

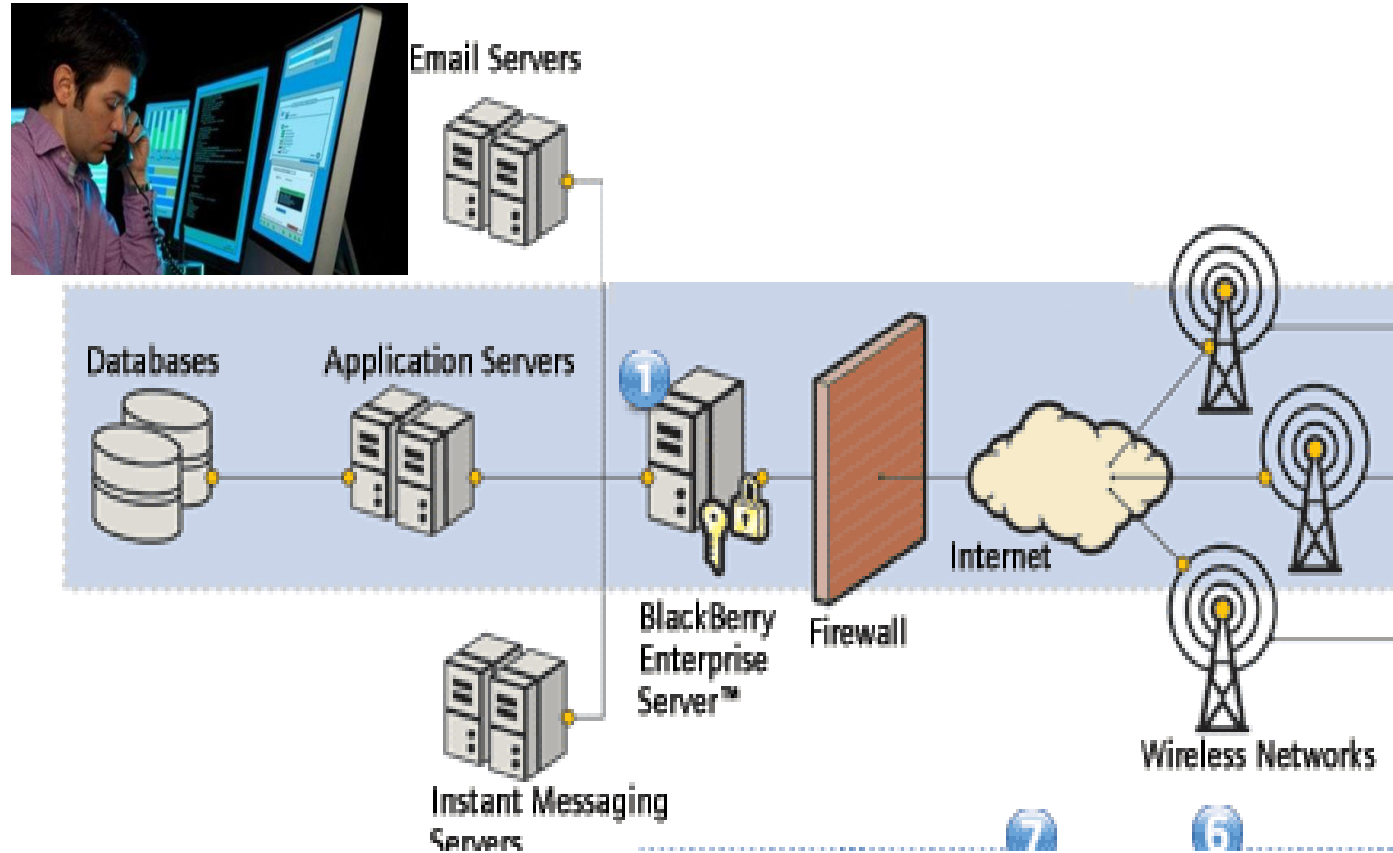
Welcome to



Introduction to Information Technology

for IT Professionals

Introduction to IT



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What is Information Technology, IT ?

- Information Technology covers a broad spectrum of hardware and software solutions that enable organizations to gather, organize, and analyze data that helps them achieve their goals.
- It is also described as systems of hardware and software that capture, process, exchange, store and/or present information using electrical, magnetic and/or electromagnetic energy.
- The term is also generically used to refer various computer-related work and widely used in business and field of computing

Information Technology, IT

- These days many corporations create a so-called "IT departments" to manage the computer technologies related to their business.
- Today, IT departments have responsibilities in areas like: (**main focus areas for IP personnel**)
 - Computer tech support
 - Business computer network and database administration
 - Business software development
 - Information security

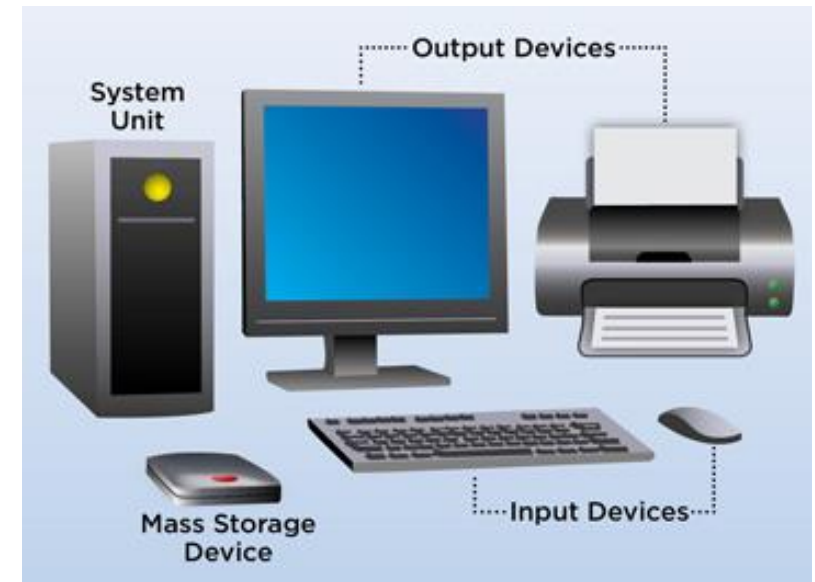
Computer

- The Computer
 - An **electronic device** for **storing and processing/manipulating data**, typically in binary form, according to instructions given to it in a variable program.
[www.dictionnaire.com]



Computer

- Is a programmable machine.
- Principal characteristics of a computer
 - Responds to a specific set of instructions in a well-defined manner
 - It can execute a prerecorded list of instructions (a program).
- Modern computers are electronic and digital. The actual machinery — wires, transistors, and circuits — is called *hardware*; the instructions and data are called *software*.



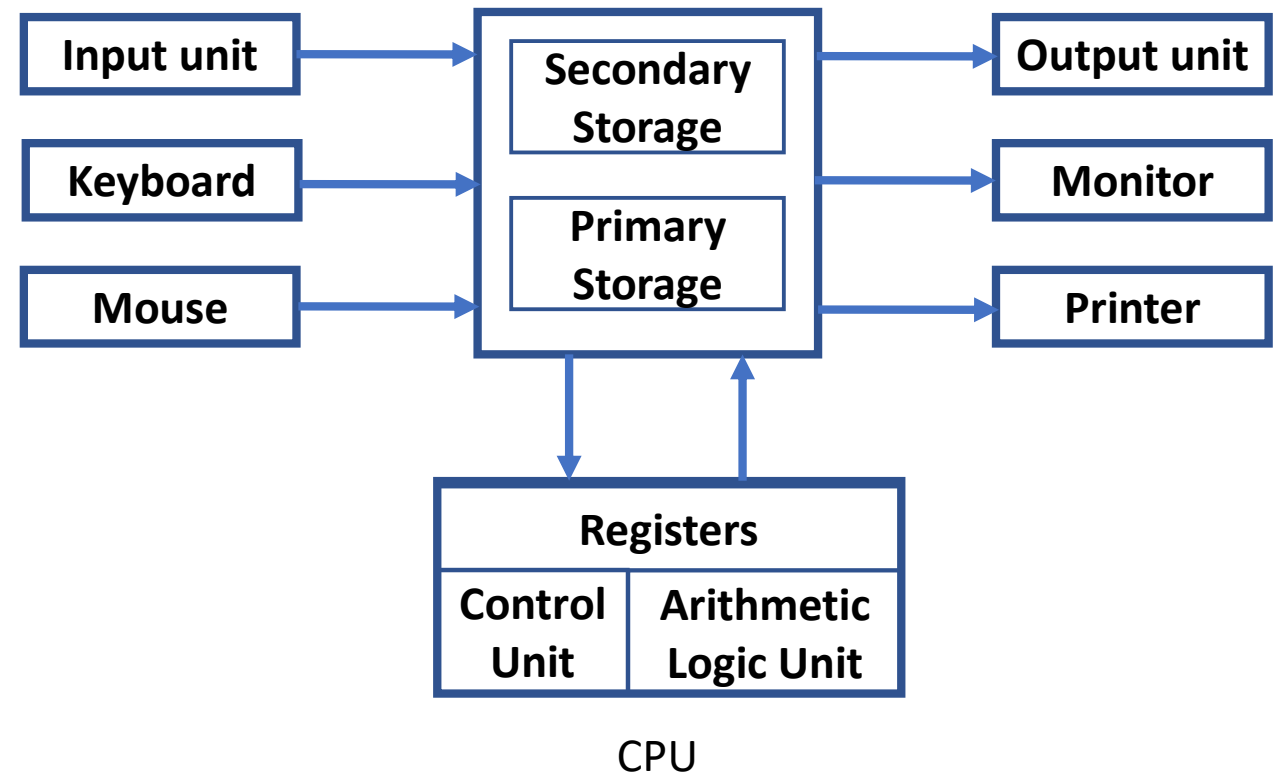
Hardware Components of Computer

- General-purpose computers require the following hardware components:
 - **Memory:**
 - enables a computer to store, at least temporarily, data and programs.
 - **Mass storage device:**
 - allows a computer to permanently retain large amounts of data. Common mass storage devices include solid state drives (SSDs) or disk drives and tape drives.
 - **Input device:**
 - usually a keyboard and mouse, the input device is the conduit through which data and instructions enter a computer.
 - **Output device:**
 - a display screen, printer, or other device that lets you see what the computer has accomplished.
 - **Central processing unit (CPU):**
 - The **heart of the computer**, this is the component that actually executes instructions

Block Diagram of Computer

The Basic components & parts of computer system :

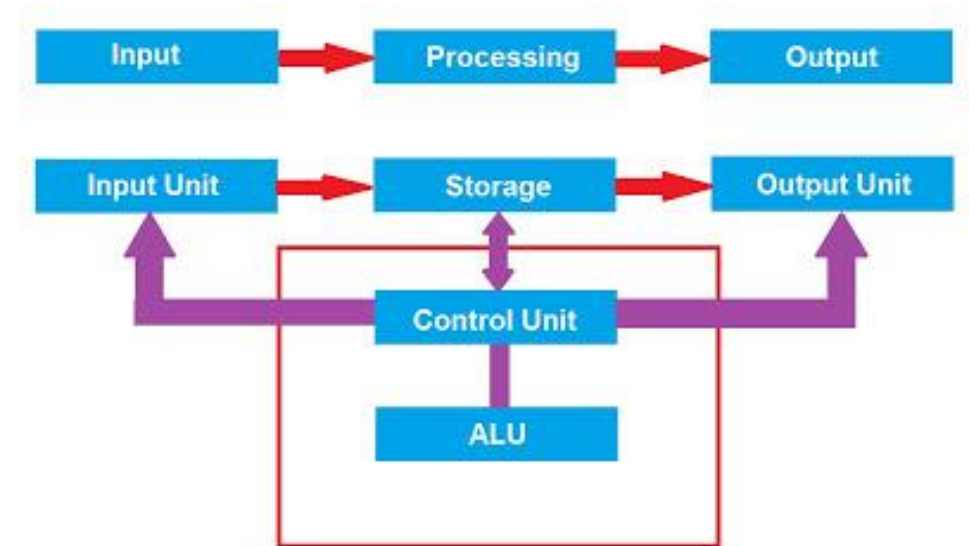
- Input Devices
- Output Devices
- CPU (Central Processing Unit)
 - ALU(Arithmetic Logic Unit)
 - Control Unit
 - Registers
- Storage Unit



Major Computer Operations

Five major computer operations or functions irrespective of their size and make. These are

1. it accepts data or instructions by way of input,
2. it stores data,
3. it can process data as required by the user,
4. it gives results in the form of output, and
5. it controls all operations inside a computer.



Classification of Computers

- Generally classified by size and power. As the technology advances the classification gets smaller, creating small/powerful/cost-friendly components.
 - **Personal computer**: a small, single-user computer based on a microprocessor. In addition to the microprocessor, a personal computer has a keyboard for entering data, a monitor for displaying information, and a storage device for saving data.
 - **Workstation**: a powerful, single-user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and a higher-quality monitor.
 - **Minicomputer**: a multi-user computer capable of supporting from **10 to hundreds** of users simultaneously.
 - **Mainframe**: a powerful multi-user computer capable of supporting **many hundreds** or thousands of users simultaneously.
 - **Supercomputer**: an extremely fast computer that can perform **hundreds of millions** of instructions per second.

What is inside .?...

