrag hard drive						
Run scandisk on your drives						
Full system back up						
Check for optical drive firmware updates						
Check for video adapter updates						
Refresh achieve backups						
Check for motherboard BIOS updates						
Clean system thoroughly, inside and out						

Fig. 9.1.3: A sample of a checklist

UNIT 9.2: Interacting with People

Unit Objectives ◎

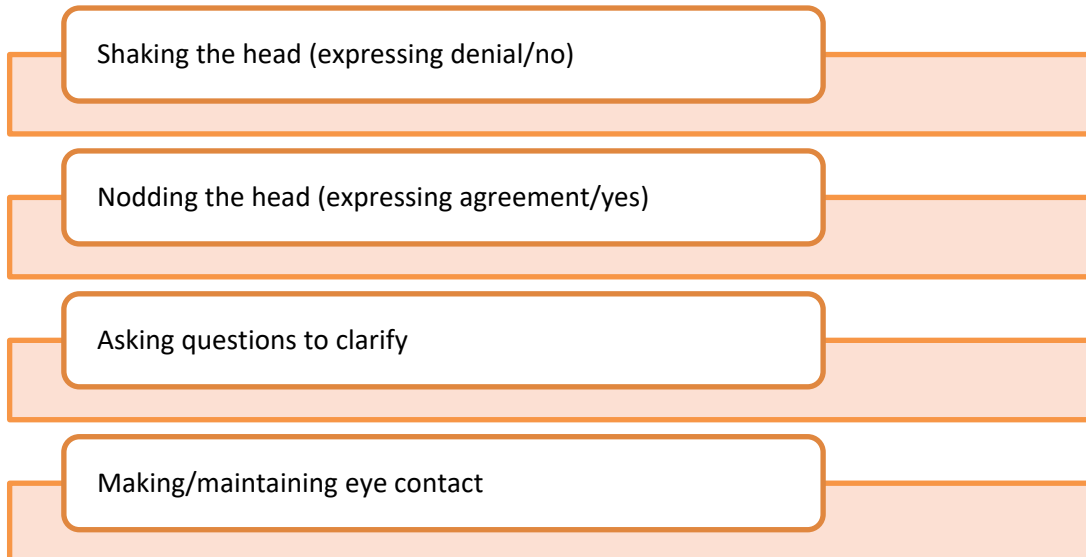**At the end of this unit, you will be able to:**

- Identify the basic communication skills
- Define listening, communication, critical thinking and decision making
- Identify critical thinking skills
- Recognize factors that limit decision making skills

9.2.1 Listening

No matter where a technician may be, whether in a field or in an organization, the person does not want only to be heard but also to be understood. Therefore, active listening plays a vital role while interacting with people. This skill can be developed with practice and patience.

What is Listening?

In a layman's term, listening means paying attention. It means full concentration, engagement and absorption of what the other person is trying to convey. It includes expressing and giving responses by various actions as listed in the following figure:

Shaking the head (expressing denial/no)

Nodding the head (expressing agreement/yes)

Asking questions to clarify

Making/maintaining eye contact

Fig. 9.2.1: Ways of expressing and giving response to show active listening

Why is Listening Important?

In the field, while working with a customer, supervisors and colleagues, there are three major reasons as to why listening is essential.

The following figure lists these three major reasons:

Shows respect for colleagues and earns their trust

- Given the amount of pressure and stress at a workplace, people like to have understanding and supportive colleagues.
- A person's value increases when they show understanding and reach out.

Helps to understand issues and provide solutions

- An active listener gains a better insight into the colleague's concerns.
- A deeper understanding of the problem results in providing better and accurate solutions.

Helps to diffuse conflict

- A workplace loaded with ideas is subject to conflict of interests.
- A person's openness to opinions and different perceptions revolving around a situation helps in diffusion of conflicts.

Fig. 9.2.2: Importance of listening

How Does Listening Improve Workplace Performance?

