# Summary

ملخص "تـقـن" Chapter 2 CT

"هذا الملخص لا يغني عن الكتاب."

الله يوفق الجميع !

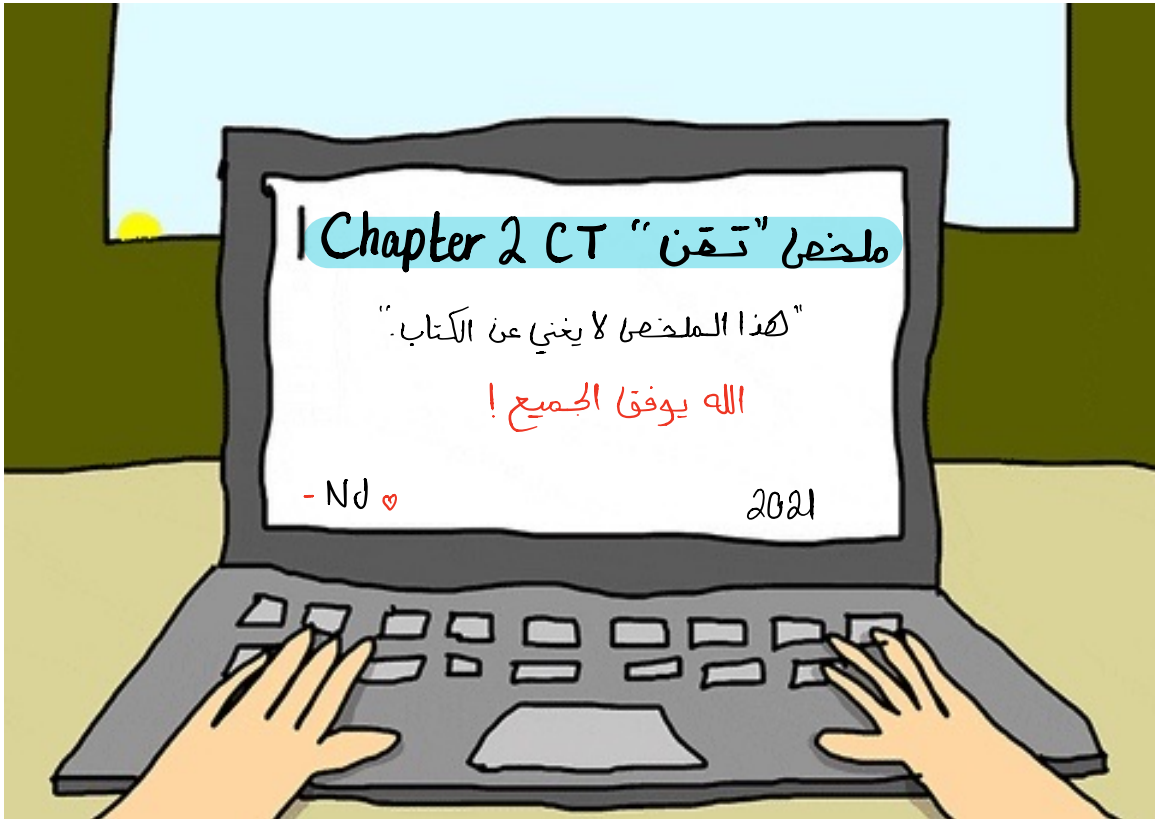- NJ ♡                                          2021

# IT-Skills

# ♡Chapter 2 Session 1♡

## Data and Information

Data is defined as a collection of raw facts, figures, or statistics, which are collected and processed to deduce information, which in turn is used to make decisions. The raw facts (or factual information) and statistics are first represented in the computer as quantities, characters, or symbols; any necessary operations are then performed, and the output is stored and transmitted in the form of electronic signals and finally recorded on a media device.

### Example

Some companies obtain people's opinions by collecting data via distributed surveys. This data is collected, in whatever form the people provide it, and the data needs to be summarized into reports to be presented to management (decision makers). The managers then make important decisions based on the data collected through surveys and the reports prepared from the data. The following figure illustrates the process, from data transmission to information.

**Data Survey** → **Processing Summarizing** → **Information Reports**

## Types of Data

Data comes in different forms that a computer can take as input => process it => info. output.

### Text

Text is a sequence of alphabetic and other characters, each of which is represented as a binary bit pattern (0's and 1's) or a code. It includes combinations of alphabets, both lowercase and uppercase. These are stored and populated using an encoding system called "ASCII" (American Standard Code for Information Interchange). Each text symbol is a different bit pattern, and each character occupies one byte (which is eight bits) that is made up of numbers.

*Convert charachter. --*

| LETTER | ASCII CODE | BINARY |
|--------|-----------|--------|
| k | 107 | 01101011 |
| K | 075 | 01001011 |
| s | 115 | 01110011 |
| S | 083 | 01010011 |
| u | 117 | 01110101 |
| U | 085 | 01010101 |

**For example:**
The abbreviation for King Saud University is "KSU" and the codes representing it are shown in given table

### Numbers

Numbers include all combinations of digits from 0 to 9. Numbers are also represented by bit patterns. However, numbers do not use the ASCII table, because they are directly converted to binary numbers, to simplify mathematical operations.

## Images

Images are also represented by bit patterns. An image is composed of pixels, where each pixel is a small dot. Its size depends mainly on the image resolution—the higher the resolution, the more memory the image occupies.

## Audio

Audio refers to sound or music. It is different from the previous data types because it is not discrete, but continuous.
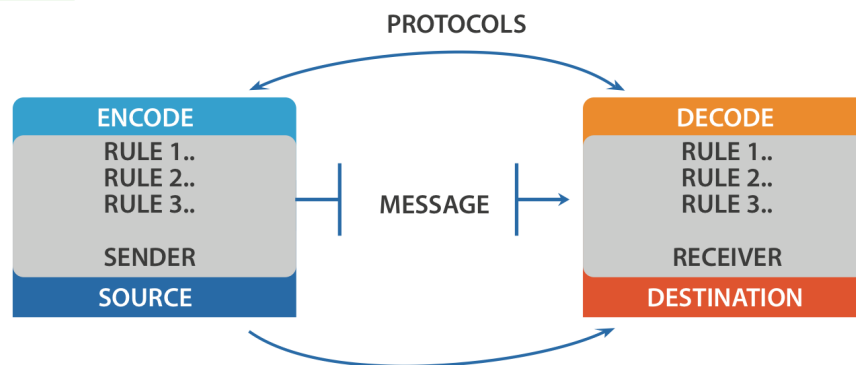
## Video

Video refers to a continuous data that is being broadcast or recorded, as a combination of audio, such as sound or music, and a sequence of images. For example, output from a TV camera.

# Data Communication Systems

The process of transmitting and exchanging data and information is called "data communication." This process involves the communication between Hardware(physical equipment) and Software(programs), which are part of the communication system. Hardware, as discussed in Chapter 1, involves the devices of the sender and the receiver.

The hardware devices of the sender, receiver, and intermediaries are used to pass and transmit the data. The software involves rules that specify what is communicated and how it is communicated. These rules, or processes are called as protocols.

PROTOCOLS

| ENCODE | MESSAGE | DECODE |
|---|---|---|
| RULE 1.. | | RULE 1.. |
| RULE 2.. | | RULE 2.. |
| RULE 3.. | | RULE 3.. |
| SENDER | | RECEIVER |
| SOURCE | | DESTINATION |

# Components of a Data Communication System

## Contains 5 main components
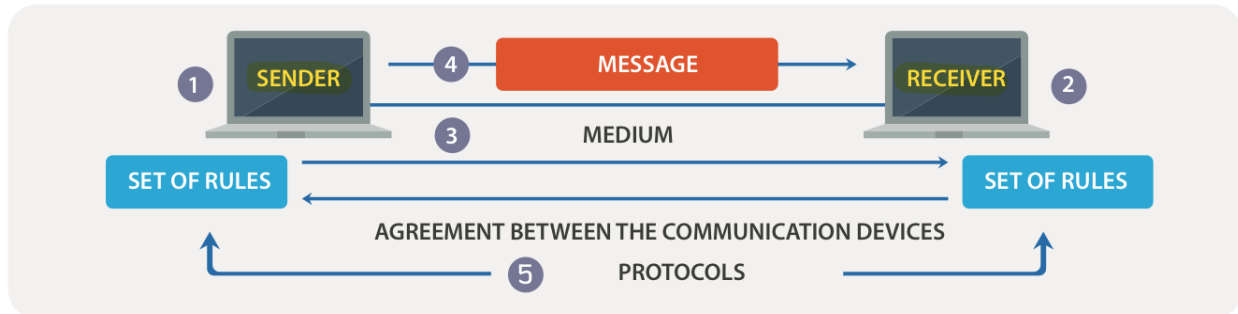


## 1 - Sender

The sender is the hardware device that sends the message. It can be a computer, telephone handset, workstation, video camera, or any other device that can send data. Normally, a computer is used as the sender in information communication systems.

## 2 - Receiver

The receiver is a device that can receive a sent message. It can be a computer, workstation, telephone handset, television, printer, fax machine, or any other computer-related device. The receiver must be capable of accepting the message.

## 3 - Transmission medium

The transmission medium is the physical path that connects the sender with the receiver, which is used to transmit data between the sender and receiver. It can be wires, such as twisted-pair, hub, cables, or optical fiber, or it can be wireless, such as microwaves and radio waves.

## 4 - Message

The message is the actual data or information to be communicated between the sender and receiver. The message may include all data types. Some data will be converted, depending on its type. For example, text is converted into binary, and images into pixels, whereas the other types will be sent as it is.

## 5 - Protocol

When two devices establish a connection, no communication can be accomplished without an agreement on the rules that will be followed during this communication. Therefore, when two devices communicate, they need an agreement; this agreement, called a protocol, is a set of rules that encode and decode messages and govern and control message transmission between computers on the network.

# Data Communication System Characteristics

## a - Delivery

The data system should deliver the message to the right destination and guarantee the receipt of the message by the intended device.

## b - Accuracy

The system must guarantee the accuracy of the delivered message. Data that is received is not altered in transmission.

## c - Timeliness

The system must deliver the data in a timely manner; late data delivery is useless. For some data types, timely delivery means delivering the data as it is produced and in the same order (for example, video and audio). This kind of delivery is called "real-time transmission."

## d - Jitter

Jitter is the variance in the arrival time of the data packets over the network. For example, when two computers are communicating, both will transfer data packets. If the network is in good condition, the packets travel at equal intervals, which allows the receiving computer to process the data. However, if there is a jitter in the intervals, the process becomes disrupted.

# Data Flow

The data flow describes the direction of the messages sent via communication channel.

## a - Simplex

As shown in the figure, simplex communication means that only one device can transmit the data, and the other device will act as a receiver only, so messages are sent in only one direction.