Processor
(CPU)



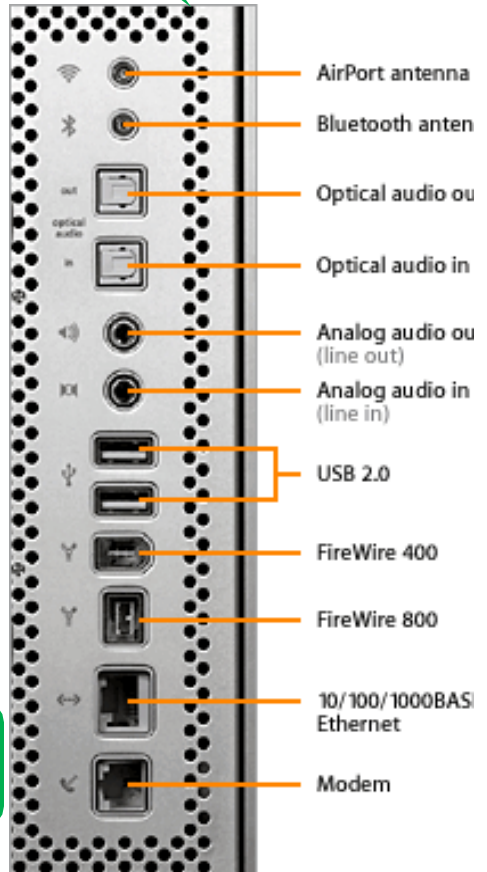
Memory
(RAM)



Ports



Hard Disk



Communication Bus (On the Mother Board)

What is inside .?...

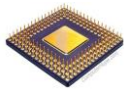
RAM



Hard Disk



CPU

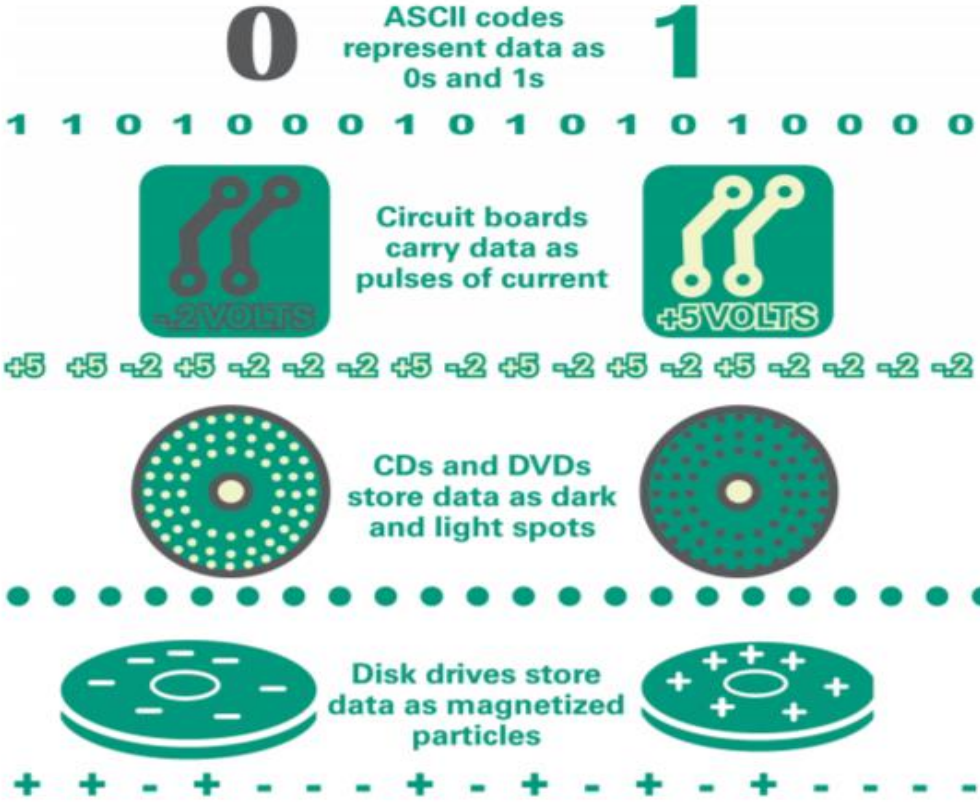


Motherboard

Data Representation

- Data Representation refers to the form in which data is stored, processed, and transmitted.
- Computers store data in **digital formats** that can be handled by electronic circuitry, in the form of 0s and 1s.
- The 0s and 1s used to represent digital data, referred to as binary digits.
- A bit is a 0 or 1 used in the digital representation of data.

Data Representation



Representing Numbers

- Numeric data consists of numbers that can be used in **arithmetic operations. (base 10)**
- Digital devices represent numeric data using the binary number system, (base 2)

Representing number with different bases

Decimal (Base 10)	Base 2 (Binary)	Base 3	Base 4	Base 5	Base 6
0	0	0	0	0	0
1	1	1	1	1	1
2	10	2	2	2	2
3	11	10	3	3	3
4	100	11	10	4	4
5	101	12	11	10	5
6	110	20	12	11	10
7	111	21	13	12	11
8	1000	22	20	13	12
9	1001	100	21	14	13
10	1010	101	22	20	14
11	1011	102	23	21	15
12	1100	110	30	22	20

Decimal Numbering System

- We humans use decimal numbering system
- It is positional numbering system employing 10 as the base, radix
- It requires 10 different numerals, symbols
 - 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
- It also requires a dot (decimal point) to represent decimal fractions.
- Numerals, symbols, used in denoting a decimal number take different place values depending upon position.
- Example : In a Decimal Numbering System, base-10 system
$$592.71 = (5 \times 10^2) + (9 \times 10^1) + (2 \times 10^0) + (7 \times 10^{-1}) + (1 \times 10^{-2})$$

Binary Numbering System

- Is the internal language of electronic computers.
- It is a number expressed in the **base-2 numeral system** or **binary numeral system**,
- Uses only two symbols: typically "0" (zero) and "1" (one).
- Each digit is referred to as a bit.
- Addition, subtraction, multiplication, and division can be performed on binary numerals.
- Data, instructions and operations are processed by computer using binary numbers.

Converting from Decimal to Binary and Vice versa

- Converting from Decimal to Binary
 - To convert from a base-10 integer to its base-2 (binary) equivalent, the number is divided by two. The remainder is the least-significant bit, LSB. The quotient is again divided by two; its remainder becomes the next least significant bit. This process repeats until a quotient of one is reached.
- Converting from Binary to Decimal
 - Write down the binary number and list the powers of 2 from right to left. Start at 2^0 , evaluating it as "1". Increment the exponent by one for each power. Stop when the amount of elements in the list is equal to the amount of digits in the binary number.

Converting from Decimal to Binary and Vice versa

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	1	1	1	1	1
128	64	32	16	8	4	2	1

The binary number 1111 1111 converts into the decimal number:

$$128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255$$

Converting from Decimal to Binary and Vice versa

- Example/Exercises
 - A. Convert $(34)_{10}$ to Binary Number
 - B. Convert $(101)_{10}$ to Binary Number
 - C. Convert $(1011)_2$ to Decimal Number
 - D. Convert $(101)_2$ to Decimal Number

Signed and unsigned numbers

- Signed and unsigned numbers are two different ways of mapping bits to numbers.
- Unsigned binary numbers,
 - Used for positive numbers that do not require an arithmetic sign.
 - An m -bit unsigned number represents all numbers in the range 0 to $2^m - 1$.
 - Example,
 - 8-bit unsigned binary numbers is from 0 to 255_{10} and from 00 to FF_{16} in hexadecimal.
 - 16-bit unsigned binary numbers is from 0 to $65,535_{10}$ and from 0000 to $FFFF_{16}$ in hexadecimal.
- Signed binary numbers
 - The most significant bit (MSB) represents the *sign*. A 1 in the MSB bit position denotes a negative number; a 0 denotes a positive number. The remaining $n - 1$ bits are preserved and represent the *magnitude* of the number.
 - Methods
 - Signed magnitude Representation
 - 1's Complement Representation
 - 2's Complement Representation
 - Represent n -bit signed binary numbers in the range -2^{n-1} to $+2^{n-1} - 1$.

Representing Text

- Character data is composed of letters, symbols, and numerals that are not used in calculations.
 - Examples : name, address, letter.
- Commonly referred to as “text.”
- Types of codes to represent character/data
 - ASCII code
 - Unicode
 - UTF-8

Representing Text

- ASCII stands for American Standard Code for Information Interchange.
 - Each letter is stored in a byte, (8 bits)
- Unicode
 - Each letter is stored in 2 bytes, (8 bits) and provides codes or 65,000 characters.
 - This is a used for representing the alphabets of multiple languages.
 - <https://unicode-table.com/en/#control-character>
- UTF-8 is a variable-length coding scheme
 - Uses seven bits for common ASCII characters but uses sixteen-bit Unicode as necessary.

ASCII control characters

00	NULL	(Null character)
01	SOH	(Start of Header)
02	STX	(Start of Text)
03	ETX	(End of Text)
04	EOT	(End of Trans.)
05	ENQ	(Enquiry)
06	ACK	(Acknowledgement)
07	BEL	(Bell)
08	BS	(Backspace)
09	HT	(Horizontal Tab)
10	LF	(Line feed)
11	VT	(Vertical Tab)
12	FF	(Form feed)
13	CR	(Carriage return)
14	SO	(Shift Out)
15	SI	(Shift In)
16	DLE	(Data link escape)
17	DC1	(Device control 1)
18	DC2	(Device control 2)
19	DC3	(Device control 3)
20	DC4	(Device control 4)
21	NAK	(Negative acknowl.)
22	SYN	(Synchronous idle)
23	ETB	(End of trans. block)
24	CAN	(Cancel)
25	EM	(End of medium)
26	SUB	(Substitute)
27	ESC	(Escape)
28	FS	(File separator)
29	GS	(Group separator)
30	RS	(Record separator)
31	US	(Unit separator)
127	DEL	(Delete)

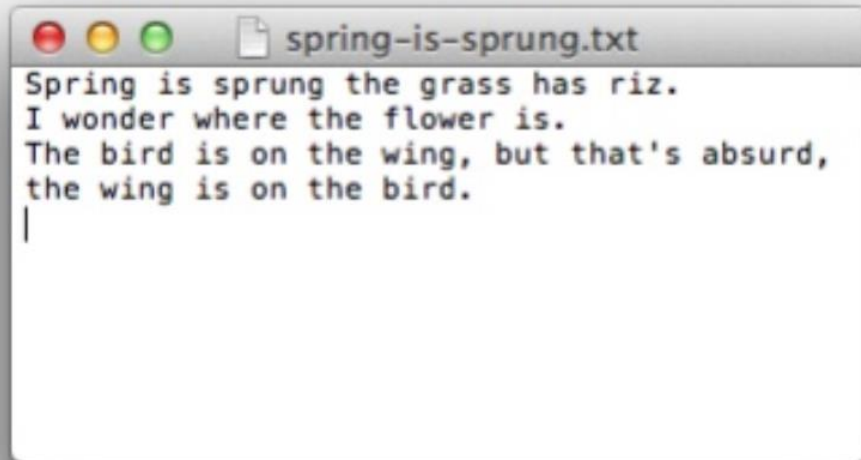
ASCII printable characters

32	space	64	@	96	`
33	!	65	A	97	a
34	"	66	B	98	b
35	#	67	C	99	c
36	\$	68	D	100	d
37	%	69	E	101	e
38	&	70	F	102	f
39	'	71	G	103	g
40	(	72	H	104	h
41	)	73	I	105	i
42	*	74	J	106	j
43	+	75	K	107	k
44	,	76	L	108	l
45	-	77	M	109	m
46	.	78	N	110	n
47	/	79	O	111	o
48	0	80	P	112	p
49	1	81	Q	113	q
50	2	82	R	114	r
51	3	83	S	115	s
52	4	84	T	116	t
53	5	85	U	117	u
54	6	86	V	118	v
55	7	87	W	119	w
56	8	88	X	120	x
57	9	89	Y	121	y
58	:	90	Z	122	z
59	;	91	[	123	{
60	<	92	\	124	|
61	=	93	]	125	}
62	>	94	^	126	~
63	?	95	_		