One can notice the benefits, if emphasis is laid on effective listening at work. It results in better productivity, timely achievement of goals and a better coordination between employees. The following figure lists the factors that help in improving workplace performance:

Reduces Conflicts	Reflects Caring Attitude	Increases Working Rate	Decreases Duplication of Efforts
• People if not heard tend to look for other opportunities because it builds resentment. • A good listener always helps colleagues and reduces the communication gap.	• Employees react to the open door policy in a positive manner. • Employees are aware that they will be heard and the issues will be resolved with the best solution.	• When employees listen effectively, the tasks are accomplished before time and the pace of work is much faster. • This step helps in maintaining focus and clarity towards the task.	• Good listeners tend to make less mistakes while working, leading to higher productivity. • For someone who is not an efective listener, the productivity is low due to less comprehension.

Fig.9.2.3: Factors that help in improving workplace performance

9.2.2 Communication

Communication means sending/receiving information by writing or speaking. There are a lot of technicians who often struggle while communicating.

When on a visit to a customer's site, to ensure good service, the customer's requirement should be understood and a solution should be suggested.

The following figure represents the points to be taken care of while communicating with a customer:
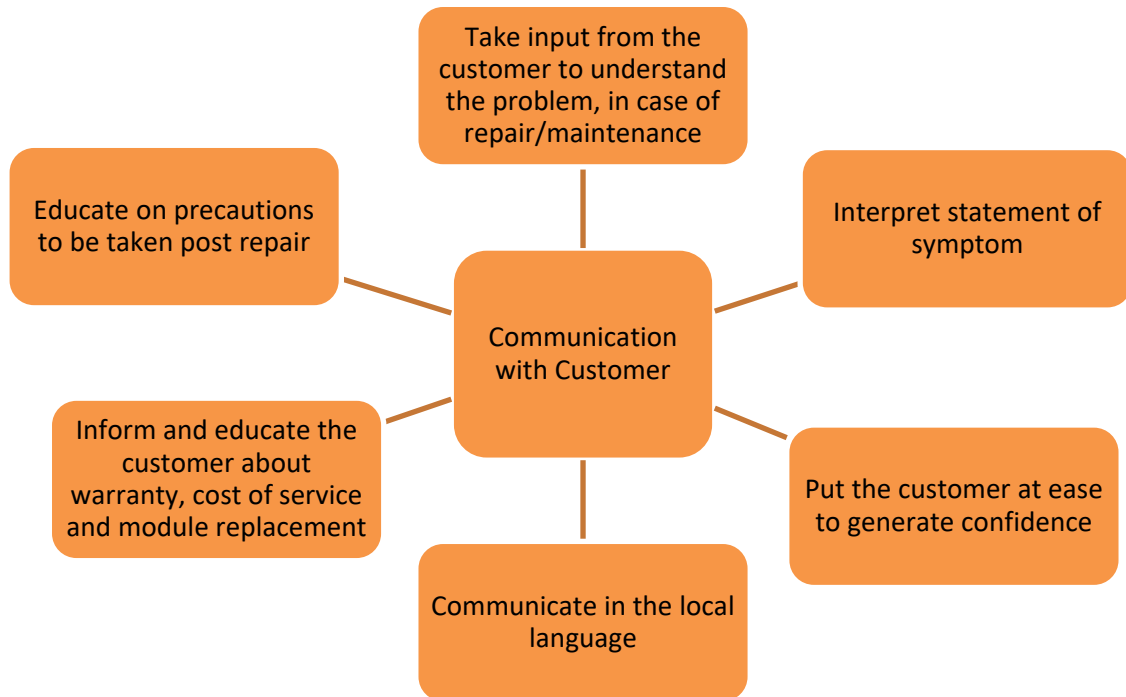

Fig 9.2.4: Communicating with a customer

There may be instances during conflicts when people may lose their temper. It is important for a person to control anger at all times, as it leads to mistakes. The following figure lists a few points on how to communicate when angry:

Fig. 9.2.5: Steps on how to communicate when angry

In case a person is very angry, it is advisable to stop and step back to breathe. Take a few minutes to calm down. Once the anger subsides, try to think and figure out what the real problem was and where/how the situation worsened. Finally, go ahead and talk to the concerned person. After talking, listen carefully to what the other person is saying and try to understand his/her feeling.