**DIRECTION OF THE DATA**

**SENDER (DEVICE)**     **RECEIVER (DEVICE)**
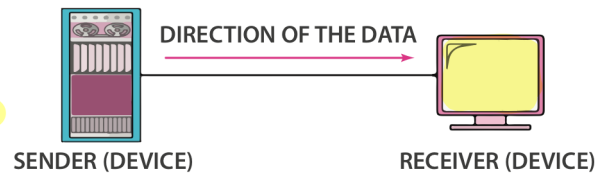
**Examples**  TV broadcasting; keyboards and monitors, where the keyboard provides the input and the monitor accepts it as output.

## b - Half duplex

In half-duplex communication, each station can transmit and receive, but not at the same time. One station acts as the sender and sends the message that the other station receives. This mode is used when there is no need to communicate in both directions at the same time. Once the message has reached the receiver, the receiver can reply to the message.



**DIRECTION OF THE DATA AT TIME 1**

**DIRECTION OF THE DATA AT TIME 2**
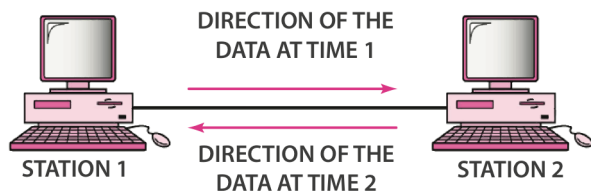
**STATION 1**     **STATION 2**

**Examples**  walkie-talkie, with a "push to talk" button that sends data with no reply needed at the send time.

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## c - Full duplex

As shown in the figure, full-duplex communication is when messages can be transmitted from and received by both stations/devices simultaneously.



**DIRECTION OF THE DATA ALL THE TIME**

**STATION 1**     **STATION 2**
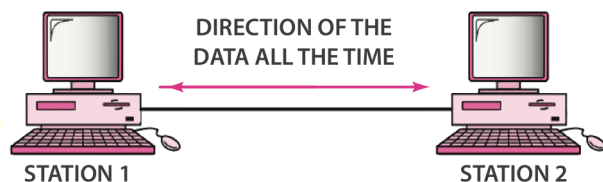
**Examples**  the telephone and cell phone networks, where two people can talk and listen on the phone at the same time. It is used when communication is required all the time.

# Computer Networks

A computer network is an interconnection of a group of computer systems and other hardware at different locations. Two or more computers are linked through a "data communication device" and a "medium" to share resources and information.

Following are some of the benefits of Computer Networks

## Facilitate communication

By using a computer network, users can communicate easily and efficiently via different communication channels. Examples include sending emails, video conferences, and telephone calls.

## File sharing

By using a computer network, files can be shared between computers, which gives users flexibility to access files remotely. Shared files can include photos, music, and documents. Users can use a home network to save copies of important data on different computers, as well as to keep backup copies that can be retrieved when needed..

## Resource sharing

A computer network allows the sharing of peripheral devices such as printers, faxes, scanners and copy machines. It also allows sharing of software between multiple users. For example, a small home network can share a single printer between multiple users, as well as sharing a single copy of software.

## Internet sharing

A computer network allows multiple users to use a single internet connection, which is cost-effective.

## Increase storage capacity

A computer network allows authorized users to access & store files and multimedia remotely, instead of saving a copy on each computer.

## Multi-player games

A computer network enables friends and family to play together, simply by joining the same network.

## Home entertainment

A computer network can be used to share home entertainment products, including video-game consoles such as Nintendo and Xbox. Adding such consoles to the network enables internet gaming and video sharing.

## Improved communication

A computer network can be used by different parties related to a business, such as staff, suppliers, and customers, to exchange instant information, improve communications, and share information easily and efficiently. They can also access common databases, where data is securely saved via the network, thereby saving time and preventing errors.

# Network Categories

> Computer networks are categorized by purpose and size, where the size is determined by the number of computers and the geographic area covered.

## PAN - Personal Area Network

Sometimes called HAN (Home Area Network), these are networks organized around an individual within a small area, usually a single building, allowing data transmission among devices. For example, uploading a photo from a personal cell phone to the user's desktop computer.  *Room /house*
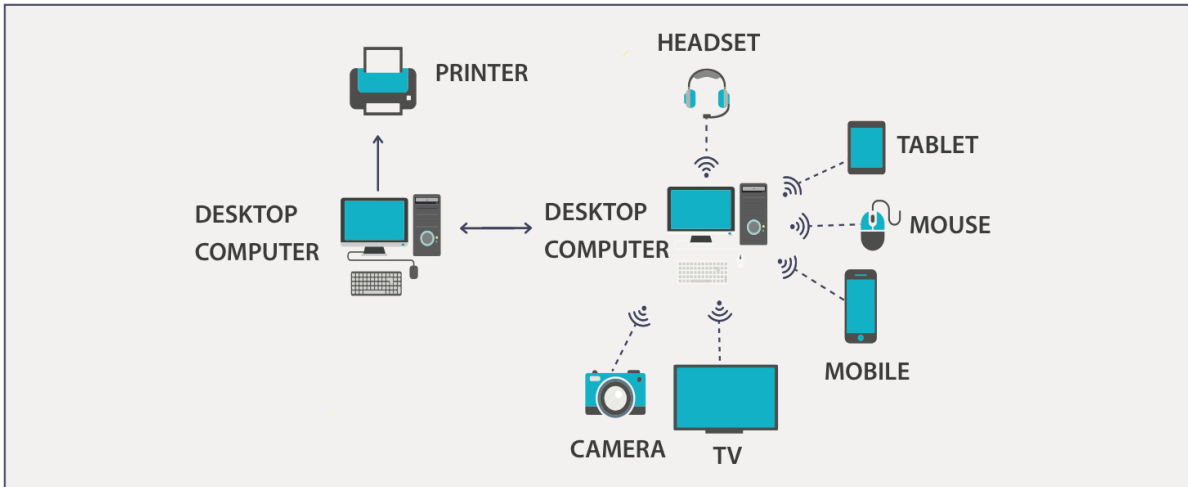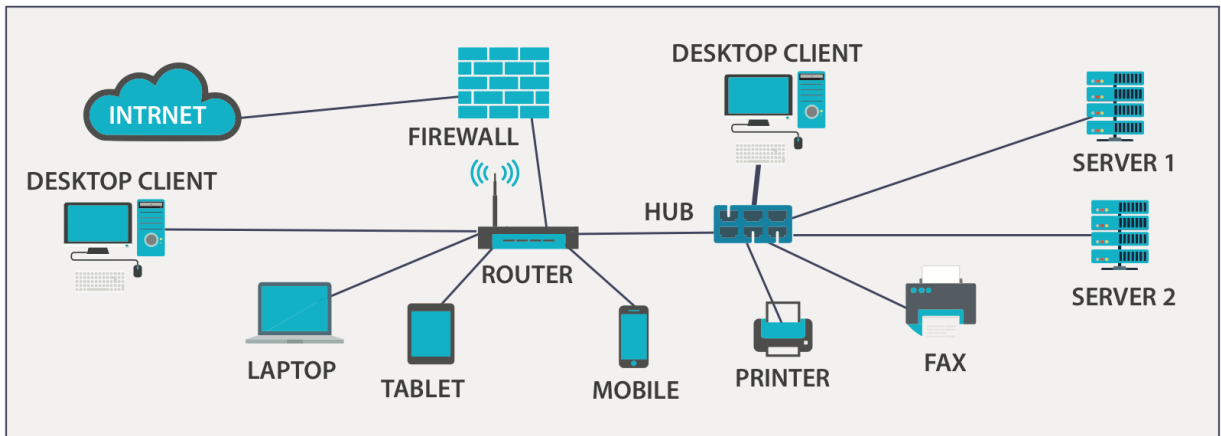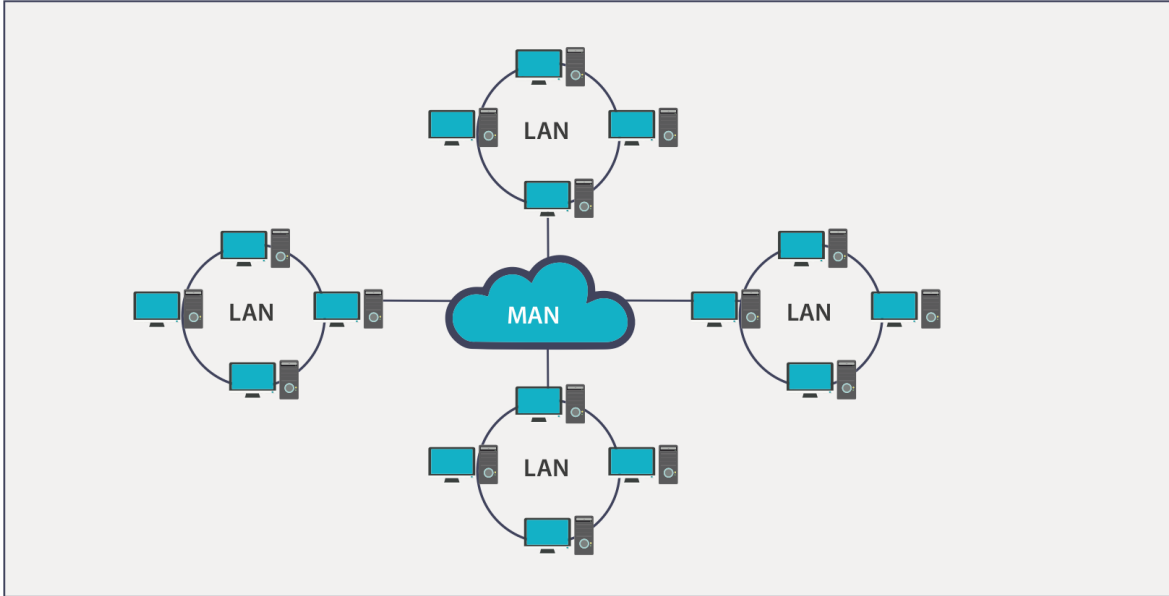


## LAN - Local Area Network

A group of computers located in a clearly defined geographical area, ranging from one floor of a building to a group of small buildings on a single site.  *10m - 1k*
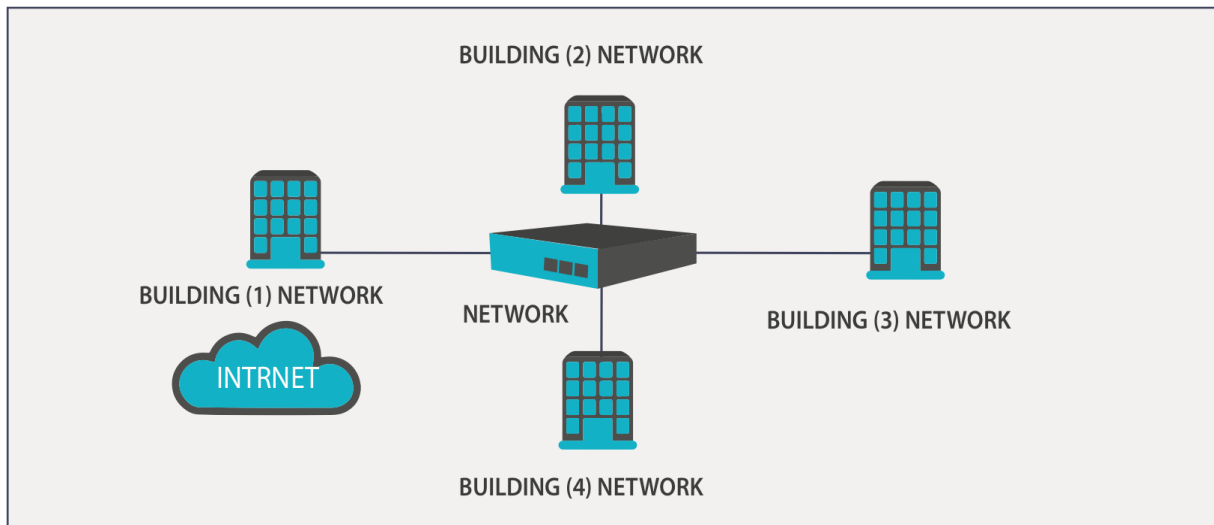
## MAN - Metropolitan Area Network

A computer network that connects multiple LANs at different locations. A MAN may cover an area from around 3 to 30 miles (5 to 50 km). For example, it could connect different stores located in one city.