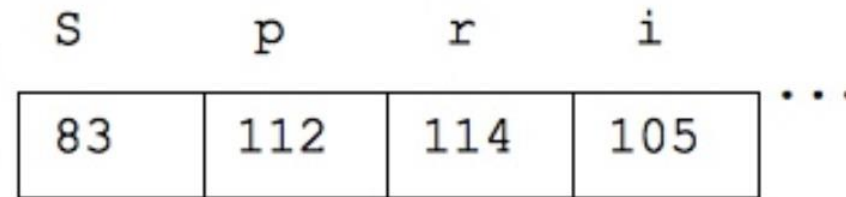
Extended ASCII characters

128	Ç	160	á	192	Ł	224	Ó
129	ü	161	í	193	ł	225	ô
130	é	162	ó	194	Ł	226	õ
131	â	163	ú	195	ł	227	ö
132	ä	164	ñ	196	—	228	ő
133	à	165	Ñ	197	†	229	Õ
134	å	166	ª	198	ä	230	µ
135	ç	167	º	199	Ä	231	þ
136	ê	168	¿	200	Ł	232	ƒ
137	ë	169	®	201	┌	233	Ú
138	è	170	™	202	└	234	Û
139	ï	171	½	203	┌	235	Ü
140	ì	172	¼	204	└	236	Ý
141	í	173	⅓	205	=	237	Ÿ
142	Ä	174	«	206	≠	238	ˉ
143	Å	175	»	207	□	239	˙
144	É	176	⋮	208	ø	240	≡
145	æ	177	⋮	209	Ð	241	±
146	Æ	178	⋮	210	Ê	242	±
147	ò	179	└	211	È	243	¼
148	ó	180	└	212	É	244	¶
149	ô	181	À	213	ı	245	§
150	ù	182	Â	214	í	246	÷
151	ú	183	À	215	î	247	˙
152	ÿ	184	©	216	ï	248	˙
153	Ö	185	┌	217	ı	249	˙
154	Ü	186	└	218	ı	250	˙
155	ø	187	┌	219	■	251	˙
156	£	188	└	220	■	252	˙
157	Ø	189	¢	221	ı	253	˙
158	×	190	¥	222	ı	254	■
159	ƒ	191	₱	223	■	255	nbsp

Representing Text



Underlying bytes in RAM





Text Representation

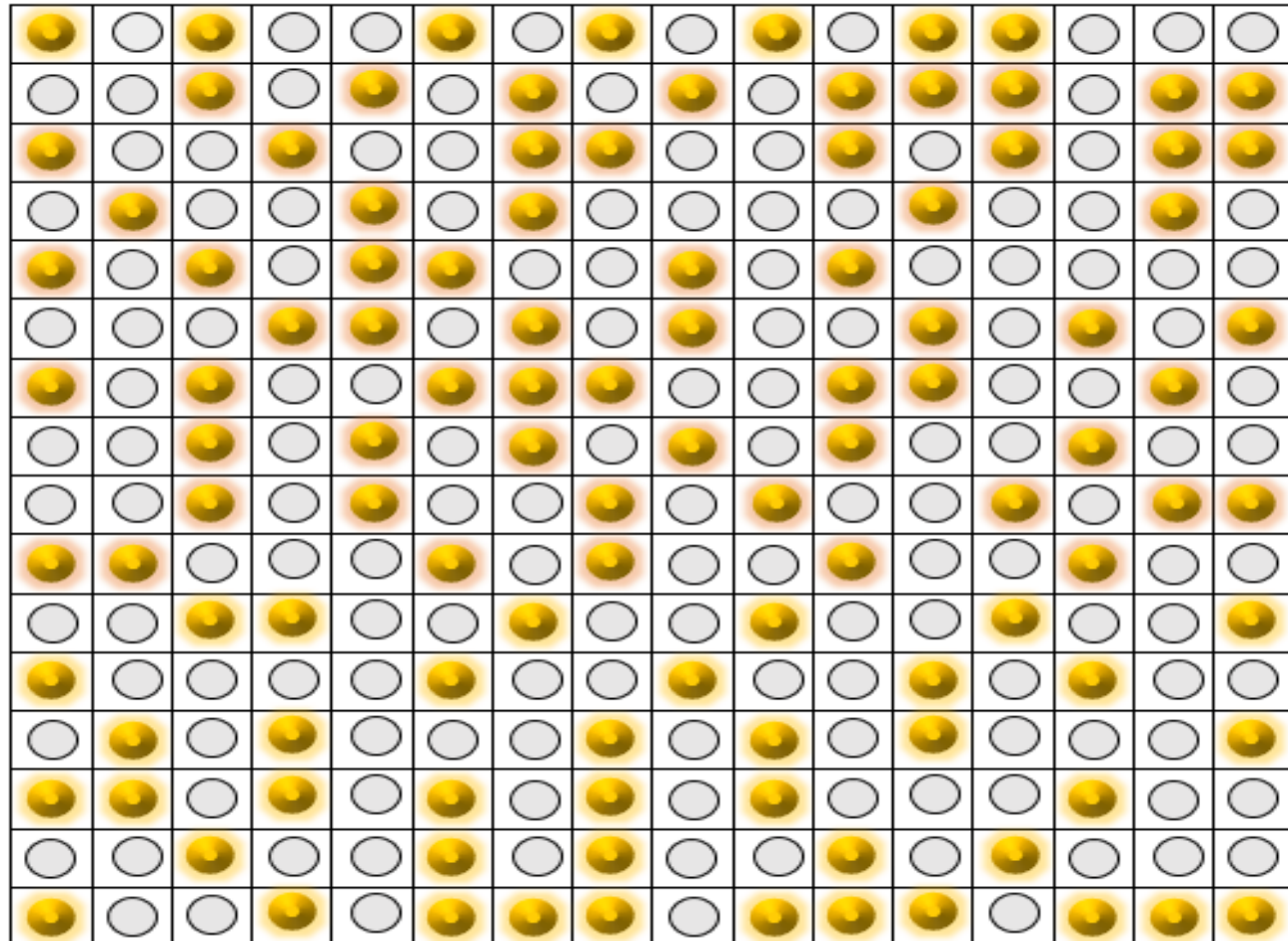
- Write your name on RAM

Simulating how RAM Works

- Random Access Memory (RAM) is one of the basic components of computer
- RAM is made up of billions of memory cells
 - Every memory cell is made up of transistors and capacitors combined
 - Each memory cell is meant to represent Binary Digit
- In the following diagram, we will simulate each memory cell as light bulb – which can be ON or OFF
- The ON and OFF states represent the intended binary numbers 1 and 0 respectively.

Simulating how RAM works – Computer data representation

-  ON=1
-  OFF=0



Bits and Bytes in a Memory

- At the smallest scale in the computer, information is stored as bits and bytes.
- Bit
 - a "bit" is atomic: the smallest unit of storage
 - A bit stores just a 0 or 1, with only two separate states
 - "In the computer it's all 0's and 1's" ... Bits
- Byte
 - Group of 8 bits together to makes 1 byte,
 - Example : 10010110
 - One byte can store one character
 - Example : 'A' or 'x' or '\$'

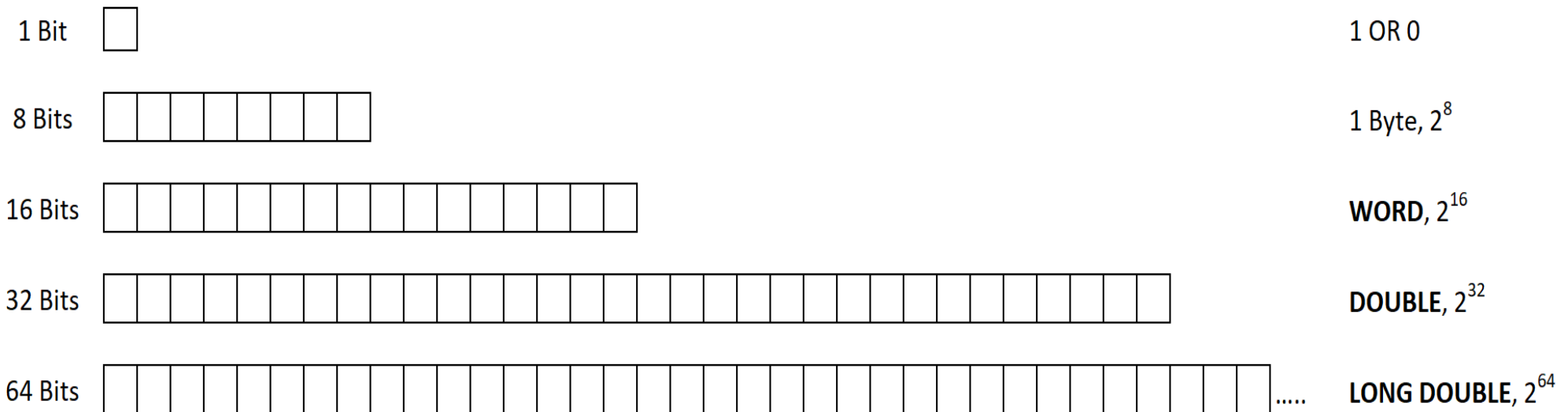
Information Storage

- Byte
 - 1 byte is group of 8 bits
- "Byte" - unit of information storage
- All storage is measured in bytes, despite being very different hardware
 - **Kilobyte**, KB, about 1 thousand bytes (2^{10} bytes = 1024 bytes)
 - **Megabyte**, MB, about 1 million bytes (2^{20} bytes = 1024 Kilobytes)
 - **Gigabyte**, GB, about 1 billion bytes (2^{30} bytes = 1024 Megabyte)
 - **Terabyte**, TB, about 1 trillion bytes (2^{40} bytes = 1024 Gigabyte)

Number of patterns with N bits

Number of bits	Different Patterns	Number of Patterns
1	0 1	2
2	00 01 10 11	4
3	000 001 010 011 100 101 110 111	8
4	0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111	16
5	00000 00001 00010 00011 00100 00101 00110 00111 00111 01000 01001 01010 01011 01100 01101 01110 01111 10000 10001 10010 10011 10100 10101 10110 10111 11000 11001 11010 11011 11100 11101 11110 11111	32
6	000000 000001 000010 000011 000100 000101 	64
7	0000000 0000001 0000010 0000011 0000100 0000101 	128

Information Storage



Encoding information on a fixed element of length **n** with a base **b** gives **b^n** non-redundant/unique possibilities

Information Coding

- Information coding on computer can be done using binary, octal or hexadecimal
 - Binary : Base 2
 - Symbols : 0, 1
 - Successively dividing a decimal number by 2
 - Octal : Base 8
 - Symbols : 0, 1, 2, 3, 4, 5, 6, 7
 - Successively dividing a decimal number by 8
 - Binary number can also be converted to octal numbering by grouping 3 bits
 - Hexadecimal : Base 16
 - Symbols : 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F
 - Successively dividing a decimal number by 16
 - Binary number can be converted to hexadecimal numbering by grouping 4 bits

Information Coding

EXAMPLE

DECIMAL NUMBER : 196

BINARY NUMBER : 11000100

OCTAL : 304

HEXADECIMAL : C4

Operations of Bits

- In arithmetic-logic unit (which is within the CPU), mathematical operations like: addition, subtraction, multiplication and division are done in bit-level.
- Bit-level operations
 - AND
 - OR
 - NOT
 - XOR

Operations of Bits

Boolean Operators

- AND, OR, XOR, NOT

AND	0	1
0	0	0
1	0	1

OR	0	1
0	0	1
1	1	1

XOR	0	1
0	0	1
1	1	0

Operations of Bits

Bit 7 6 5 4 3 2 1 0
0 1 1 1 1 1 0 0 Byte A
0 1 1 0 1 0 1 0 Byte B
0 1 1 0 1 0 0 0 Result

Bit 7 6 5 4 3 2 1 0
0 0 0 0 1 1 0 0 Byte A
0 1 1 0 0 0 0 0 Byte B
0 1 1 0 1 1 0 0 Result

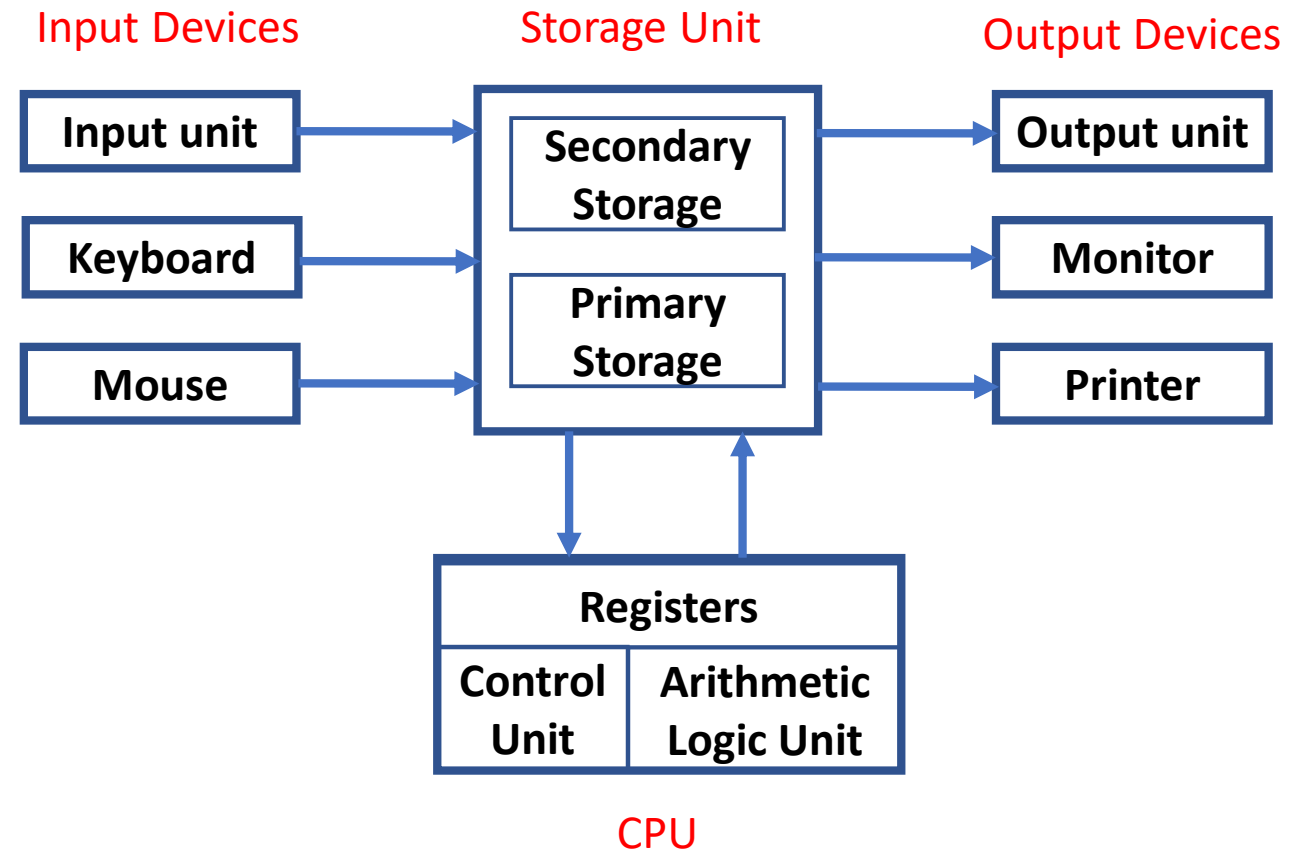
Bit 7 6 5 4 3 2 1 0
0 1 1 1 1 1 0 0 Byte A
0 1 1 0 1 0 1 0 Byte B
0 1 1 1 1 1 1 0 Result