UNIT 9.3: Decision Making

Unit Objectives
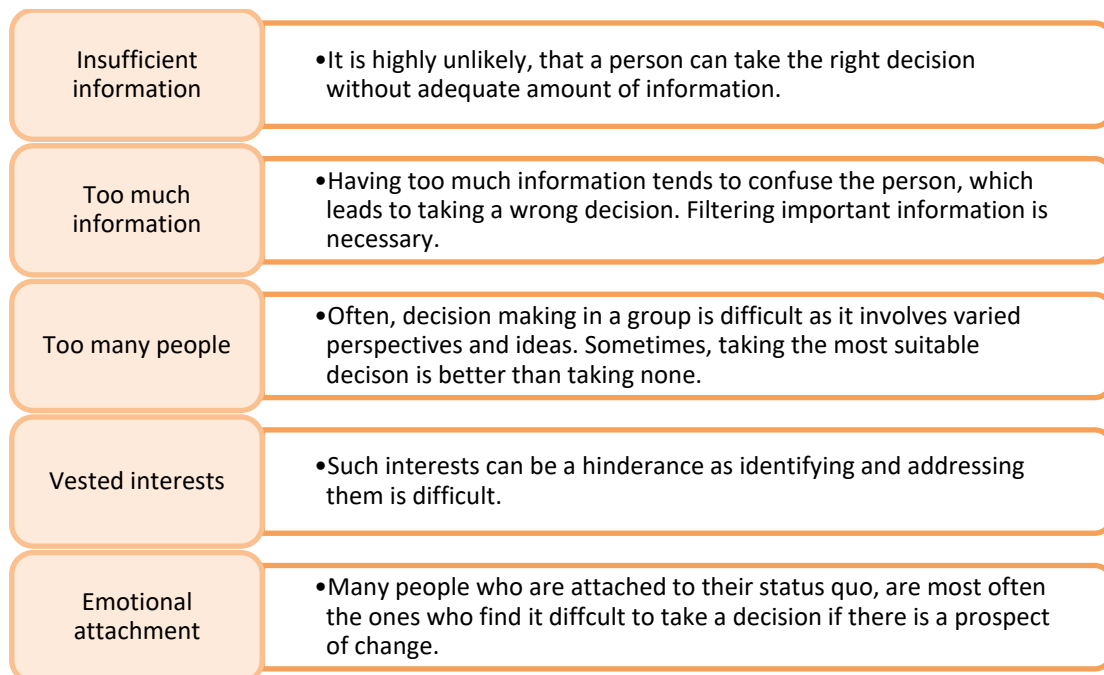
At the end of this unit, you will be able to:

- Make on-spot decisions in the field
- Decide whether to call customer care or not

9.3.1. Making Decisions in the Field

The ability to choose the best between multiple courses of action is called decision making. It involves using either a person's intuition or reasoning, or both.

Deciding upon something using the 'gut-feeling' is called as intuition. It typically involves a person making decisions on the basis of prior work experience, values or both. Reasoning involves using factual data to interpret a situation and take a final decision. Emotional aspects are usually ignored while taking such decisions.

Numerous issues can limit a person from taking the right decision. The following figure explains the factors responsible for this problem:

Insufficient information	• It is highly unlikely, that a person can take the right decision without adequate amount of information.
Too much information	• Having too much information tends to confuse the person, which leads to taking a wrong decision. Filtering important information is necessary.
Too many people	• Often, decision making in a group is difficult as it involves varied perspectives and ideas. Sometimes, taking the most suitable decison is better than taking none.
Vested interests	• Such interests can be a hinderance as identifying and addressing them is difficult.
Emotional attachment	• Many people who are attached to their status quo, are most often the ones who find it diffcult to take a decision if there is a prospect of change.