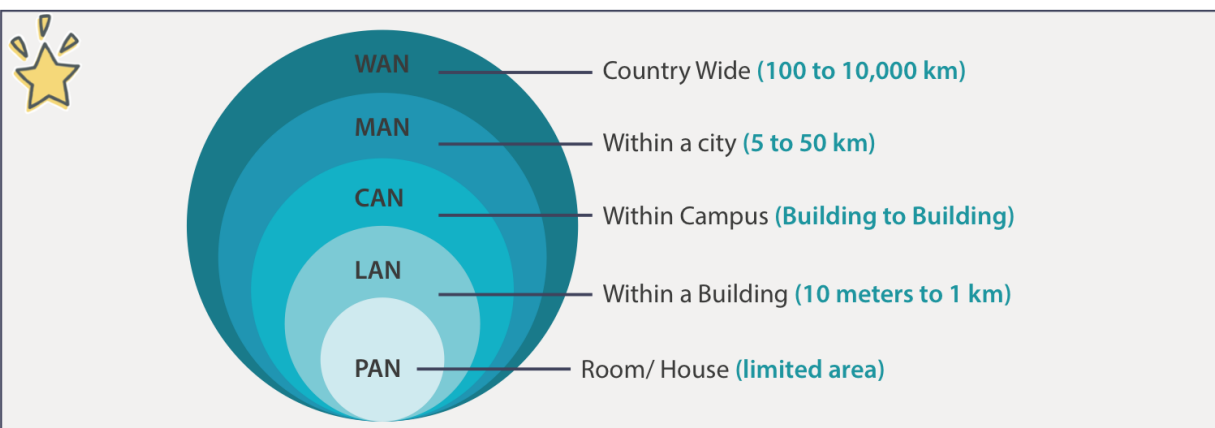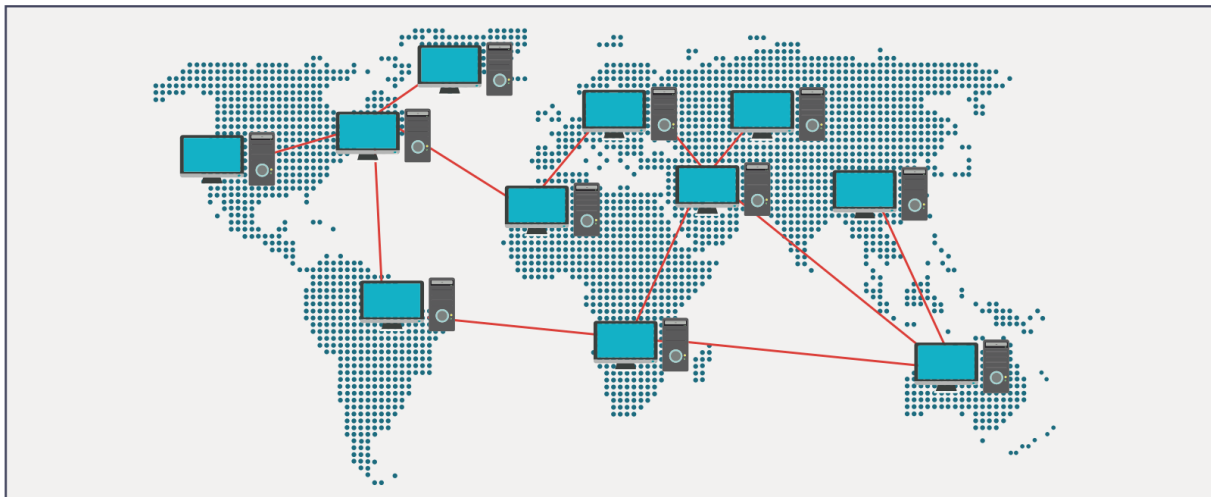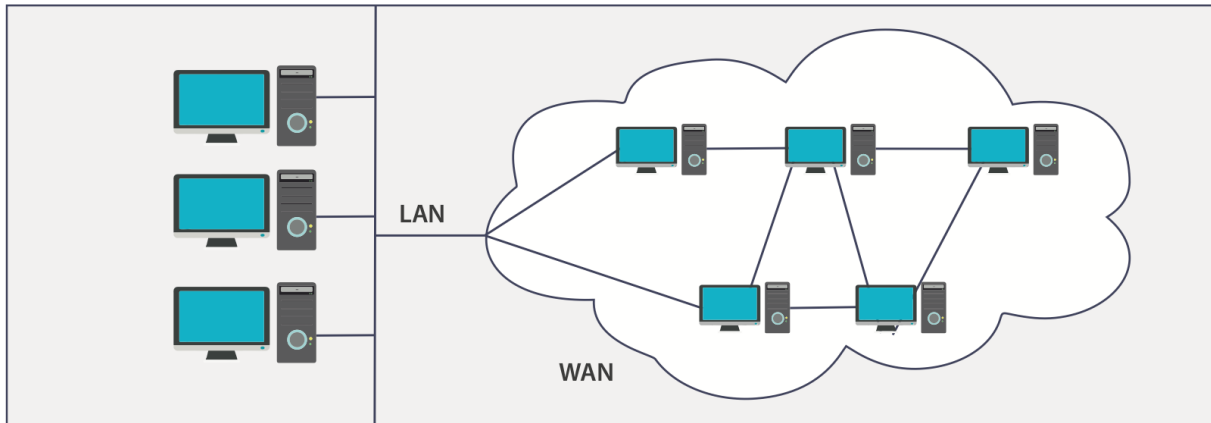
## CAN - Campus Area Network

A network that is made up of an interconnection of LANs within a limited geographical area (somewhere between LAN & MAN). For example, government agencies or a university, where each college within the university has its own network and all networks are under the university umbrella.

Building to building

A computer network used to connect large geographical areas, such as countries. The largest and most well-known such network is the internet.

LAN

WAN

| | |
|---|---|
| WAN | Country Wide **(100 to 10,000 km)** |
| MAN | Within a city **(5 to 50 km)** |
| CAN | Within Campus **(Building to Building)** |
| LAN | Within a Building **(10 meters to 1 km)** |
| PAN | Room/ House **(limited area)** |

# Network Components

## Servers

Servers are computers that hold the main applications, files, and network operating system. Servers enable users to access all network resources, with each server providing several functions:

**Benifit**      **Clients**

**for example**    print server, mail server, file server, application server, database server, and message server.

- **File Servers**
  provide file functions, such as storing and retrieving data, which allow users to read, write, exchange, and manage files.

- **Print Servers**
  provide printing functions on a network and can handle fax services.

- **Application Servers**
  help to reduce cost by sharing software resources, such as allowing users to share one copy of expensive software.
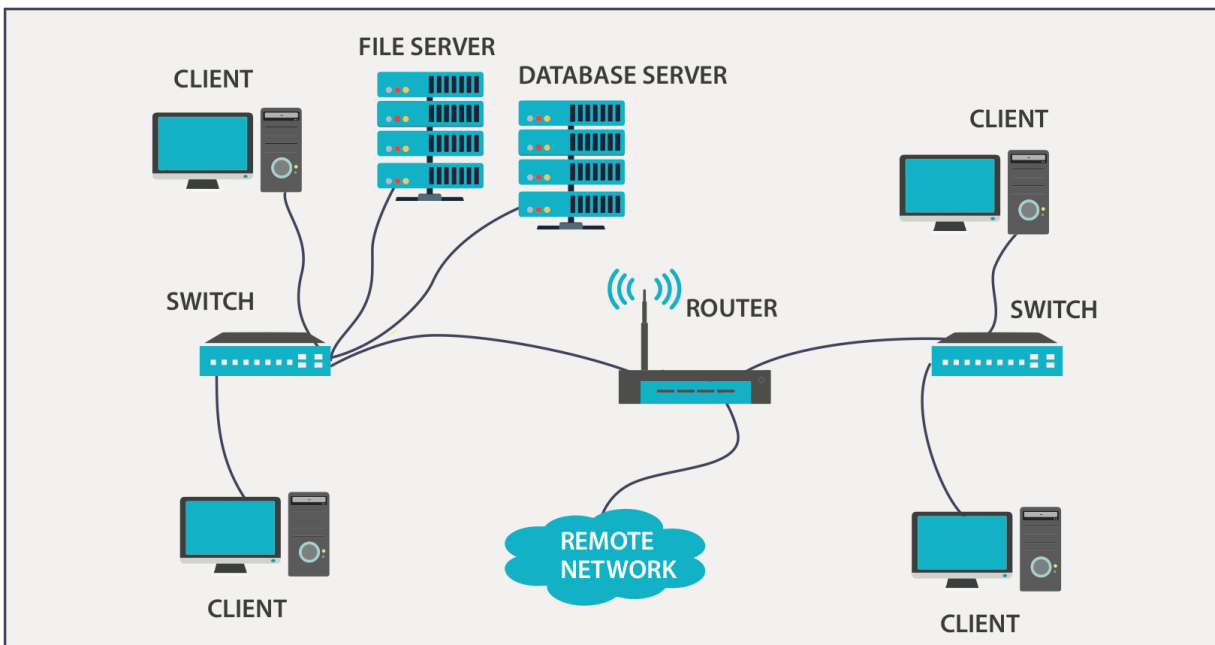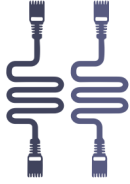
- **Database Servers**
  provide users access to strong, centralized databases.