Bit 7 6 5 4 3 2 1 0
0 1 1 1 1 1 0 0 Byte A
0 0 0 0 1 1 1 1 Mask
0 0 0 0 1 1 0 0 Result

Block Diagram of Computer

The Basic components & parts of computer system :

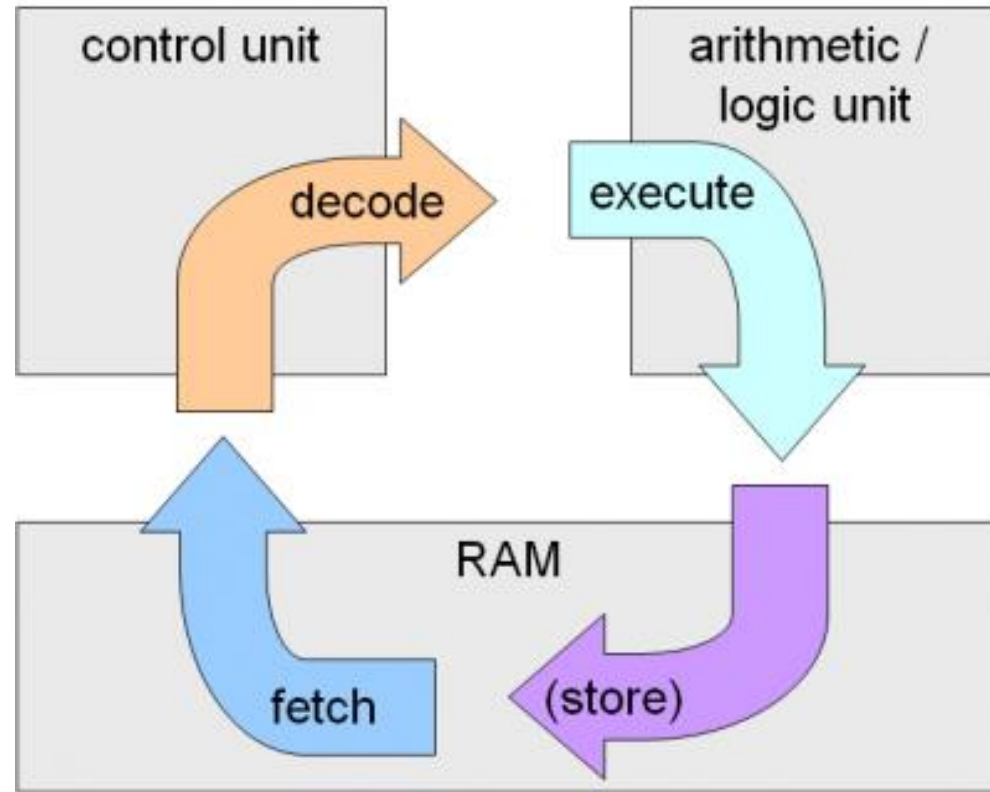
- Input Devices
- Output Devices
- CPU (Central Processing Unit)
 - ALU(Arithmetic Logic Unit)
 - Control Unit
 - Registers
- Storage Unit



Central Processing Unit, CPU

- Also referred to as Processor, Central Processor, Microprocessor
- Also referred as the brain of the computer
- It handles all instructions it receives from hardware and software running on the computer.
- Controls all the internal and external devices and performs arithmetic and logic operations.
- Controls the speed of computer system.
- Fabricated as single IC, Integrated Circuit. It is placed and secured on the [motherboard](#).
- The speed of processor is measured in MHz (Mega Hertz) and GHz (Giga Hertz) i.e. the number of instructions per second. (clock frequency for execution of instructions per second)

Instruction Cycle

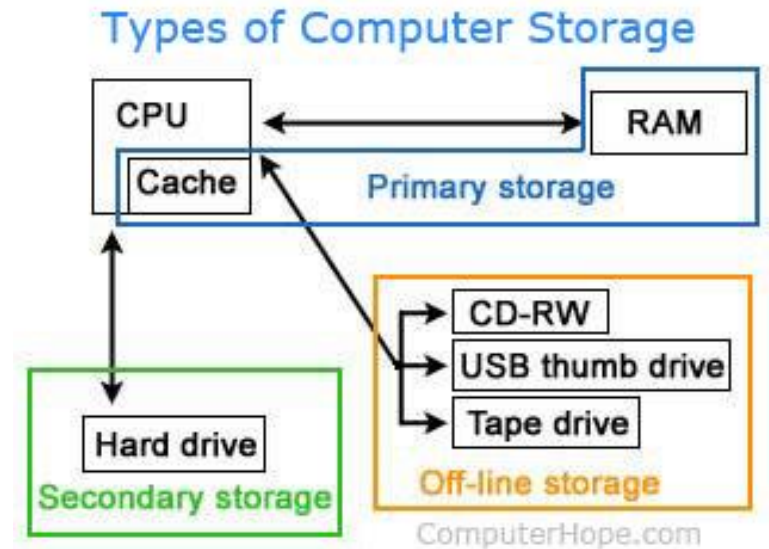


How CPU Process Instructions.....

- CPU execute instruction and process data by 4 phases
 - Fetch Phase
 - CPU retrieves the data and instruction to be executed
 - Decode Phase
 - The code is translated to the instruction to the form understandable by the Control Process so that is is workable by ALU.
 - Execute Phase
 - The decoded instruction is executed by ALU, 'Arithmetic Logic Unit''
 - Writeback Phase
 - The result is stored for future use

Storage Unit

- It is any hardware capable of holding information either **temporarily** or **permanently**.
- Types of storage devices used with computers:
 - A primary storage device, such as RAM and Registers (Cache)
 - A secondary storage device, like a hard drive.
 - Can be removable, internal, or external.



Storage Unit

- **Primary Storage Device**

- Random-Access Memory (RAM) / Cache
 - Stores [data/machine code](#) currently being used.
 - Uses special circuitry to help fast reading or writing the entry.
 - Holds memory for short periods of time while a computer is running.
 - It is **volatile** and **non-removeable**

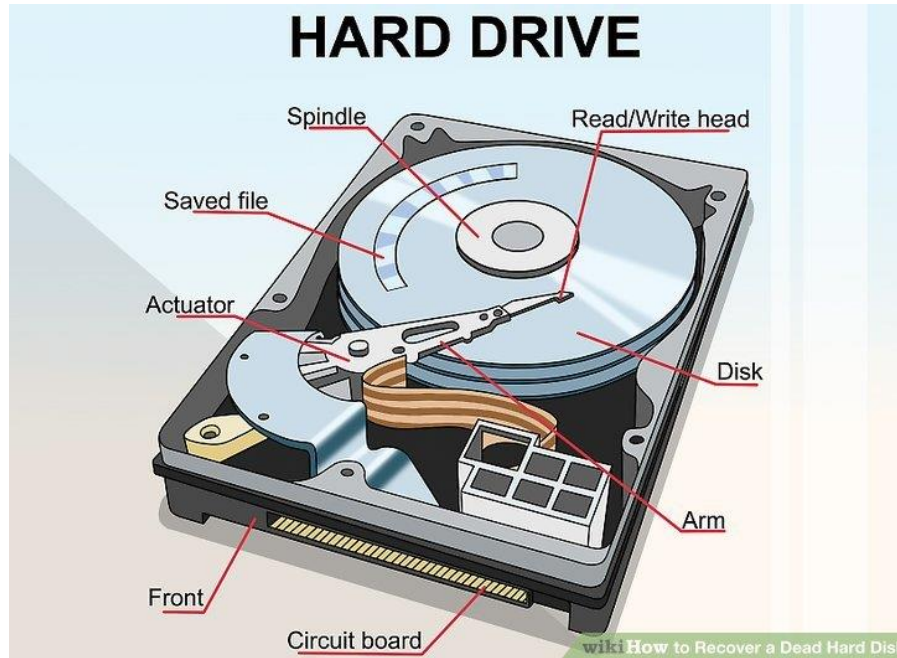


Storage Unit

- **Secondary Storage Device**

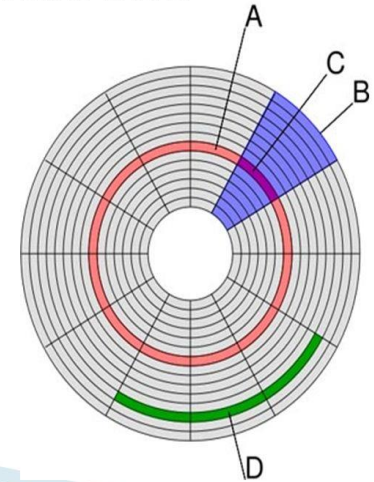
- A hard disk is a sealed unit containing a number of platters in a stack.
- **Electromagnetic read/write heads** are positioned above and below each platter.
- As the platters spin, the drive heads move in toward the center surface and out toward the edge.
 - In this way, the drive heads can reach the entire surface of each platter.
- Rings on each side of each platter called tracks, and sections within each track called sectors.
- A sector is the smallest physical storage unit on a disk, almost always 512 bytes in size.

Storage Unit



Hard Drive/Hard Disk

- A = Track (Red)
- B = Sector (Slice)
- C = Sector Track
- D = Cluster



[Video](#)

Storage Unit

- A DVD stores information as a series of microscopic **pits** arranged in a very long spiral.
- A red **laser** reads these pits from the other side, so it sees them as bumps.
- The bumps reflect the laser's light to a sensor. Electronics within the DVD player read the information from the sensor as a **digital** signal.

Storage Unit

- Examples for Secondary Storage
 - Hard Drive
 - Solid State Drive, SSD
 - USB Thumb drive
 - SD Card
 - CD
 - DVD
 - Floppy diskette
 - Tape Drives

Input Device

- An **input device** is any hardware device that sends data to a computer, allowing user to interact with and control it.
- The most commonly used or primary input devices on a computer are the keyboard and mouse.
- All input devices send data from the device over a cable or wireless transmission to the computer.
- Other examples,
 - Joy Stick, Light pen, Scanner, Graphic Tablet, Microphone, Magnetic Ink Card Reader(MICR), Optical Character Reader(OCR), Bar Code Reader... etc