Fig. 9.3.1: Factors that limit decision making

9.3.2. Points to Consider for Decision Making

While making decisions in the field, the points listed in the following figure need to be considered:

What decision needs to be taken	What are the choices and risks involved	Compare the choices and evaluate the options	Select the best possible option	Implement the decision and check the results

Fig. 9.3.2: Points to be considered for decision making

When making important decisions related to work, a field technician needs to ask the following questions and the answers to these questions would help make the correct decision at the right time:

- What decision needs to be taken? Is it a spontaneous decision? Can it be made at a technician level and is it absolutely necessary to make the decision immediately?
- What are the choices and risks involved? Analyse the risks that are involved if the technician does make a decision and implements it in the field. If the risks are too high, it is best to avoid making the decision. Then, analyse all the choices available and the best choice which involves the least risk.
- What is the best choice? Compare the choices and evaluate the options to arrive at the best choice.
- Which seems to be the best possible choice for the current situation in the given time frame? Select the best possible option based on the circumstances and time.
- Will the results be as expected? Implement the decision and check the results.

UNIT 9.4: Team Work and Multitasking

Unit Objectives ◎

At the end of this unit, you will be able to:

- Identify essential aspects of working in a team
- Share work load as required
- Achieve the targets given on service and sales

9.4.1 Working in a Team

A field technician needs to be able to work in a team. To do this, a technician should be able to get along with fellow technicians, respect others and always show a cooperative behaviour.

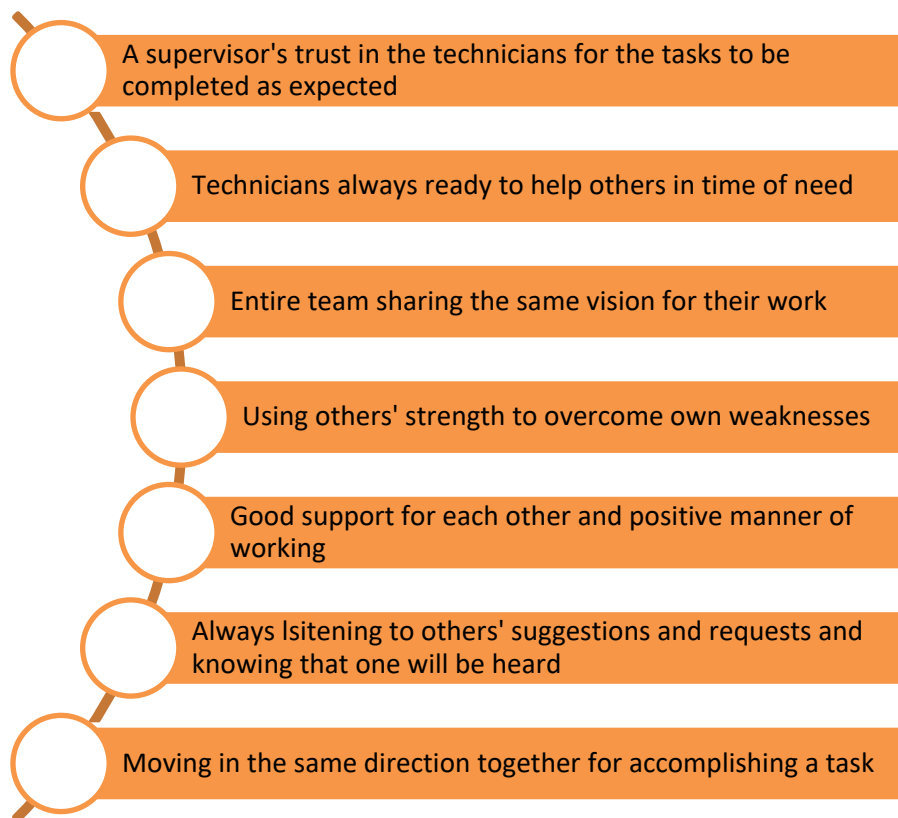Working in and as a team enables some positive aspects as listed in the following figure:

A supervisor's trust in the technicians for the tasks to be completed as expected

Technicians always ready to help others in time of need

Entire team sharing the same vision for their work

Using others' strength to overcome own weaknesses

Good support for each other and positive manner of working

Always lsitening to others' suggestions and requests and knowing that one will be heard

Moving in the same direction together for accomplishing a task

Fig. 9.4.1: Points to be considered while working in team

To make teamwork effective at workplace, the points listed in the following figure need to be considered:
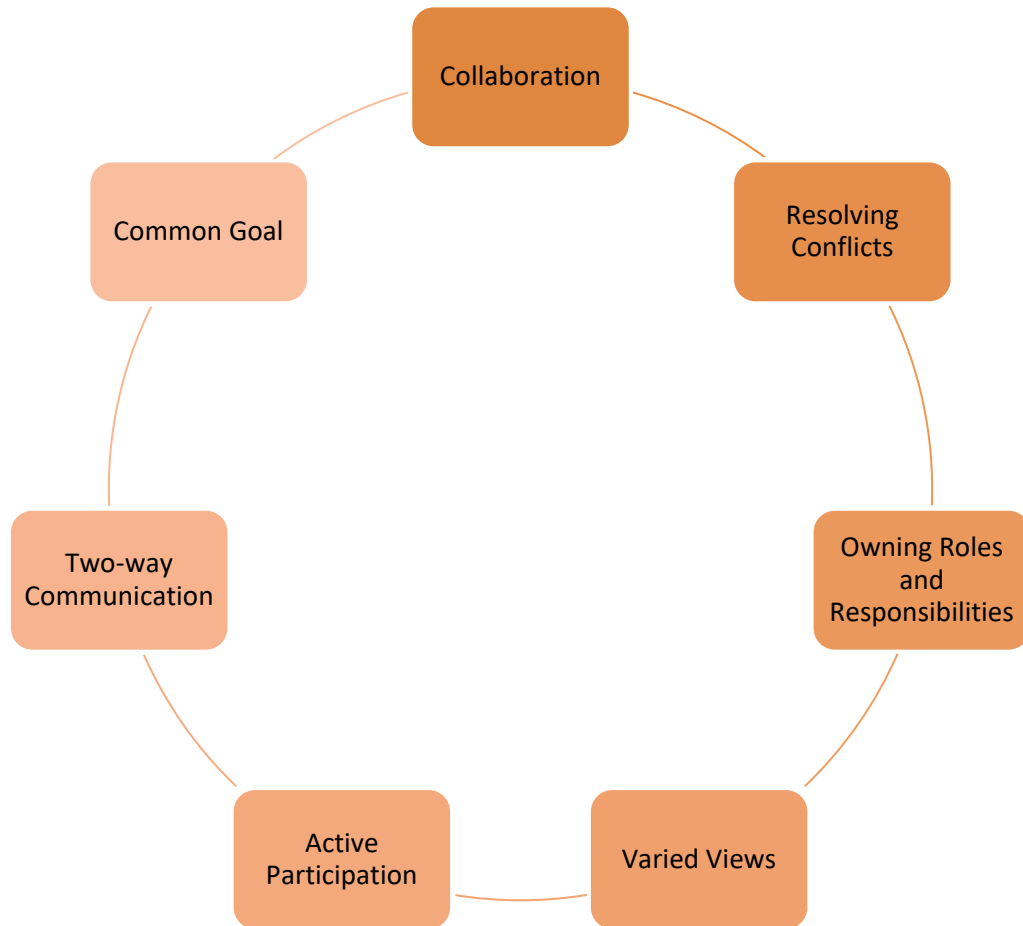
Fig. 9.4.2: Points to be considered for effective teamwork

Activity: Discussion

Case study discussion: Understanding behaviour type

You have a colleague who is always pressed for work. He never seems to have time for completing his work. He comes late to work, is continuously on his job without taking a break, and at the end of the day is scolded by his superior for not completing his work. He is also bullied by some colleagues, who give their work to him because of which he is unable to complete his own work.