## Clients

Clients are users' computers that use the network and its resources, requesting and receiving services from the network.

## Transmission media

Transmission media are facilities that are used to connect computers, such as twisted-pair wire, cable, optical fiber or WiFi.

## Network interface card (NIC)

network interface card is an electronic device (card) that is installed in a computer, which allows a connection to the network. For example, lab computers are connected to a university LAN through network interface cards.

## Operating system

Every computer needs a local operating system to function, which allows users to access files, print documents, etc. The network operating system is needed on server computers to communicate over the network. One example is Microsoft's Windows Server.

## Hub

A hub is a hardware device that splits the network connection and distributes it to multiple computers. It works as a center for distributing the connection and can receive multiple requests and transmit them to the entire network.

## Switch

A switch is a hardware device that connects multiple devices together to receive and process data and to forward it to its destination. The switch works as a control unit in the electronic circuit (on and off), where it connects network segments.

## Router

A router is a device that is used to connect a computer to the internet, share a single internet connection with multiple computers, and forward data between computers.

## Ethernet cable RG 45

An ethernet cable is a network wire that is used to connect different devices to the internet or to other devices on the network, such as printers.

Applications are the tools that a computer uses to perform operations. The applications that are run on the computer and are not connected to other computers are called **"stand-alone applications."** Examples include word processors, web browsers, spreadsheets, and presentation software. They function even if they are offline; for example, a document written using Microsoft Word 2016 and saved to the computer would have both the program and file stored locally.

In contrast, **"network applications"** are tools and programs that utilize the internet or another network to perform useful functions, such as file transfer from one point to another. Network applications use a client-server format, in which both computers are connected to the network.

A server is programmed to provide services to a client, which can be a desktop, a laptop, or even an iPhone. The server could be any of these, but it is typically a computer in the data center. ⭐
An example of a typical network might be a client computer running a web client program (web browser), such as Firefox, Google Chrome, or Microsoft Edge, with the server running a web server program like Apache or Microsoft Internet Information Server. Data can be saved locally on the client or on the server, but it operates over a network rather than on either individual computer.
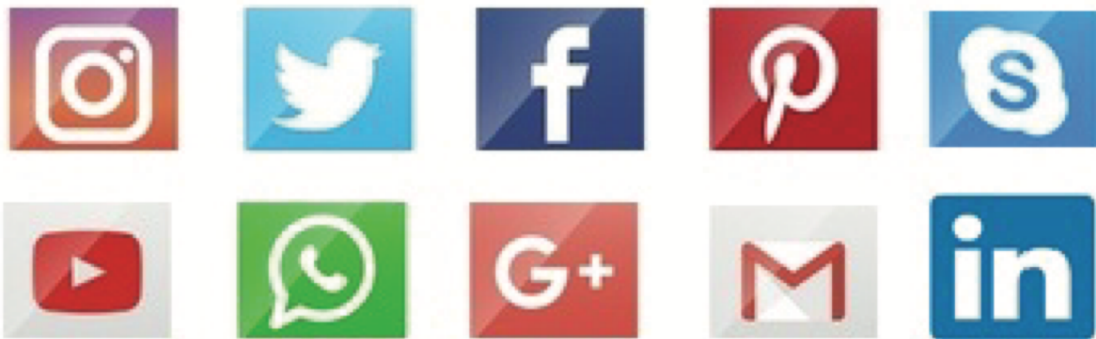
| | |
|---|---|
| ASCII | American Standard Code for Information Interchange. |
| Protocol | The rules or process that specify what is communicated and how it is communicated; acts like a translator |
| Simplex | Sender transmits the data; the other device acts as a receiver only |
| Half-duplex | Each device can transmit and receive the information, but not at the same time |
| Full-duplex | The sender and receiver devices can transmit and receive the information, simultaneously |
| Jitter | The variance in the arrival time of the data packets in milliseconds (ms) over a communication network |
| Network Interface Card (NIC) | Electronic device (card), which allows a connection to the network |
| Hub | Hardware device that splits the network connection and distributes it to multiple computers |
| Router | Hardware device used to share a single internet connection to multiple computers |
| Ethernet Cable | Network cable used to connect different devices to the internet |

**Data Communication and Networking**

- Data and Information
  - Data Types
- Data Communication System
- Data Communication System Characteristics
- Data Flow
- Computer Network
  - Network Components
  - Network Benefits
  - Properties of Computer Networks
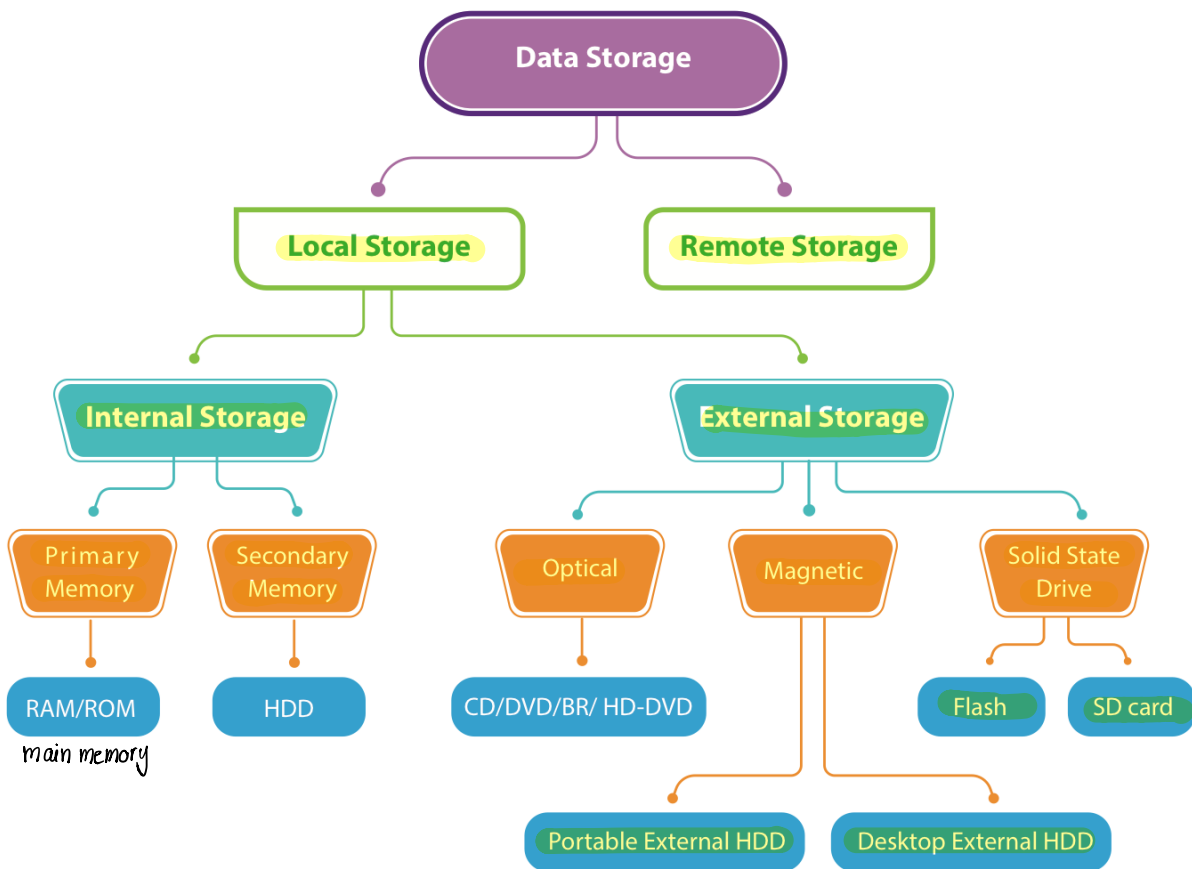  - Network Applications
  - Network Categories
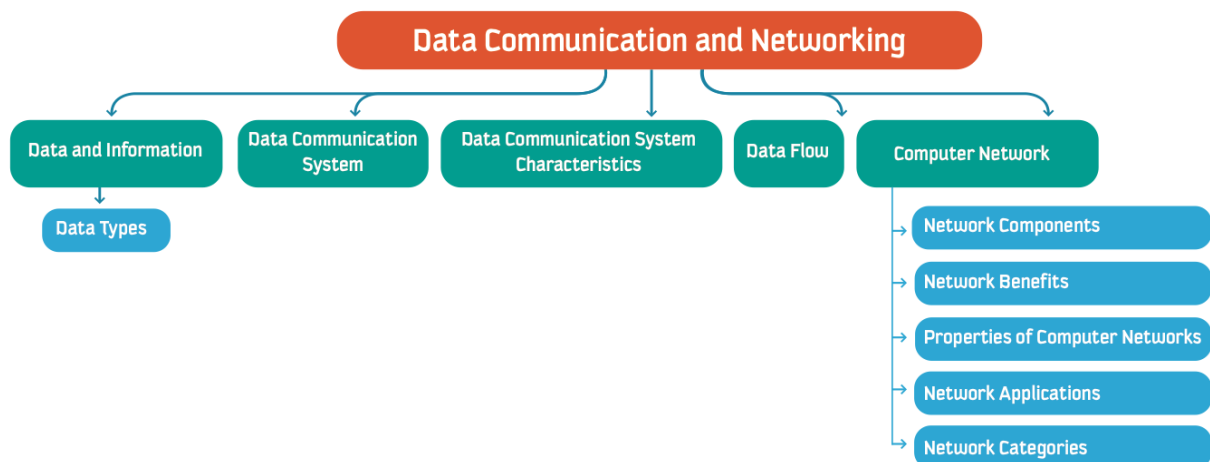
# Introduction to Data Storage

Data storage refers to the ways of using recording media to store data in a computer or other storage devices, in digital format. A storage device is an electronic memory device used to store and extract data, media, and other types of files.

## Types of Data storage

The following diagram provides a hierarchy of the various types of data storages.

```
                    Data Storage
                    /          \
          Local Storage      Remote Storage
          /          \
  Internal Storage    External Storage
   /        \          /      |        \
Primary  Secondary  Optical Magnetic Solid State
Memory    Memory                       Drive
  |          |         |      |        /    \
RAM/ROM     HDD    CD/DVD/BR/        Flash  SD card
                    HD-DVD
main memory              |      |
                  Portable    Desktop
                  External    External
                    HDD         HDD
```

# Local Storage

Data stored on storage devices that are locally attached to the computer. Local storage is the process of storing digital data on physical storage devices, such as hard disc drives (HDDs), solid state drives (SSDs), or external storage devices, such as thumb drives or discs. Local Storage is of two types Internal Storage and External Storage.