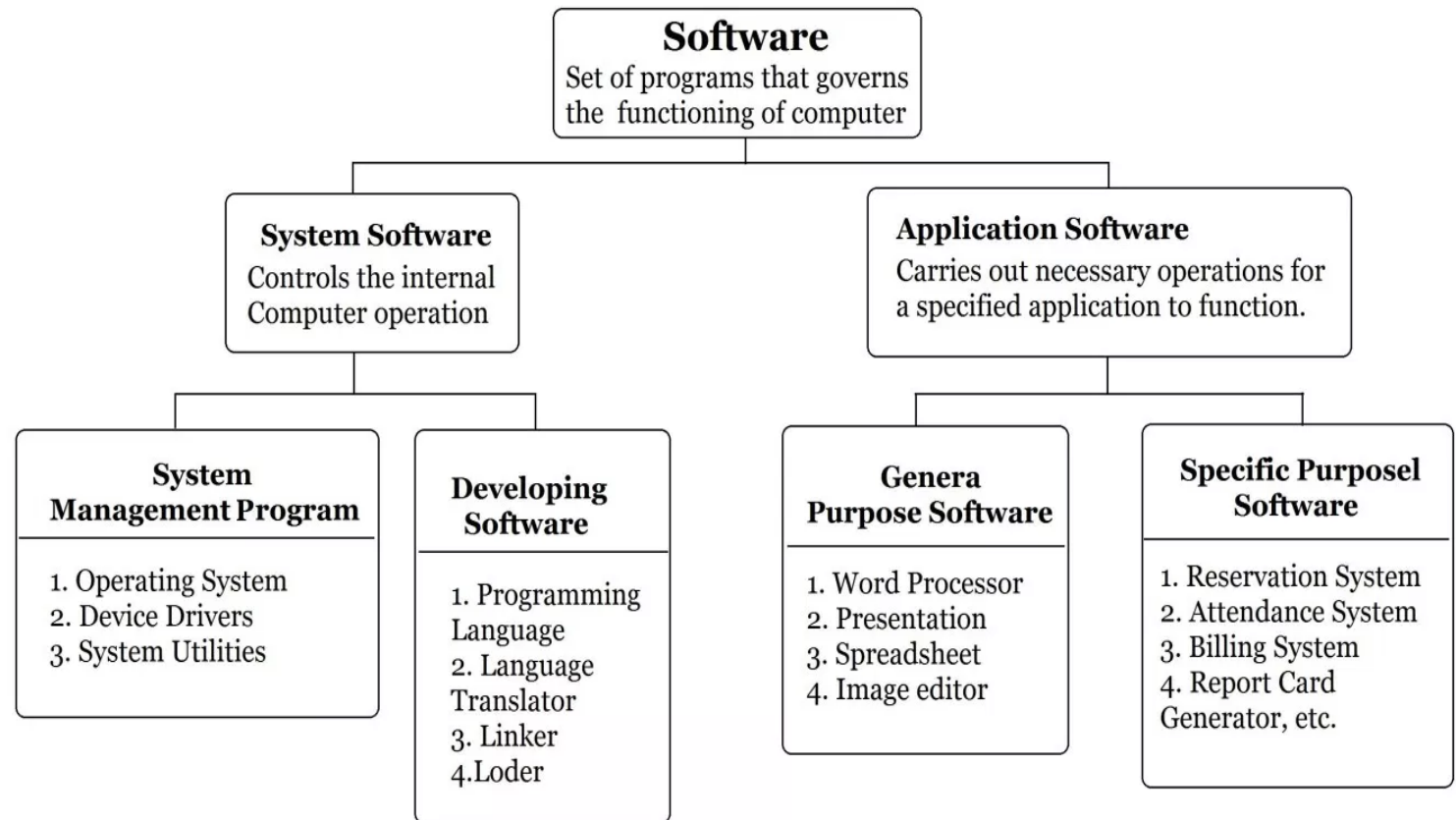


Computer Software

- A computer system consists of hardware and **software** .
- It provide the instruction to the computer what to do and how to do.
- A software is an **interface** between user and computer.
- It is a set of instructions, programs that are used to give **command** to hardware.
- It **controls, integrate and manage** the computer hardware for accomplishing specific tasks.

Computer Software

- Types of software
 - System Software
 - Application Software



Computer Software

- System Software
 - programs, which are directly responsible for controlling, integrating and managing the **individual hardware components** of a computer system.
 - The purpose is to insulate the applications programmer as much as possible from the detail of the particular complex computer being used.
 - Provides a platform for the applications software to run on
 - Further divided into two major categories;
 - System Management Program and
 - **Operating System**, Device Drivers, System Utilities
 - Developing software.
 - Programming Language, Language Translator, Linker, Loader

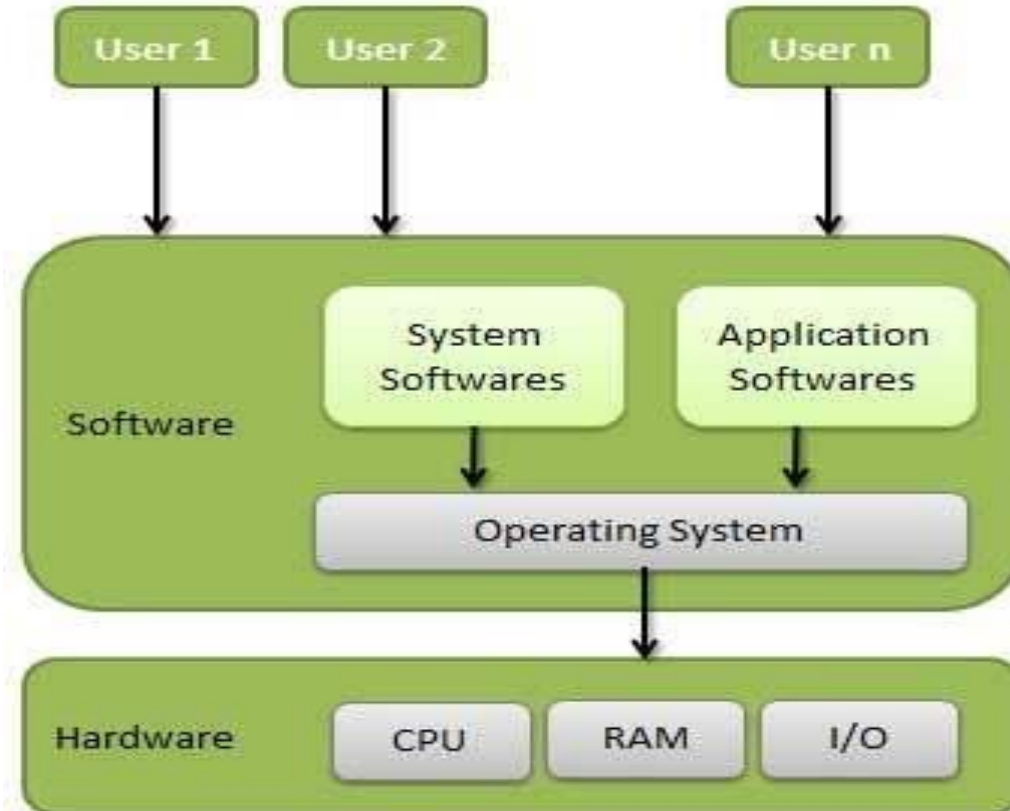
Computer Software

- Operating System
 - consists of programs, which controls, coordinates and supervises the activities of the various components of a computer system.
 - Its function is to provide link between the computer hardware and the user.
 - It performs all internal management functions (disk access, memory management, task scheduling and user interfacing) and ensures systematic functioning of a computer system.
 - It provides an environment to run the programs.
 - Example
 - MS-DOS, windows XP/2000/98, Unix Linux, etc.

Computer Software

- Main Functions of Operating System,
 - **Input / Output Management**
 - Manages all external communication ports
 - **Memory Management**
 - Facilitate appropriate use of RAM space by Applications
 - **Process Management**
 - Put program executions (processes) in a queue to avoid conflicts
 - **File Management**
 - Manage files on storage devices – includes file systems, proper organization of files (directory service) and indexing

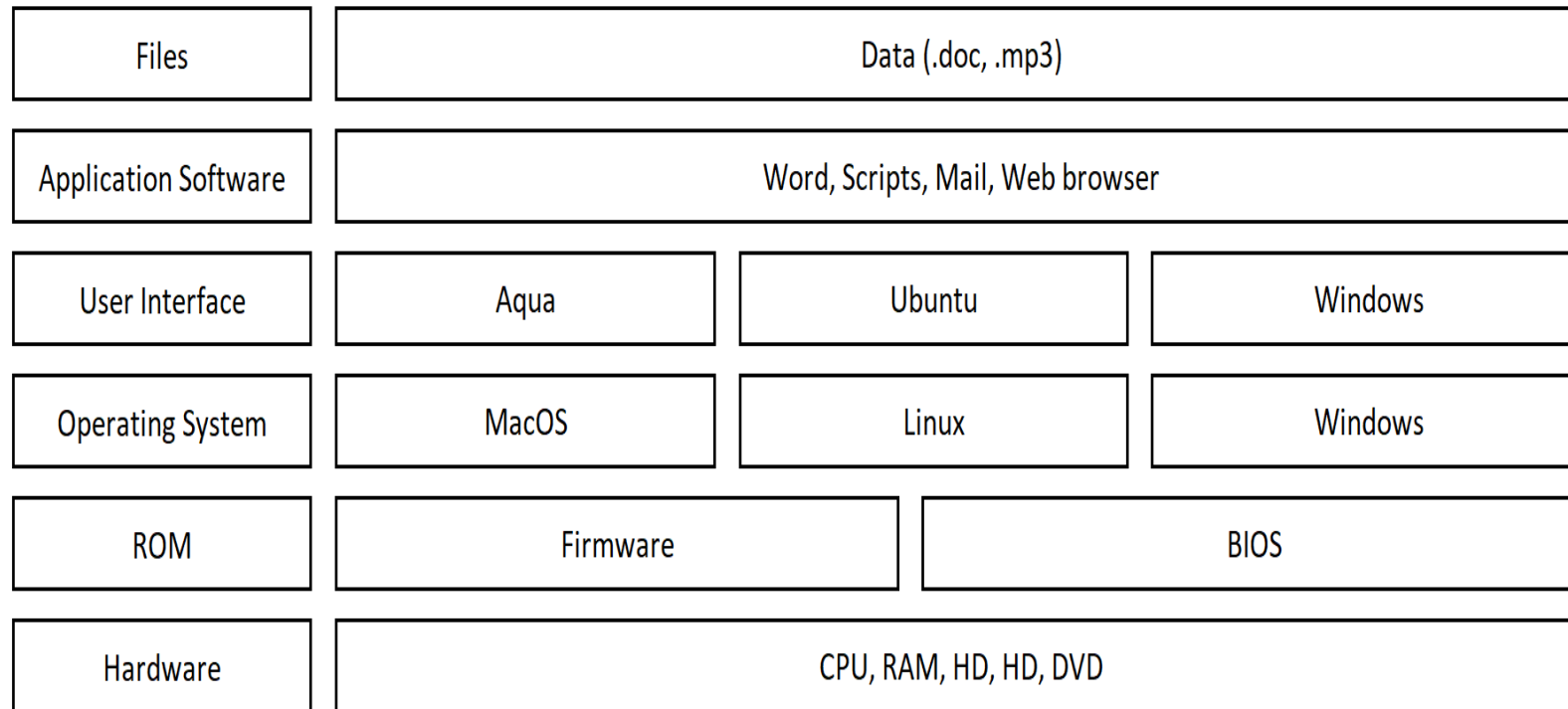
Operating System, OS



Computer Software

- Application Software
 - Designed to help the user to perform singular or multiple tasks.
 - Designed for specific uses or applications, that enable the user to interact with a computer.
 - Application software are also called the end-user programs.
 - These programs do the real work for users.
 - Types
 - General Purpose Software
 - Designed to perform general tasks
 - Example : Word processing, Database Management System..... etc
 - Specific Purpose Software
 - Designed to perform specific task, has only one purpose to execute
 - Example : Student Management System, Hotel Management System, Reservation System

Hardware and Software Layers



File Systems

- The structure and logic rules used to manage the groups of information and their names is called a "file system".
- A **file system** controls how data is **stored** and **retrieved**.
- Without a file system, information placed in a storage medium would be one large body of data with no way to tell where one piece of information **stops** and the next **begins**.
- By separating the data into pieces and giving each piece a **name**, the information is easily isolated and identified.
- each group of data is called a "**file**".

File Systems

- What exactly is a file
 - It is a computer resource for recording data discretely in a computer storage device.
 - User can work on files using computer programs (File Operations)
 - Create, open, read, change/modify, save, close, reopen, copy
 - Organized by the file system
 - Keeps track of where the files are located on disk to enable access
 - It is identified by a name and a logical address (or path)
 - Type depends on the purpose of the file
 - text, graphical, video, audio, computer program.... etc

Path / File Name

File

- It is identified by a name and a logical address (or path)

- Example

Path

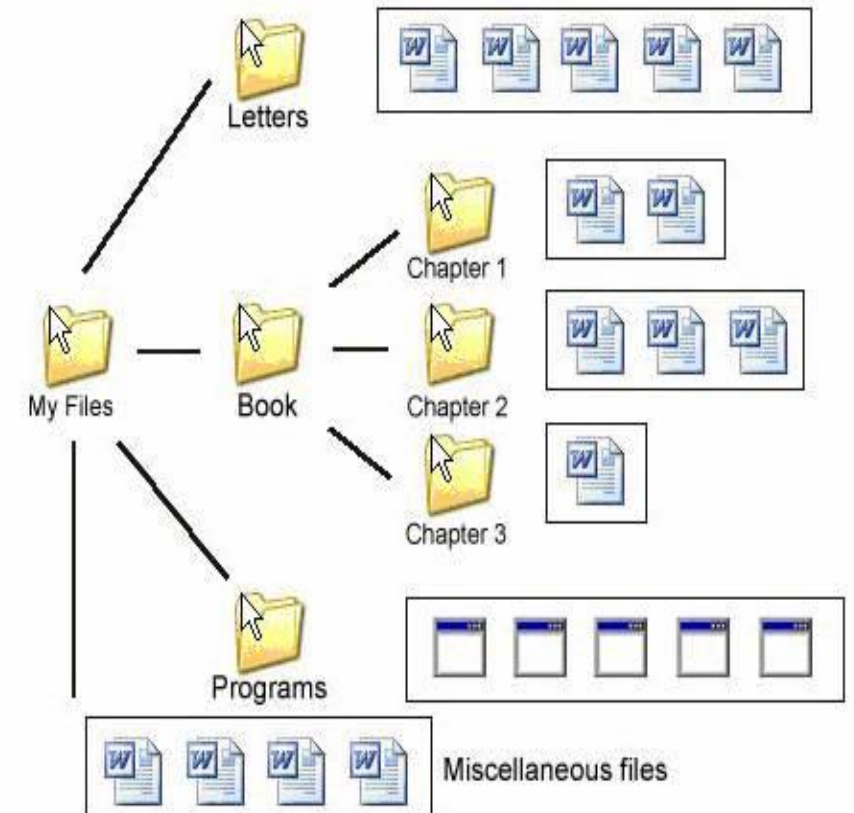
File Name

Suffix

D:\My Documents\My Files\Book\Chapter 1\CHAPTER 1.docx

- Other information

- Owner/Creator
- Type of the file
- Size
- Date
 - Create
 - Modified
 - Accessed