How will you, as a colleague, help him resolve his problem?

UNIT 9.5: Reflective and Critical Thinking

Unit Objectives ◎

At the end of this unit, you will be able to:

- Define reflective thinking
- Use critical thinking to improve work processes
- Reduce repetition of errors
- Spot process disruptions and delays
- Report customer concerns to superiors without delay

9.5.1. Improving Work Processes using Critical Thinking

Reflective thinking is enabled by deep thought and depends more on prior understanding and thinking about the subject.

Another important skill that a field technician should possess is critical thinking. It allows a person to make critical decisions and enables a person to judge a situation while the speaker is talking.

Critical thinking is defined as a person's ability to make logical decisions in a particular situation, keeping all the emotions aside. This quality enables a technician to:

- Collect information for analysis of a situation
- Generate ample solutions to resolve a problem
- Get feedback
- Add value to business solutions

Critical thinking helps a person to go through many possible solutions for a situation by analysing it, and coming up with the best possible solution.

The following figure lists the benefits of critical thinking and reflective thinking:
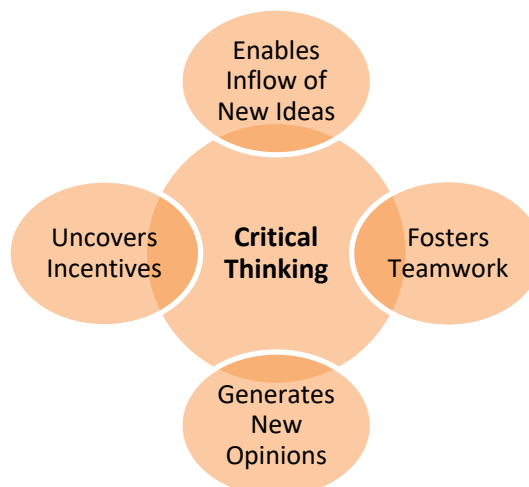
*Fig. 9.5.1: Benefits of critical thinking*

Critical thinking can be divided into three fundamental skills. The following figure lists these skills:
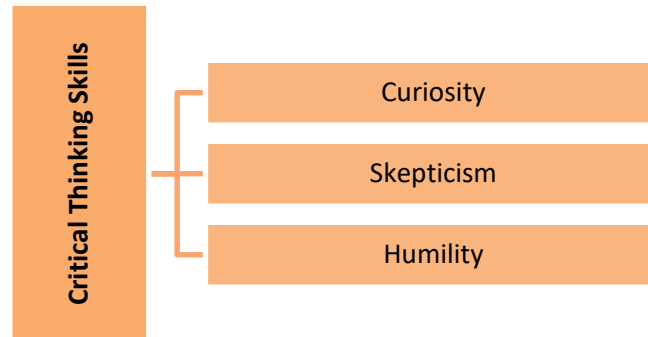
Fig. 9.5.2: Critical thinking skills

Curiosity is the hope of learning and garnering more information/knowledge as well as looking for evidence and welcoming new ideas. Scepticism includes not believing everything that a person comes across and putting questions to get convinced fully. Humility involves acceptance by a person if an idea gets rejected or is not considered suitable. At the same time, the person is open to new ideas.