## Internal Storage

A system component embedded within the computer and used for storing data and programs. It consists of the following:

- **Primary Storage (RAM & ROM)**
- **Secondary Storage(HDD)**

Primary and secondary storage refer specifically to the components inside the computer; RAM and ROM are therefore considered to be primary storage, while the internal hard drive is secondary storage

## External Storage

These are the storage devices that are externally connected and controlled by a computer but are not integrated with it. There are usually three main categories of storage devices:

- **Optical Storage**
- **Magnetic Storage**
- **Solid State(Semiconductor) Storage**

# Primary Storage (Primary Memory)

Primary memory is the storage space where data and programs are kept on a short-term basis and made accessible to the central processing unit (CPU). Primary memory is also known as the "main memory" of the computer. It is smaller in size and closely connected to the processor. It consists of two memories:

## RAM
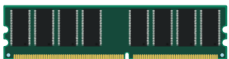
RAM is also known as volatile or temporary memory. It holds the frequently required instructions and data that the processor is currently working with. The computer can access it randomly at any time, it needs a constant power supply and it is used to run applications on a computer system, such as Microsoft Office.

## ROM
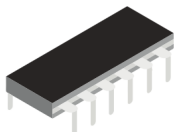
ROM is also known as non-volatile memory. It is a built-in memory chip that contains instructions used by the computer for the initial booting process. These instructions cannot be modified, but only read by the processor.
Unlike RAM, ROM retains its data even if the device is Switched off.

# Secondary Storage

It is the storage space where software and data can be stored on permanent basis. Secondary storage is necessary because primary storage loses its data when a computer is turned off whereas secondary storage does not lose any data. A secondary storage device refers to any non-volatile storage device that can be internal or external to the computer.

## Hard Disk Drive (HDD):

A hard disk drive (HDD) is a low-cost, high-capacity physical storage medium that permanently stores the operating system files, software applications, user's personal files, etc. Its storage capacity can range from 120 GB to 4 TB, and the upper limit is gradually increasing. Data is recorded magnetically onto a hard disk; rapidly spinning platters, which are divided into tracks and sectors, are used as the recording medium. The electromagnetic heads are placed just above or below the surface of the platters and are used to read data from, and write data to, the platter. The hard drive spins thousands of times per minute.

The internal hard drive is considered the main long-term storage device, while external hard drives and other external media are additional storage devices.

# Optical Storage

It is an electronic storage method that uses lasers to store and retrieve data. Optical storage devices save data as patterns of **dots** created using the laser beam. It uses light spots to represent the 1 bit and dark spots to represent the 0 bit. This process is known as **'burning'** data onto a disc. Following are three main categories of optical storage.

## Compact Disc (CD)

These are optical plastic discs that store up to 700 MB of data and are normally used for multimedia applications. There are several types in the market:

**CD-ROM** – A read-only storage medium. The data is written on it before being sold by the manufacturer. They are used to distribute software applications, video games, user guides, etc.

**CD-R** – A recordable disc. It is written only once, and its contents cannot be overwritten.

**CD-RW** – A rewritable disc. The user can write, erase, and overwrite its contents.

## Digital Versatile Disc (DVD)

These are physically similar to CDs, but with enhanced storage capacity from 4.7 GB to 17 GB. Like CDs, DVDs are also in the form of DVD-ROM, DVD-R, and DVD-RW

**DVD-ROM** – The data can only be read and cannot be written or erased.

**DVD-R –** This is recordable. The user can write data only once, and the data is then readable, but its contents cannot be overwritten.

**DVD-RW –** This is rewritable. The user can write, erase, and overwrite its contents.

**HD-DVD –** This has higher-definition playback capability than normal DVDs.

## Blu - Ray Disc (BD-Optical Disc)

This is designed to store large amounts of data and especially high-definition videos. The sizes range from 25 to 50 GB. They are in the form of BD-ROM, BD-R, and BD-RW.

## Optical Storage Capacity

The main difference among CD's, DVD's, Blu-Ray discs, and HD-DVDs is their storage capacity as shown in following table. To read and write different disc types, the user needs a disc drive and applications that can read all the formats and write to all the discs.

| Storage Device | Single Layer | Double Layer | Triple Layer | Quadruple |
|---|---|---|---|---|
| **BD** | 25 GB | 50 GB | 100 GB | 128 GB(BD-R-only) |
| **HD DVD** | 20 GB | 40 GB | 45-50 GB | - |
| **DVD** | 4.7 GB | 17 GB | - | - |
| **CD** | 700 MB | - | - | - |

### Optical Storage- Advantages and Disadvantages

The following table lists some advantages & disadvantages of Optical Storage.

| Advantages | Disadvantages |
|---|---|
| • Cheap and portable. | • Slower than HDD. |
| • Convenient for multimedia storage with better picture and sound quality. | • Can lose data when scratched. |

# Magnetic Storage

It is a storage method that stores the data in the form of magnetized dots as a combination of 1s or 0s. The following are some magnetic storage devices. Data is read from the hard drive by means of a read-write head on a mechanical arm that scans the surface of the disk for the presence or absence of magnetism, or 1s and 0s.

## Portable External Hard Drive

A portable magnetic disk drive that is plugged into the computer via a USB or FireWire cable.

## Desktop External Hard Drive

It has the same functionality as a portable drive, but is designed for stationary use. The major difference between these drives is that the portable drive does not need a powered connection, as is it powered by the USB, whereas the desktop drive needs a separate power connection.

### Magnetic Storage- Advantages and Disadvantages

The following table lists some advantages & disadvantages of Magnetic Storage.

| Advantages | Disadvantages |
|---|---|
| • Portable and affordable storage with high storage capacity. | • Can be easily damaged and will eventually stop computer from working. |
| • Persistent storage and longer life span. | • Loss of data due to disk crash. |
| • Fast access and retrieval times compared to optical storage devices. | • Lower access rate than RAM, ROM and Solid State Drives. |
| | • High power consumption. |

# Solid State Drive (SSD)

They rely solely on semiconductors and electronics for data storage making it a more reliable and robust than traditional magnetic storage. They have no moving parts or rotating platers due to which they use less power than traditional hard drives and are much faster.

## Flash Drive

An integrated circuit memory chip that is portable and often around the size of a human thumb. They are sometimes called thumb drives, pen drives, memory units, data sticks, and keychain drives. The physical size of the memory is becoming very small, and the capacity is expanding and currently ranges from 2 GB to 4 TB.

## SD Card

A flash memory card is used to store images, videos, and other digital data for electronic devices, such as digital cameras, MP3 players, printers, cell phones, and game consoles. Capacities range from 4 GB to 128 GB.

### Solid State Drive- Advantages and Disadvantages

The following table lists some advantages & disadvantages of Solid State Drive.

| Advantages | Disadvantages |
|---|---|
| • Compact in size. | • More expensive per unit than magnetic storage. |
| • High speed of data transfer. | • Due to its small size, it is more likely to be lost or stolen. |
| • Low power consumption. | • Sharing between many computer systems can make data unreadable. |
| • Persistent storage and longer life span. | |

# Remote Storage

Remote storage, sometimes known as cloud storage, allows users to store data on a remote device through the internet, by reserving space that is accessible from a computer with an active internet connection.

## Features of Remote Storage

**• Accessibility:** Remote storage provides easy access to all stored files. However, accessibility is limited to the availability of an internet connection.

**• Space:** Remote storage provides a variety of capacity options. However, users may have to pay annual or monthly fees, which can sometimes be expensive.

## The Comparison of Local and Remote Storage.

The following table compares local storage and remote storage based on parameters such as Security, Cost, File Transfer, File Access & File Share.

The following table compares local storage and remote storage based on parameters such as Security, Cost, File Transfer, File Access & File Share.

| Factor | Local Storage | Remote Storage |
|---|---|---|
| Security | • Since it is physical device, you have full control of the security and is not vulnerable to hacking.<br><br>• It can be damaged, stolen or lost.<br><br>• Power surges can damage the drives. | • Security is a concern as there have been security breaches from hackers to access data. |
| Cost | • The price keeps decreasing with new developments<br><br>• You can also add another storage drive to increase storage capacity. | • Subscription fee for large amount of storage. |
| File transfer | • Fast transfer rate when compared to cloud storage. | • Slow transfer as it depends on internet connection. |
| File Access & File Share | • Need to be locally attached to the computer to access and share the files. | • Files can be accessed from anywhere<br>• Files can be easily shared. |

# Storage Capacity

Storage capacity is the volume of data a storage device can hold. The smallest unit of measurement is a bit, which has a value of either 0 or 1, then a byte, which consists of eight bits, with each byte representing a single character, e.g. the binary code for letter "A" is "01000001"and the ASCII Code is "065. (each keyboard character = 1 byte).

## Units of Measurement for Data Storage

| Unit | Shorten | Value |
|------|---------|-------|
| Bit | b | 0 or 1 |
| Byte | B | 8 bits = 1 Byte |
| Kilobyte | KB | 1024 B = 1 KB |
| Megabyte | MB | 1024 KB =1 MB |
| Gigabyte | GB | 1024 MB =1 GB |
| Terabyte | TB | 1024 GB =1 TB |
| Petabyte | PB | 1024 TB =1 PB |
| Exabyte | EB | 1024 PB =1 EB |
| Zettabyte | ZB | 1024 EB =1 ZB |
| Yottabyte | YB | 1024 ZB =1 YB |

# File Compression

File compression is a conversion process in which the file size is reduced by using a particular compression technique. Some files occupy large storage space which leads to difficulty in storing, downloading, and sending those files. Compressing files reduce the size and zip one or more files together leads to reduce the time to upload and download files and saving more storage.

There are different file compression formats, such as ZIP, RAR. ZIP is more popular because it supports most of the operating systems.

## Zip a file/folder in Windows 10

When you compress files using ZIP, they take less storage space than their original size. Smaller ZIP files make sharing, transferring, and storage easier and quicker. Windows 10 has built-in tools to support the process of zipping files or folders. In Windows, you can directly zip a file or folder from its storage location.