File Types - Examples

- The type of the file is indicated by its extension
- File extensions are assigned by OS, that also restricts the format of the file
- Different OS have different approaches to a particular file's format,
- **Examples**
 - **Audio file formats by file extensions**
 - .cda - CD audio track file, .mp3 - [MP3](#) audio file, .mpa - [MPEG-2](#) audio file, .wav - [WAV](#) file, .wma - [WMA](#) audio file
 - **Compressed file extensions**
 - .7z - [7-Zip](#) compressed file, .arj - ARJ compressed file, .pkg - [Package](#) file, .rar - [RAR](#) file, .zip - [Zip](#) compressed file
 - **Data and Database extensions**
 - .db or .dbf - [Database](#) file, .log - [Log file](#), .mdb - [Microsoft Access](#) database file, .sql - [SQL](#) database file, .xml - [XML](#) file
 - **Executable file extensions**
 - .com - [MS-DOS](#) command file, .exe - [Executable file](#), .jar - [Java Archive file](#), .py - [Python](#) file, .wsf - Windows Script File
 - **Image file extensions**
 - .ai - [Adobe Illustrator](#) file, .bmp - [Bitmap image](#), .gif - [GIF](#) image, .jpeg or .jpg - [JPEG](#) image, .png - [PNG](#) image

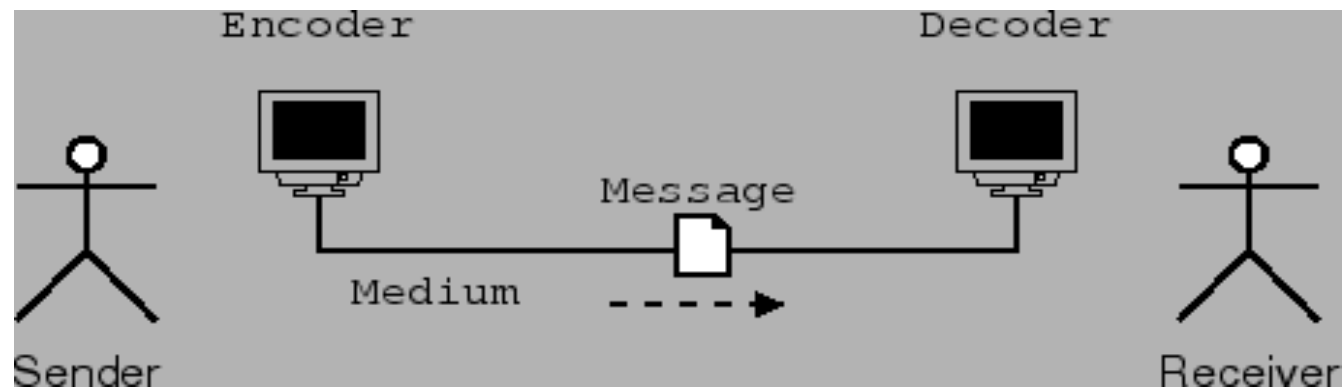
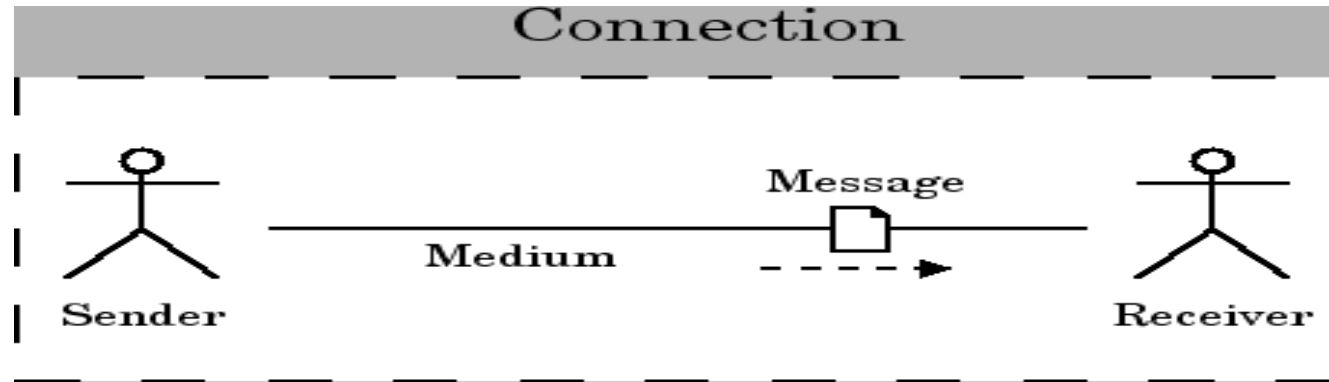
Compression / Encryption

- Compression
 - Reducing the size of the files/directory
 - Downloading, sharing and storing easier
 - Reduces the size by identifying redundant data within the file
 - Uses Algorithms for same purpose
 - Common compressed file extensions,
 - .ZIP, .RAR, .ARJ, .TGZ
- Encryption
 - **encryption** is the process of encoding a message/information in a way that only authorized parties can access it, not otherwise.
 - Ensures privacy to the users
 - Denies the intelligible content to a would-be interceptor.
 - Example : Encrypted file will have .pgp extension “Pretty Good Privacy”
- Packing (in a package),
 - Used on Linux or UNIX for storing data
 - Creates a file with extension “.tar”.
 - Compressed TAR files become TAR.GZ files

Computer Networks

[INTRODUCTION]

Simplified Communication Model



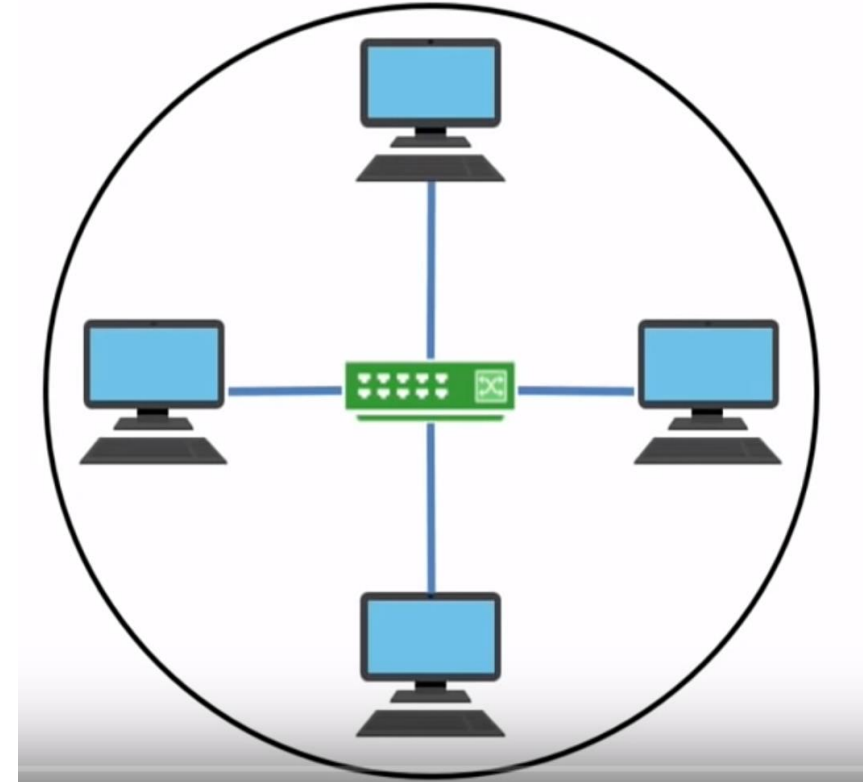
What is a Network ?

- A network is two devices connected to each other with a physical medium, such as wires or radio signals
- The connection allows those two devices to exchange data
- Advantages
 - Communication and collaboration
 - Sharing information and resources
 - Organizing data
 - Saving costs

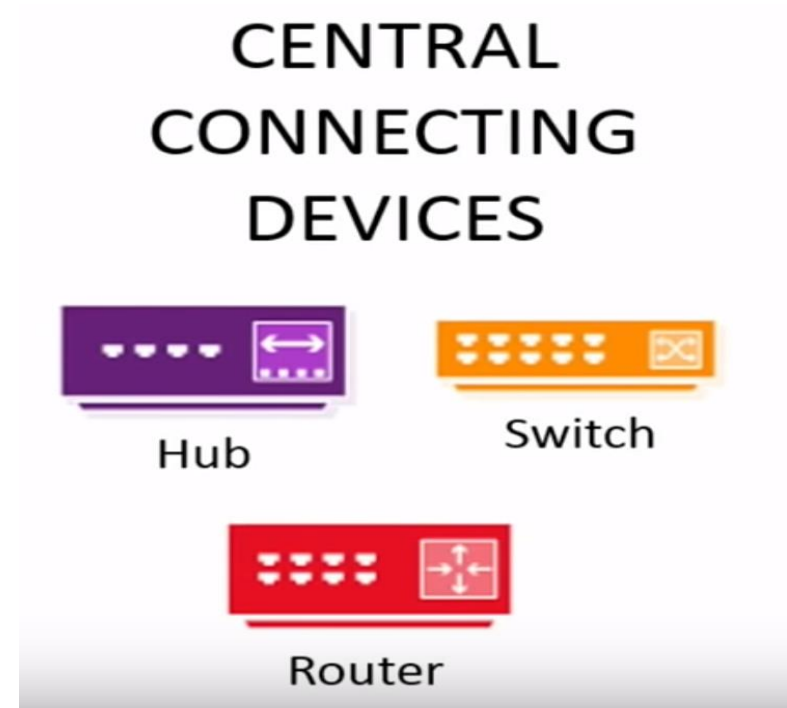
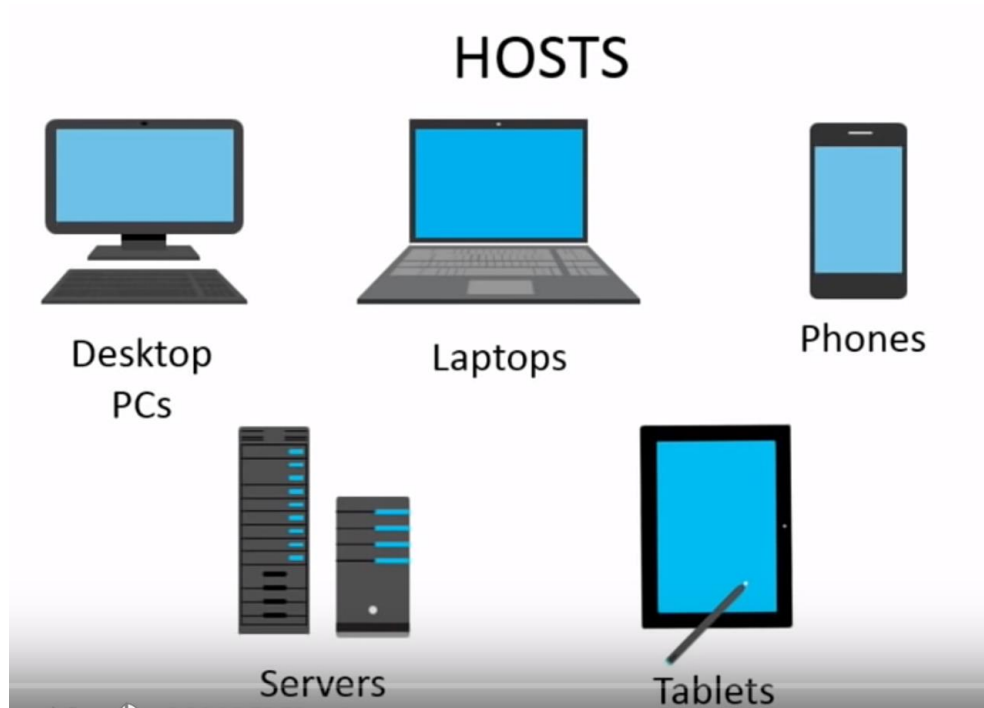


How are networks organized ?