The following figure lists other skills which are essential for critical thinking:
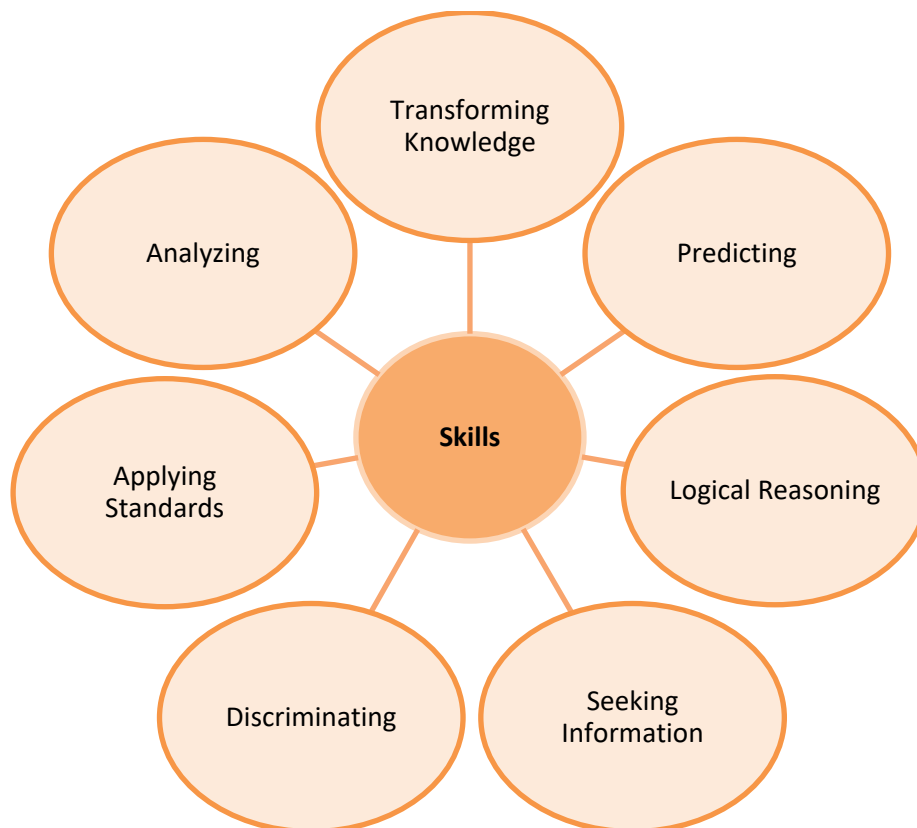
Fig. 9.5.3: Other critical thinking skills

Activity: Discussion

Shyam is a smart field technician who has recently joined an organization. After about a fortnight at work, he realizes that there are many issues, which if handled properly can increase productivity and morale of the people. There are more than two people doing the same work whereas it can be done by one. Role duplicity seems to be the case.

Also, there are two or more supervisors commanding all the field technician and they do not communicate among themselves. Thus, these field technicians pass the buck on each other. Field technician also take long breaks to have negative discussions, which sets in a bad morale in the rest of the wiremen.

What should Shyam do to improve the situation? Also, what should be the correct steps for him to follow? Discuss and write the measures.

UNIT 9.6: Personal Grooming

Unit Objectives 🎯

At the end of this unit, you will be able to:

- Identify the importance of personal grooming
- Use proper etiquette during customer interaction

9.6.1. Importance of Personal Grooming

Apart from having technical knowledge, it is important for a field technician to develop some basic personality traits and skills, such as personal grooming.

Being well groomed at workplace reflects a positive and professional attitude towards work. The following figure shows the various aspects of personal grooming:
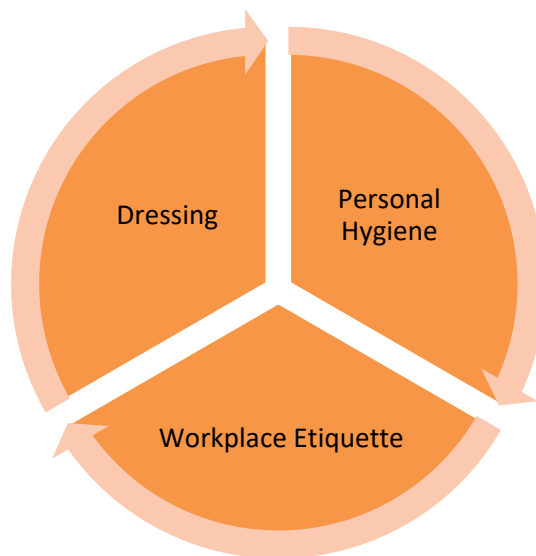