### To compress, follow these steps:
1 - Right click on the files/folders you want to compress. Point to the **"send to"** option from the displayed menu.
2 - Select the option **"Compressed (zipped) folder"** to compress your selected file/folder. A zipped file/folder will appear next to the original file.
3 - Rename the file/folder by entering the new name and press the ENTER key.
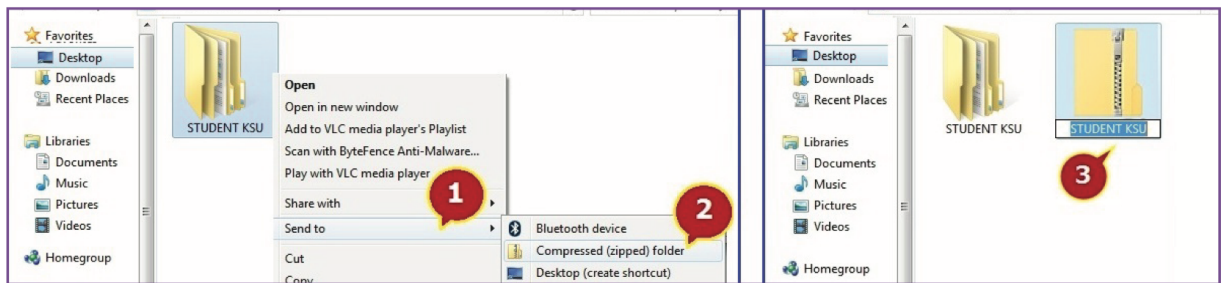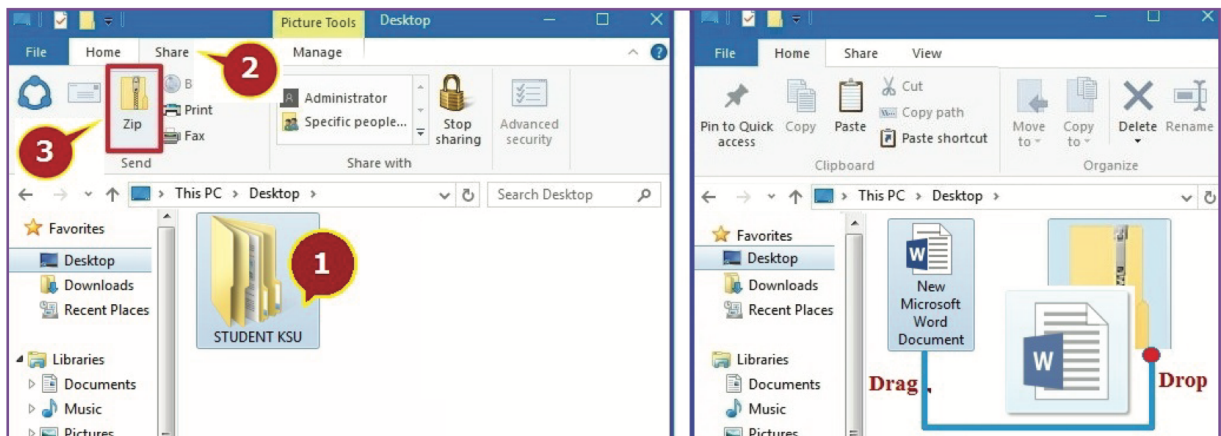


### Zip one or more files with the File Explorer ribbon menu
1 - Select the files/folders you want to compress.
2 - Click on the **"Share"** tab of **File Explorer**
3 - select the **"Zip"** command to compress the file.

### Add files and folders to an existing ZIP folder
To add files/folders to an existing ZIP folder, drag and drop the selected files/folders to the already zipped folder.

# Creating RAR Files

Windows 10 does not support RAR tools, so to use this compression format, you must have a RAR program installed on your computer (e.g. WinRAR). These use the file name extension .rar.

## Compressing a file/folder using RAR in Windows 10

**To compress files or folders using RAR, follow these steps:**

**1** - Right click on the files/folders you want to compress and select the option "Add to archive" to compress your selected file/folder.

**2** - Type the archive name and select the location to store the archive.

**3** - Click on the "OK" button.
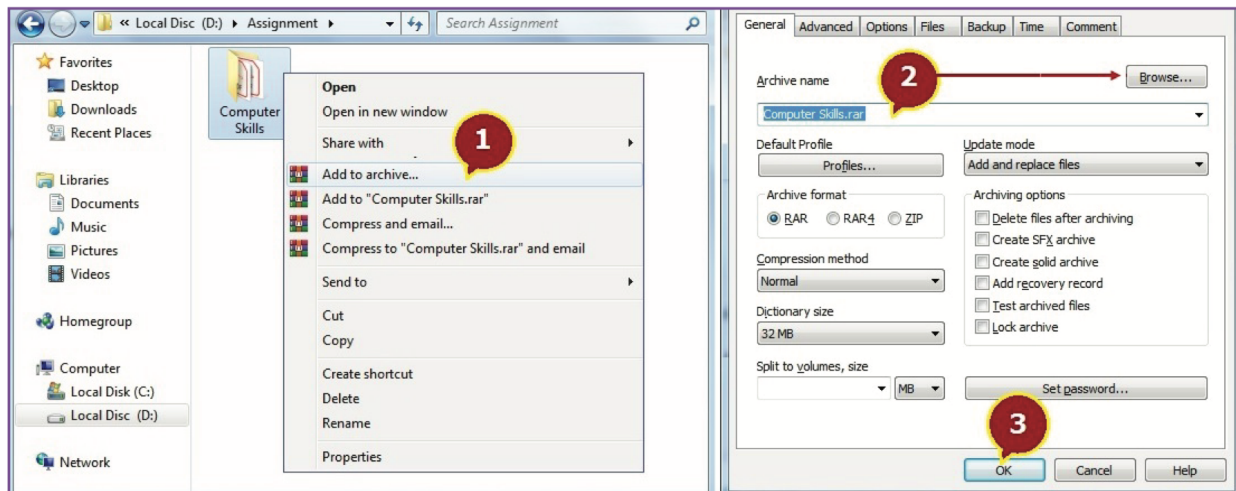


## Extracting a file/folder using RAR in Windows 10

**1** - Open the WinRAR archived file/folder you want to extract and in the WinRAR Ribbon, click the "Extract To" command.

**2** - Choose the destination location to store the extracted files/folders.

**3** - Click on the "OK" button.

You can also extract using drag and drop; simply open the archived file/folder, select the files you want to extract, and drag and drop the selected files to the destination folder. *Another method.*
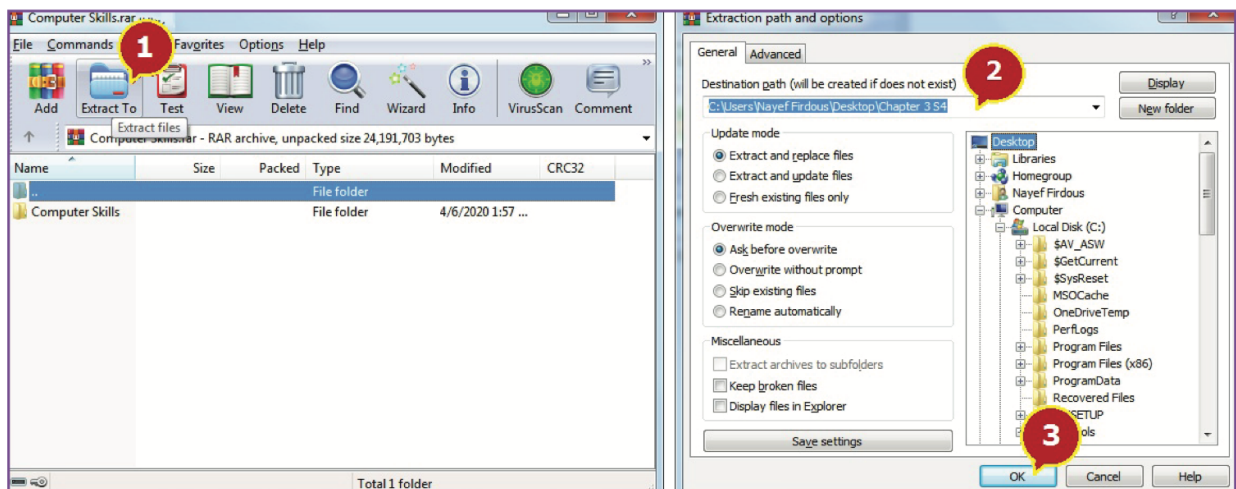
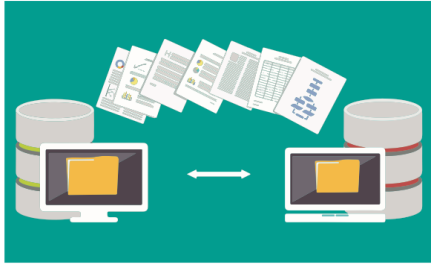| | |
|---|---|
| Portable External Hard Drive | Magnetic disk drive that is plugged into the computer via a USB |
| Local Storage | Storage devices that are locally <u>embedded</u> with the computer *attatched* |
| RAM | Random Access Memory, holds the frequently required instructions and data that the processor is currently working on |
| ROM | Read Only Memory, a built-in memory chip that contains instructions, initially used by the computer for the booting process |
| HDD | Hard Disk Drive, a low-cost, high-capacity permanent physical storage medium |
| CD | Compact Disc, optical plastic discs that stores up to 700 MB of data. |
| DVD | Digital Versatile Disc or Digital Video Disc, optical plastic discs having capacities from 4.7 GB to 17 GB |
| BD-Optical Disk | Blue-Ray Optical Disc, stores large amounts of data, specifically high-definition videos |
| Magnetic Storage | A storage method that stores the data in the form of magnetized |
| Flash Drive | A pen drive memory unit, data stick, keychain drive, etc. |
| Memory Card (SD - Secure Digital) | A flash memory card that is used to store images, videos, and other digital data |

## Data Storage

- **Types of Data Storage**
  - Local Storage
  - Remote Storage
- **Data Compression**
  - ZIP
  - RAR
- **Storage Capacity**
  - Bits, Bytes, Kilobytes, Megabytes, Gigabytes, Terabytes, Petabytes, Exabytes, Zettabytes, Yottabytes
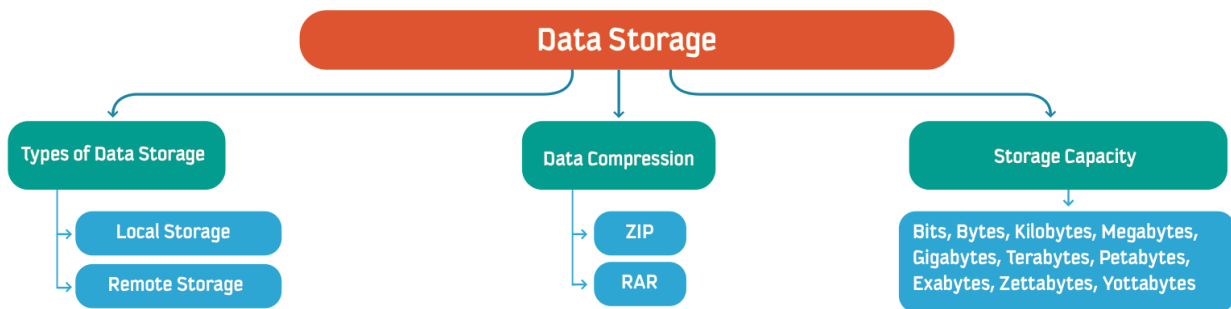
*attached = internal & external*