- Networks are organized based on their **geographic locations**
- Local Area Network, or LAN is a group of computers or devices that
 - Are confined to a small geographic area, such as building
 - Share a common communication medium, such as cabled/wired or wireless connections
 - Are connected to a central connecting device, like hub, switch or router

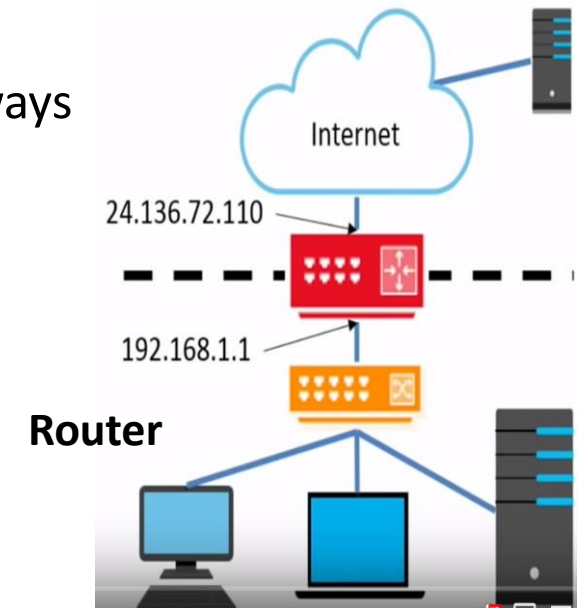
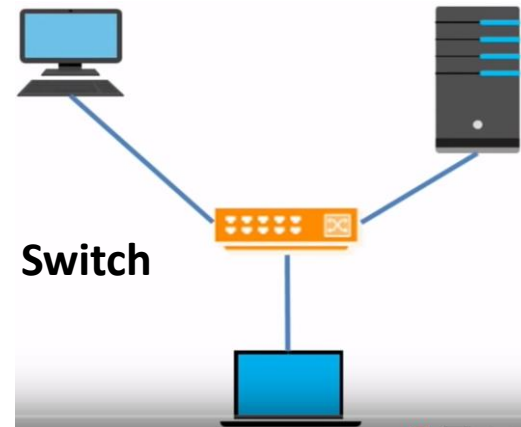
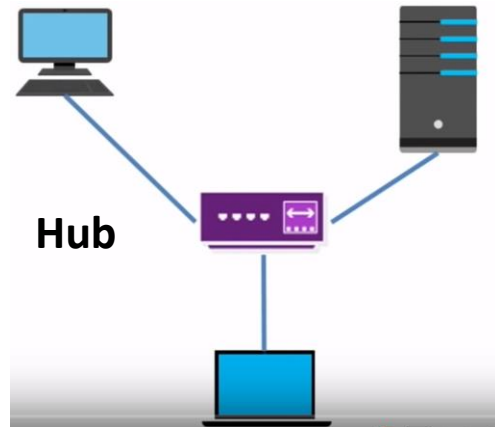


What devices make up LANs ?



How do Central Connecting Devices work ?

- Hubs, switches and routers act as central connecting devices
- Central connecting devices are responsible for
 - Connecting hosts
 - Transmitting data
- Different central connecting devices perform these functions in different ways



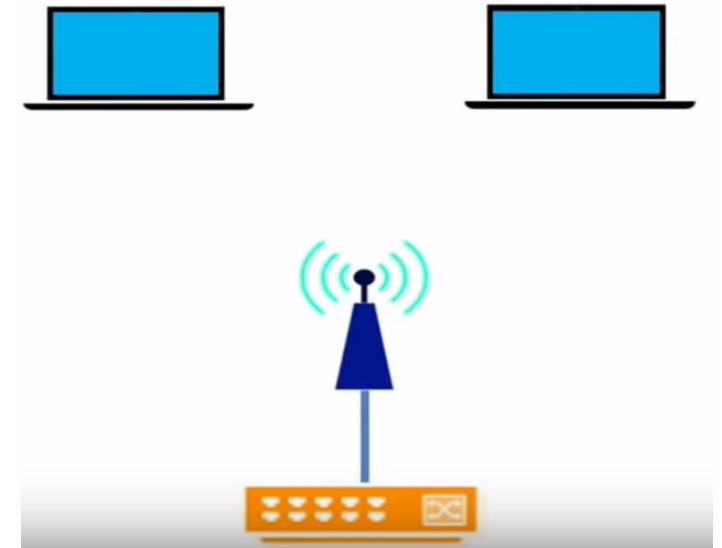
How do devices connect ?

- Computers have **network adapters**, also known as Network Interface Cards (NICs), that allows them to connect to networks
- NICs via wires or wireless signals
 - Wired adapters feature an **RJ45 port**
 - Wireless adapters feature an antenna and connect to networks using **Wireless Access Points (WAPs)**



Wireless Access Points (WAPs)

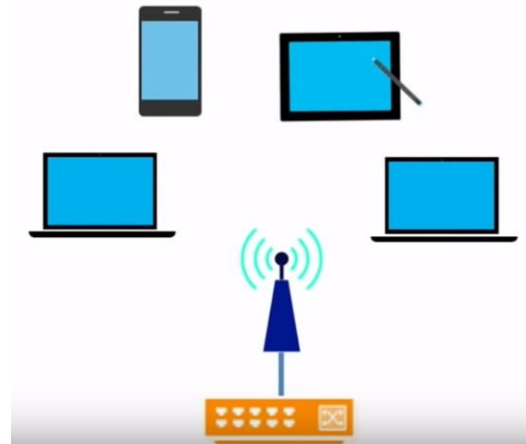
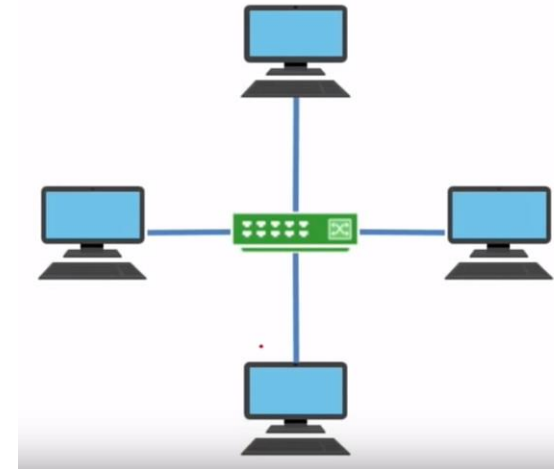
- WAPs provide central point of access for devices that want to connect to Local Area Network, LAN.
- Wireless networks can consist of many types of devices other than traditional PCs.
 - Smart phones
 - PDAs
 - Tablet Computers
 - Micro Computers
 - PCs and Laptops equipped with wireless network adapters can connect these networks as well



Types of Local Area Networks, LANs

- **Wired LANs (WLANs)**

- Hosts, such as PCs or laptops, are connected to central connecting devices by copper-based twisted pair cabling

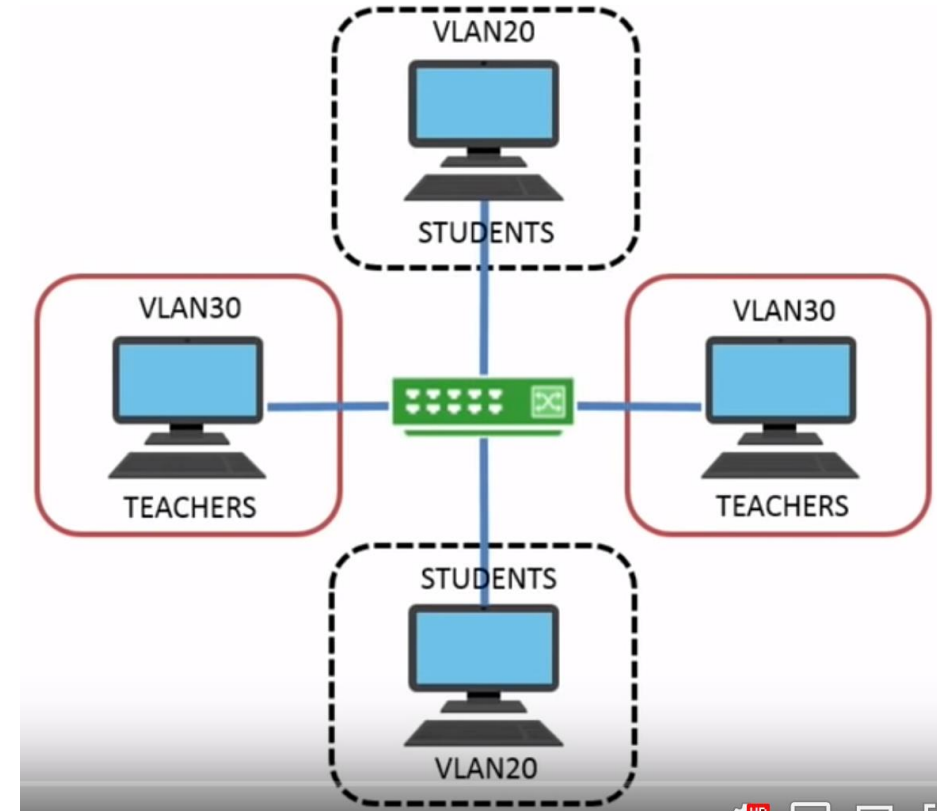


- **Wireless LANs**

- Host connect to networks through WAPs
- Device/Host must have a wireless network adapter
- In larger WLANs, the WAP has to connect to a wired switch

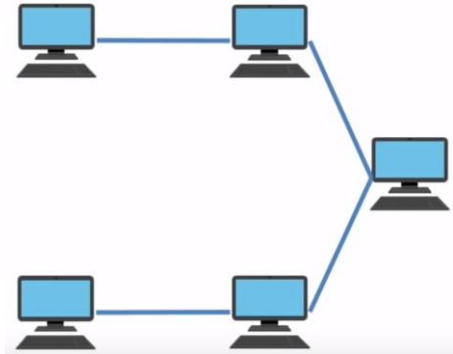
Virtual Local Network (VLAN)

- It is a special kind of Local Area Network
- Devices/Hosts in LAN are grouped based on their function
- Implemented to
 - Organize networks
 - Enhance performance
 - Increase security
- Physical location of devices does not matter

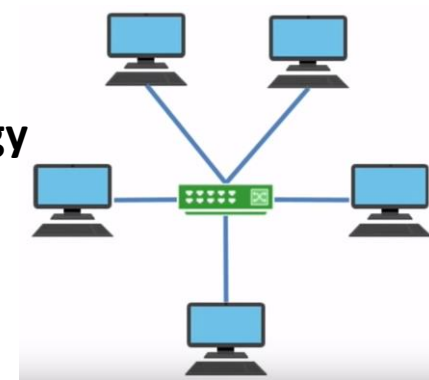


Network Topology

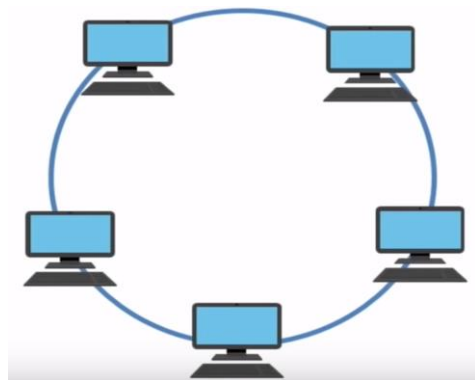
- Bus topology



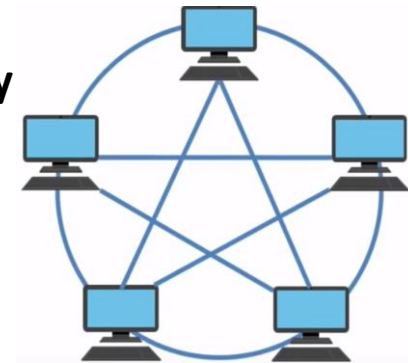
- Star Topology



- Ring topology

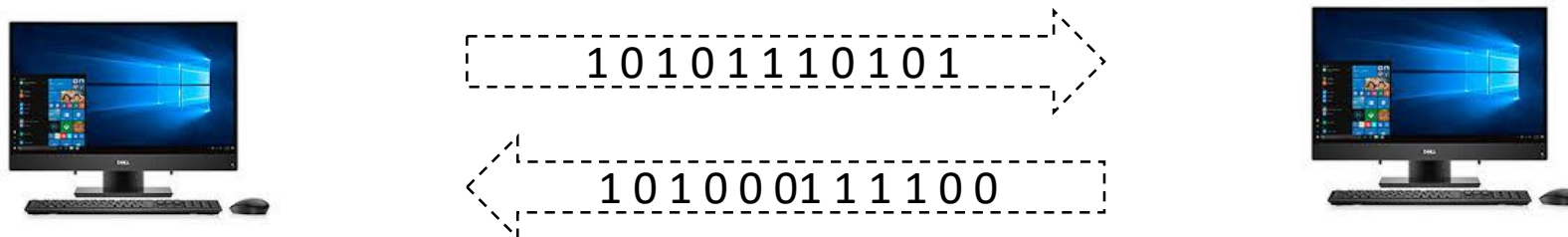


- Mesh Topology



Data Transfer on LAN

- Data is transferred in serial format
 - Transfer of one bit at a time
- Data can travel in single bit stream in both directions
 - Depends on the type of connection



How fast does data travel ?