Fig. 9.6.1: Aspects of grooming

The following image lists a few of the good practices classified under different aspects of grooming:

Dressing	Personal Hygiene	Workplace Etiquette
Clothes should be neat and clean.	Hair should be neatly combed and trimmed.	Smile and greet the customer.
Clothes should be ironed.	Nails and hair should be cut.	Be punctual.
Uniform should be worn, if the company has such a requirement.	Teeth should be clean.	Apologize on making a mistake.
	Bath should be taken everyday. Body odor and sweating should be taken care of.	Be polite.
		Be careful of body language.

Fig. 9.6.2: A few of the good practices for grooming

Field technicians need to possess qualities as shown in the following figure to ensure that they excel in their job:
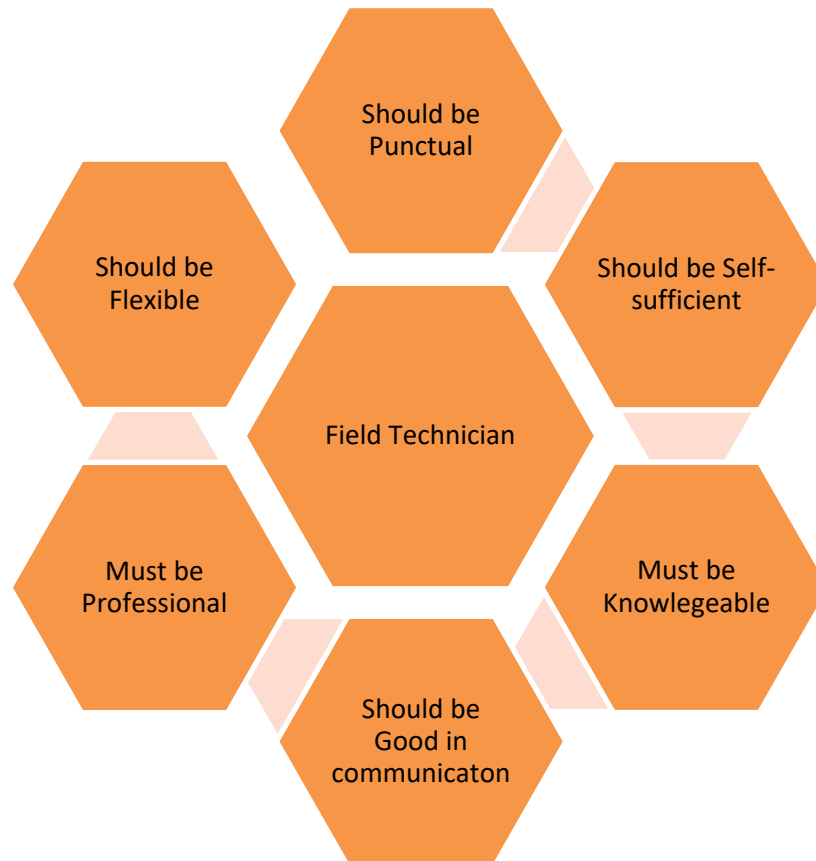
Fig. 9.6.3: A few qualities that a field technician must possess

Activity: Group Discussion

Get together in groups of three or four.

List down at least three things related to grooming which you should do and which you should avoid while on a visit to a customer's site.

Use the following table to make the list.

	Dressing	Personal Hygiene	Etiquette
To Do			
To Avoid			

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