*attatched*
*⟶ embedded ⟹ internal*
*⟶ connected ⟹ external*
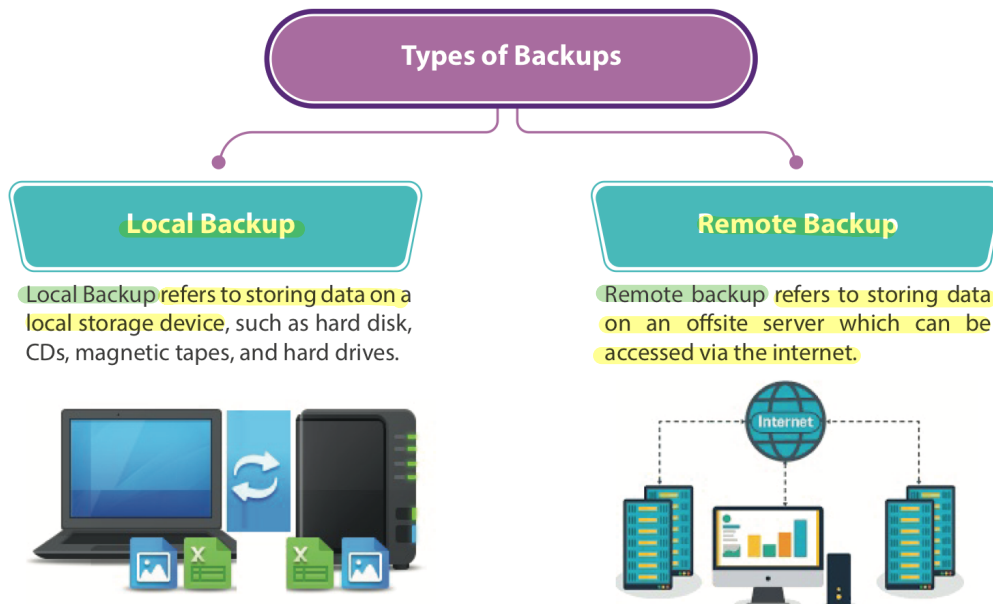
# Introduction to Backup & Restore

Backup is the process of creating copies of data to a separate storage drive or location, which is later used for restoring in case of any data loss. Backup is required to protect your data and information from any loss or to make sure that the information is available when you need it.

The process of backup is a set of procedures that users prepare and implement to obtain a protected copy of all or part of digital content that could be lost due to system failure, viruses, natural disasters, or accidental deletion. ① ② ③
④

Data restore is the process of making available a usable copy of the backed-up data. It is the replacement and restoration of lost, stolen, or damaged data to its original location or to other locations. A number of conditions can create the need for data restore, such as human error, where the data is accidentally deleted; malicious attacks, where the data is stolen or hacked; natural disasters; and machine failures.

## Types of Backups

There are usually two types of backups:

**Types of Backups**

**Local Backup**

Local Backup refers to storing data on a local storage device, such as hard disk, CDs, magnetic tapes, and hard drives.

**Remote Backup**

Remote backup refers to storing data on an offsite server which can be accessed via the internet.

# Backup Steps

Before you learn about local backup, it's important to know about some backup steps. Depending on the aim and need, the backup process consists of a number of steps, which are essential for a successful backup.

## Determine What to Backup

Users need to identify what to back up from their files and folders, which involves users going through all their digital content including vital information, setup files, installation files, programs, documents, etc. and determining the important, irreplaceable files and folders they need to backup.

## Determine Where to Backup

After choosing what data to back up, the next step is to identify the location of the backup, i.e. where to store the backup copy so that it is protected against all events leading to data loss. Users can choose a particular type of backup, including local or remote backup. Backup types are discussed later in the session. Note that the user can choose multiple backup locations to keep as many copies as needed, considering the advantages and disadvantages of each type in terms of cost, time, security, accessibility, and availability.

## Determine When to Backup

After choosing what to back up and where to back up, the backup schedule is decided. It can be a manual or automatic backup. Some folders and files are static and do not need to be backed up regularly, whereas some files are dynamically changed over time and different versions need to be backed up regularly.

**To choose the perfect time for backup, users need to consider these factors:**

### Frequency

Frequency determines how often a backup is scheduled locally or remotely, e.g. hourly, daily, weekly, or monthly. Large organizations configure special servers that are located in a backup center to back up data based on predefined times.

### Starting time

It is very important to set a starting time for each backup. There are some issues to be considered when choosing the starting time. Scheduling backups when system use is as low as possible will speed up the backup process. A connection drop might cause a backup failure. Also, any opened and in use files will not be backed up at all. Therefore, most organizations start the backup process after working hours and have the computers backed up overnight.

## Features of Good Backup Strategy

**1 -** Ability to recover lost data due to hard drive failure, viruses, natural disasters, accidental deletion, and entry errors.

**2 -** Ability to recover data as quickly as possible to save time and cost.

**3 -** Minimal requirement for human interaction.

**4 -** Ability to run automated or semi-automated backup.

# Backup Methods

There are several data backup methods. The most common methods are full backup, incremental backup, and differential backup.

## Full Backup

Full backup is the most common and popular backup type. It involves backing up all selected files and folders that are important to the user. For example: a business organization needs to maintain fresh and updated copies of data every day; therefore, it will set up an initial backup schedule that starts every night from Sunday to Wednesday. Every day, the selected data would be fully copied to the backup location as shown in the following figure.
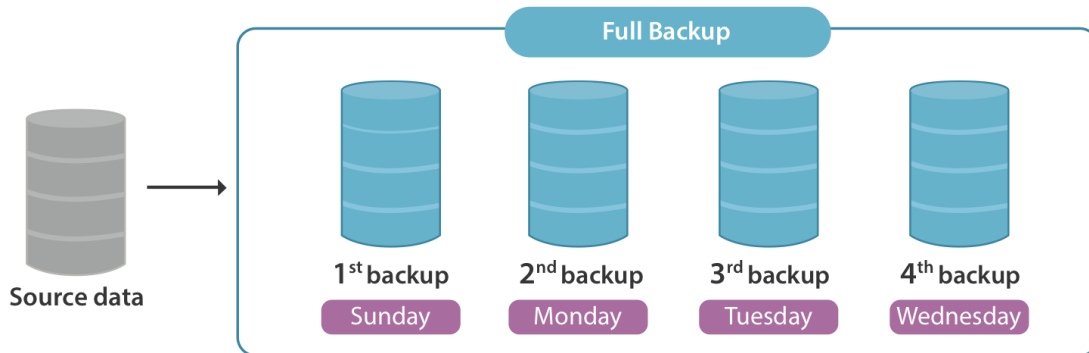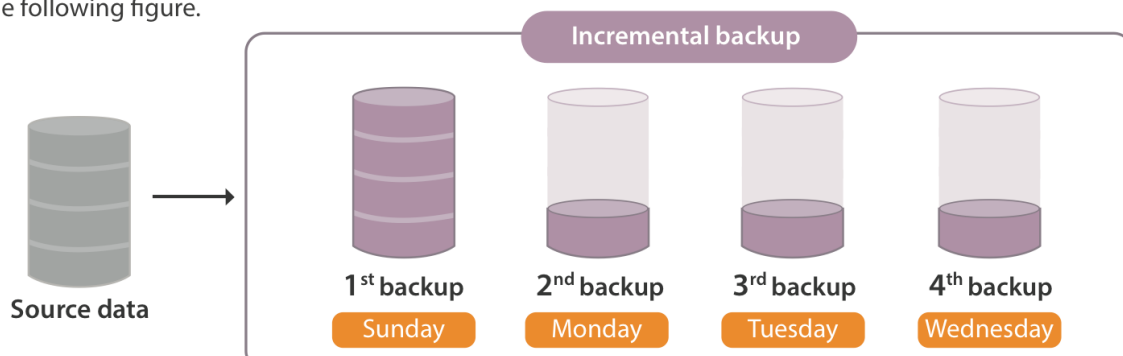


**Advantages & Disadvantages of Full Backup**

| Advantages | Disadvantages |
|---|---|
| Easy to restore since there is only one copy | Time consuming since each file will take time to be backed up every time the user run a full backup. |
| Fast restoring time as complete files are stored each time. | Space consuming, since every time the user runs a full backup, it will take more space. |

## Incremental Backup

Incremental backup involves making a backup of all changes that have been made since the last backup, which can be the initial full backup or the last incremental backup. For example: an initial backup is done on Sunday, then on Monday the backup of only those files and folders that were changed or added since Sunday takes place. The Tuesday backup will include the files or folders changed since Monday, and the cycle continues this way as shown in the following figure.
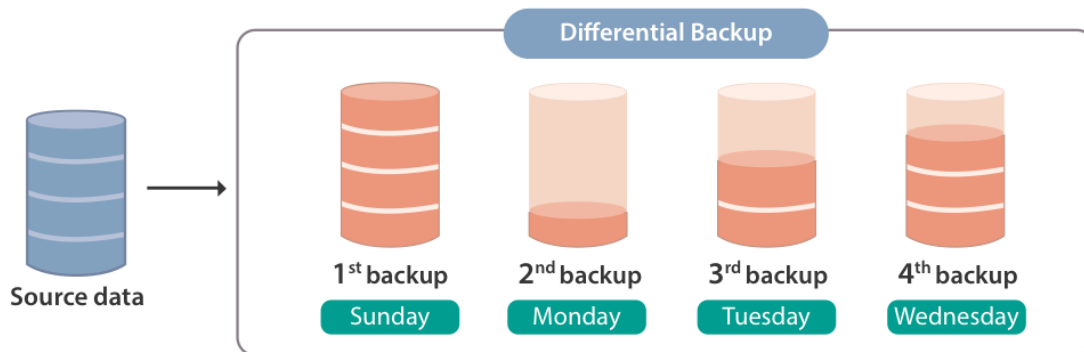


| Advantages | Disadvantages |
|---|---|
| Much faster than other backups | More time to restore than full backup. |
| Efficient use of storage. | Complicated, since it may contain a large number of files and folders. |

## Differential Backup

Differential backup records the data changes that have occurred since the last full backup. It falls in between full backup and incremental backup. Initially, a full backup is made; then subsequent backups save all changes since the last full backup.

*For example,* if a full backup is made on Sunday, then on the following day of the backup schedule (Monday), only the files that have changed since Sunday and new files added to the backup folders will be backed up. The following day (Tuesday), the files changed and added since Sunday's full backup will be copied again and the cycle goes on as shown in the following figure.



**Differential Backup**

Source data → 1st backup (Sunday) · 2nd backup (Monday) · 3rd backup (Tuesday) · 4th backup (Wednesday)

**Advantages & Disadvantages of Incremental Backup**

| Advantages | Disadvantages |
|---|---|
| Faster than full backup, *but not than incremental* | Slower than incremental backups. |
| Efficient use of storage. | Slower restore than full backup. |
| Restores faster than incremental backup. | More complicated restore than full backup. |

## Example

To understand the full, incremental, and differential backups, assume that a company decided to compare the three backups to determine the best practice for it to use by creating all types of backups for the whole week. Since the business week is 5 days, there would be 5 backups. The full backup process would take a full backup of the whole data for 5 days. The incremental backup would start at the first backup and keep copies of any changes for every day, then take the next day's backup. The last is the differential backup, which would take only the differences and the changes from the previous full backup.

| Number of Backup arranged by days | Full backup | Incremental | Differential |
|---|---|---|---|
| Backup no.1 | All data | —— | —— |
| Backup no.2 | All data | Changes from backup 1 | Changes from backup 1 |
| Backup no.3 | All data | Changes from backup 2 | Changes from backup 1 |
| Backup no.4 | All data | Changes from backup 3 | Changes from backup 1 |
| Backup no.5 | All data | Changes from backup 4 | Changes from backup 1 |

# Local Backup

When local storage such as a hard drive (internal or external) or a flash drive is used to store the backup copies, the storage medium is kept close at hand.  Typically, the storage medium is plugged in directly to the source computer being backed up or is connected through a local area network to the source being backed up. Offsite backup is the opposite. The offsite backup is used to keep the data at a different physical location; however, the local backup is used to keep copies of the data in the same physical location where the source data exists.

## Commonly Used Storage Devices for Local Backups

The given table provides a list of some common local backups.

| No | Backup Location |
|---|---|
| 1 | • Internal hard drive |
| 2 | • External hard drive (desktop or portable) |
| 3 | • Optical drives like CDs, DVDs and Blue Ray discs |
| 4 | • Solid state drives like USB or Flash Drives |
| 5 | • Network Attached Storage (NAS) |
| 6 | • Backup to a shared folder on another computer over the network |
| 7 | • Magnetic tape drives |

○ Backup to HDD

practical part is explained in page 118 - 119

# ⭕ File Back up using File History

File History is a remarkable feature of Windows. It is used to automatically back up files and folders saved on the Desktop or in Libraries, Documents, Pictures, Videos, Music, and other locations of your PC. It allows you to make regular or scheduled backup of data from your PC to an external, internal, or network-connected storage and restore them at a later stage. Creating a backup of original content means having that data saved in two locations; it's important that those two locations aren't on the same PC. To do a full backup for files and folders, the user can set up a drive for File History, which allow an easy and automated backup of data.

*practical part is explained in page 120 - 122*

# ⭕ Delete Backup files in Windows 10

You can also tell Windows 10 to delete older backups automatically, which will prevent your hard drive from filling up too quickly. Windows 10 has many backup features to protect your system and files. You may have enabled system protection to create system restore points, set up automatic image backup tasks with Backup and Restore (Windows 7), or backed up your files using File History.

*practical part is explained in page 123*

## List of Terms

| Keyword | Description |
|---|---|
| Data restore | The process of making available a usable copy of the backed-up data |
| Full backup | Popular backup type which involves backing up all selected files and folders that are important to the user |
| File history | Regular or scheduled backup of data from your PC to a storage device |
| Incremental backup | Backup of all changes that have been made since the last backup |
| Differential backup | Data backup procedure that records the data changes that have occurred since the last full backup |
| Personal computer backup | Backing up the entire PC content including all documents (files folders), installation files, programs, operating system, emails, etc. |
| System Image | Mirrored copy of the operating system |

# Offsite Backup

Offsite backup is any backup kept at a different geographic location from the source data. The data is placed locally on any storage medium, such as a hard drive, DVD, or flash drive. It becomes an offsite backup when the storage medium is physically shifted to a different location, such as another building. Remote backup is also a form of Offsite.

Offsite → Local / Remote

Local Backup
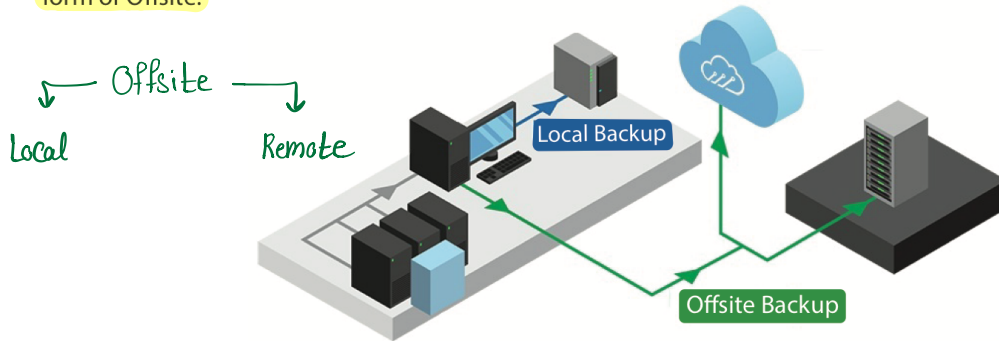
Offsite Backup

## Remote Backup

Remote backup is a form of offsite backup where the data is remotely backed up apart from the source data, i.e. in a different physical location. In remote backup, the data can be accessed online i.e. you do not need to be physically present at the backup storage facility to access the backups. The data is remotely backed up i.e. a copy of data is kept online apart from the source data. The term "remote" refers to the ability to control or administer the backups from another location.

## Advantages and Disadvantages of Remote Backup

| Advantages | Disadvantages |
|---|---|
| Requires minimal or no user intervention. The user does not have to attach HDD, CD etc. or perform other manual steps. | Available with an internet connection. |
| Stored data is accessible anywhere and anytime regardless of the location making it a flexible technology of the present times. | Proper handling of user id and password is must. If password is lost, no more data recovery will be possible. |
| Stored data is accessible anywhere and anytime regardless of the location making it a flexible technology of the present times. | Privacy and security of data is a concern. There is a possibility that the data could be stolen or viewed by unauthorized people. If the customer does not have full control, the risk increases. |
| Better protection in case of a disaster. Sometimes, the organization has a local backup and in cases of fire or natural disaster, the backup will not be available. | |
| Some remote backup services will continuously backup up files as they are changed. | More expensive than other local storage methods. |
| Most remote backup services will maintain a list of versions of your files. | Can takes a long time to store, backup, and restore, depending on the speed of the internet connection. |

Same !

# Types of Remote Backup

## File Transfer Protocol(FTP) Backup

FTP is a network standard that is used to transfer files from one computer to another via an internet connection. This type of remote backup is maintained on an FTP server using File Transfer Protocol. It is an example of offsite backup, where the FTP server is located at a different location than the source data. Usually, the FTP server is located in a commercial data center, away from the source data being backed up.

## Online Backup

These are backups that are ongoing or done continuously or frequently to a storage medium that is always connected to the source being backed up. Typically, the storage medium is located offsite and connected to the backup source by a network or Internet connection.

Since it is an ongoing backup process via the internet, it does not require human intervention for connecting drives or media for backup. Typically, it is a paid service, and many data centers provide this subscription service to consumers. Normally, the data centers are built with safety specifications against natural disasters. They have very high security standards and a monitoring system to protect the data. The backed-up data is replicated across many storage media, which grants more safety and lowers the risk of data loss.
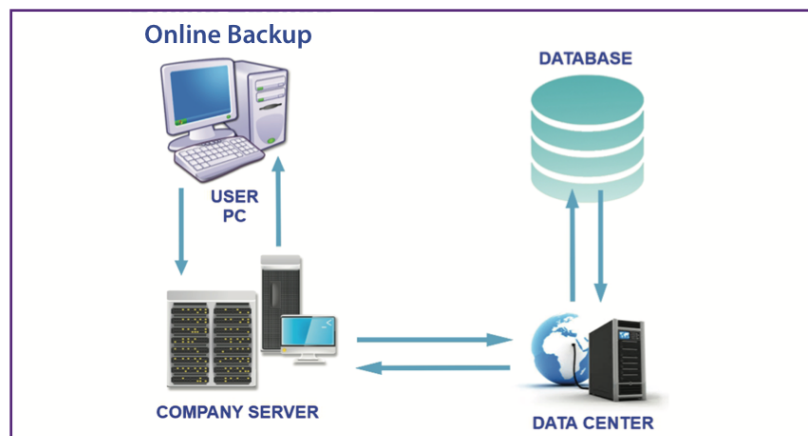


## Cloud Backup

This term is often used interchangeably with Online Backup and Remote Backup. Cloud backup refers to backing up data to a remote storage, cloud-based server. The cloud server is accessible to a computer via an internet connection. This strategy involves backing up data over the internet to an offsite server, hosted by a third-party service provider. The provider charges fees based on the usage capacity. Following are some popular Cloud Backup Services:

① Google Drive　② Dropbox　③ OneDrive

# Practical Application

## ① Google Drive

A cloud storage service that provides user the ability to share files online with many users at any time and to collaborate with others on a particular document at the same time.

**You can access Google Drive in one of the following ways**

| Browser or Device | Requirements | How to Access |
| --- | --- | --- |
| Web browser | Any web browser | www.drive.google.com |
| PC or Laptop | Install Drive File Stream from the Drive Help Center | Click Drive File Stream and then Open Google Drive. |
| Mobile device | Install the Drive app from the Play Store (Android) or App Store (iOS). | Open the Drive app on your device |

The following table lists some document types that can be created in Google Drive.

| Documents | Description | Example |
| --- | --- | --- |
| Google Docs | Text documents | Proposals, reports, shared meeting notes |
| Google Sheets | Spreadsheets | Project plans, budget sheets |
| Google Slides | Presentations | Pitch decks, training modules, team presentations |
| Google Forms | Surveys | Customer satisfaction surveys, group polls |
| Google Drawings | Shapes, charts, and diagrams | Flowcharts, organizational charts, website wireframes, mind maps |

## ② Dropbox

The Dropbox company offers a file hosting service that creates a folder (Dropbox) on user's computer while synchronizing the contents with the Dropbox server and the user's other devices, thus keeping the files updated. A Dropbox account is free with 2GB of storage space.

## ③ OneDrive

OneDrive is an online cloud storage service provided by Microsoft that allows you to store files in the cloud and access and share them anytime, anywhere on your PC, tablet, or phone. It lets a user easily back up, store, and share photos, videos, documents, and more — anywhere, on any type of device.

OneDrive is pre-installed on Windows 10, and it also works on Mac, Android, & iOS.

Note:

Practical explanation of Google Drive, Dropbox, and OneDrive is in page 137 - 142

## List of Terms

| Keyword | Description |
|---------|-------------|
| FTP | File Transfer Protocol |
| Cloud backup | Backing up of data to a remote storage, cloud-based server |
| Cloud server | Accessible to a computer via an internet connection |
| Google Drive | Cloud storage service provided by Google |
| Dropbox | File hosting service provided by Dropbox |
| OneDrive | Online cloud storage service provided by Microsoft |
| KSU Storage | Cloud storage service for university employees |
| Online backup | Backup of data to a storage center connected to the source system |
| Offsite backup | Copies of the source data in a different geographical location |
| Remote backup | Data is remotely backed up apart from the source data |



The End

وبحمد الله هكذا انتهينا .. دعواتكم لي و بالتوفيق لكم ♡ NJ -