- A data transfer rate is the maximum bits per second (bps) that can be transmitted over a network
 - Signified with a lower case 'b'
 - The lower case b differentiates bits from bytes

10 Mbps

BITRATE

Ethernet Standards

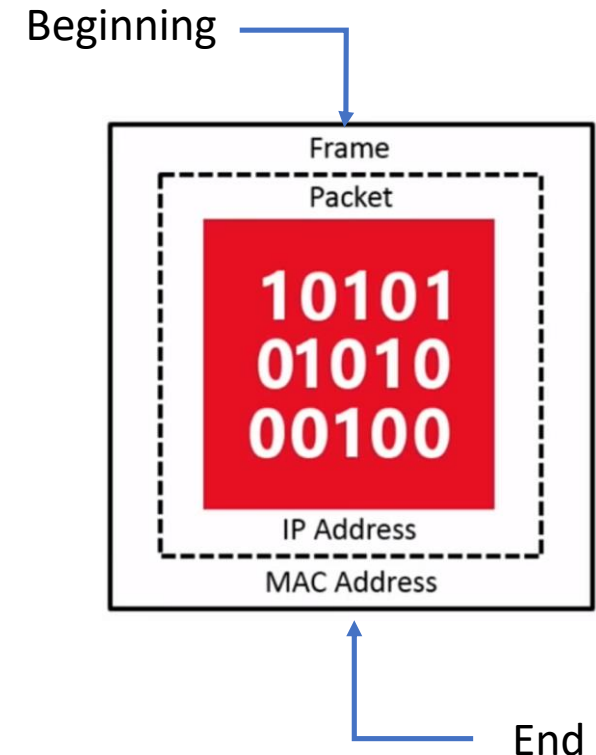
- Ethernet Standard is a standard that defines how data is sent and received between devices
- Standardized by the Institute of Electrical and Electronic Engineers (IEEE) as **802.3**
- Ethernet standard is the most widely used standard on the internet today
 - Other standards for data sending and receiving between devices
 - Token Ring, FDDI

Ethernet Standards

- LAN standard providing a communication method for high speed data exchange among devices
- Defined Physical and Data Link Layer
- 100BASE-T
 - 100 for 100 Mbps
 - BASE for baseband
 - T for twisted-pair cabling

Data transfer in LANs

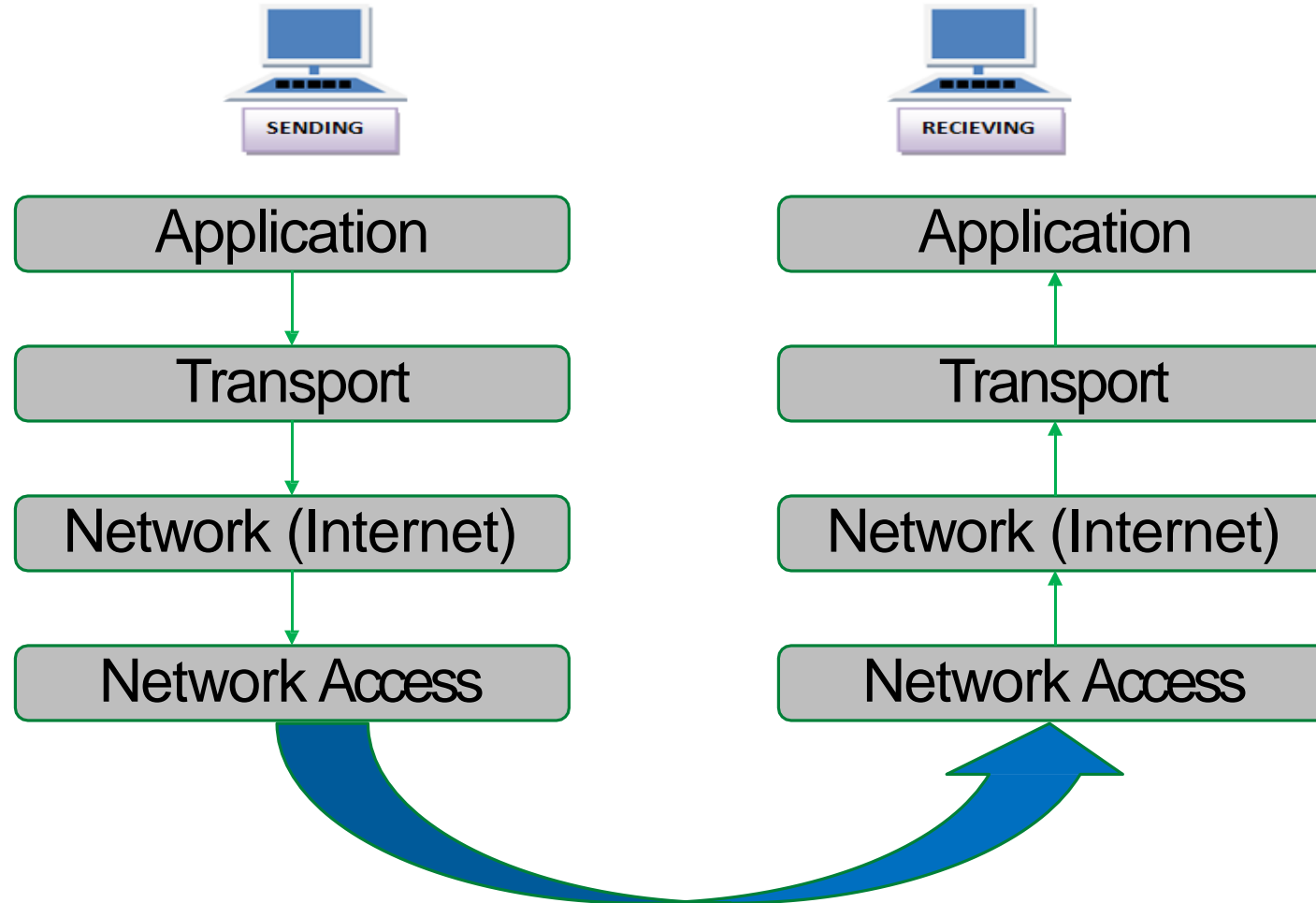
- Before data is transferred, it has to go through the following process
 1. Large chunk of data are broken into **segments**
 2. Addressing information is added to each segment, making a **packet**
 3. Packets then travel to the network adapter, where a little more information is added and they become Ethernet **frames**.
 4. Each frame is then broken into a data stream of bits -0s and 1s - that travel over physical media



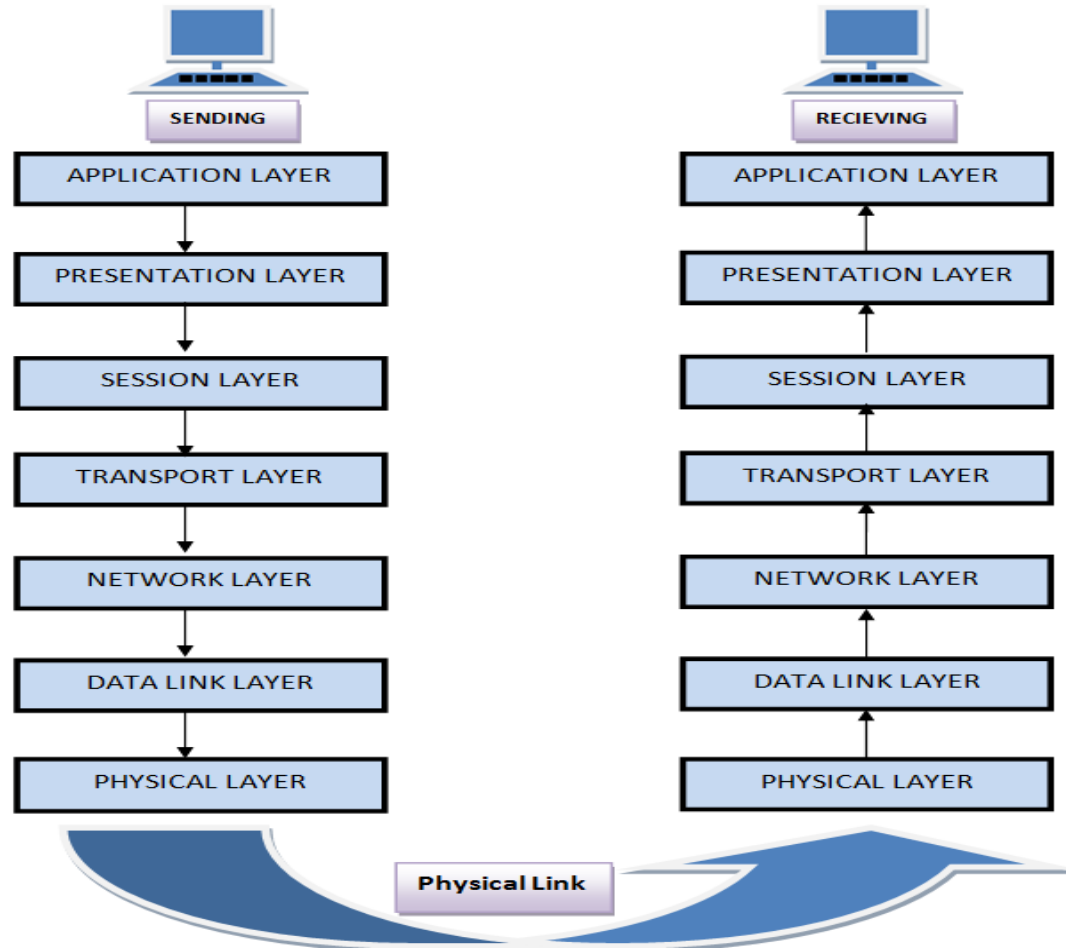
How does data know where to go ?

- Most every computer and many other devices have an Internet Protocol (IP) address
 - Uniquely identifies a device and its associated network
- A unique string of numbers separated by full stops.
- The 32-bit **IP address** is grouped 8 bits at a time, each group of 8 bits is an **octet**.
- Each of the four **octets** are separated by a dot, and represented in decimal format,
- A typical example of an IPv4 address would be 192.168.1.1
- Every IP address is broken down into two parts by a subnet mask
 - Network ID 192.168.1
 - Host ID 1

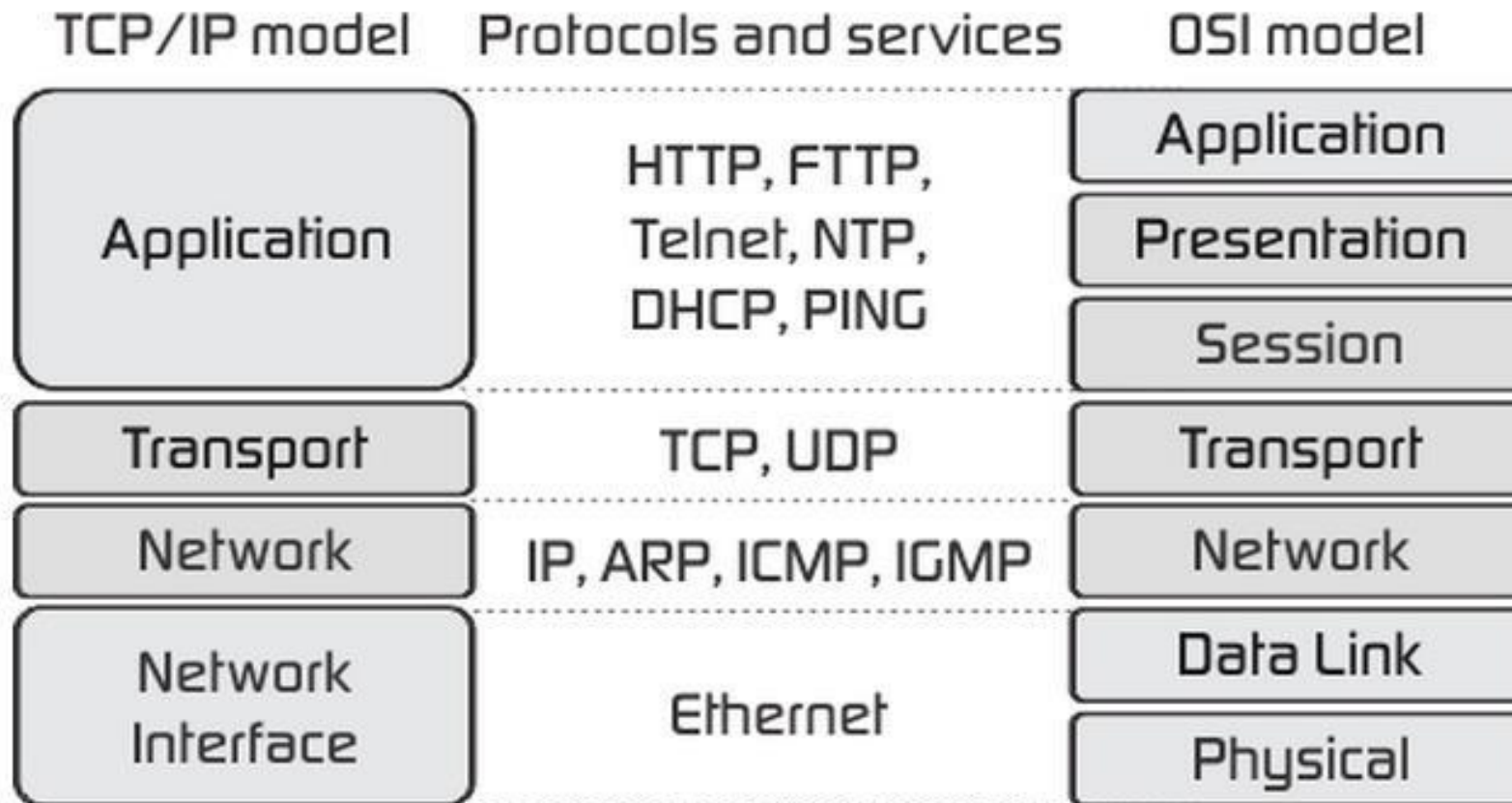
TCP/IP Communication Model (4 Layers)



ISO/OSI (7 Layers) Model



TCP/IP Vs ISO/OSI

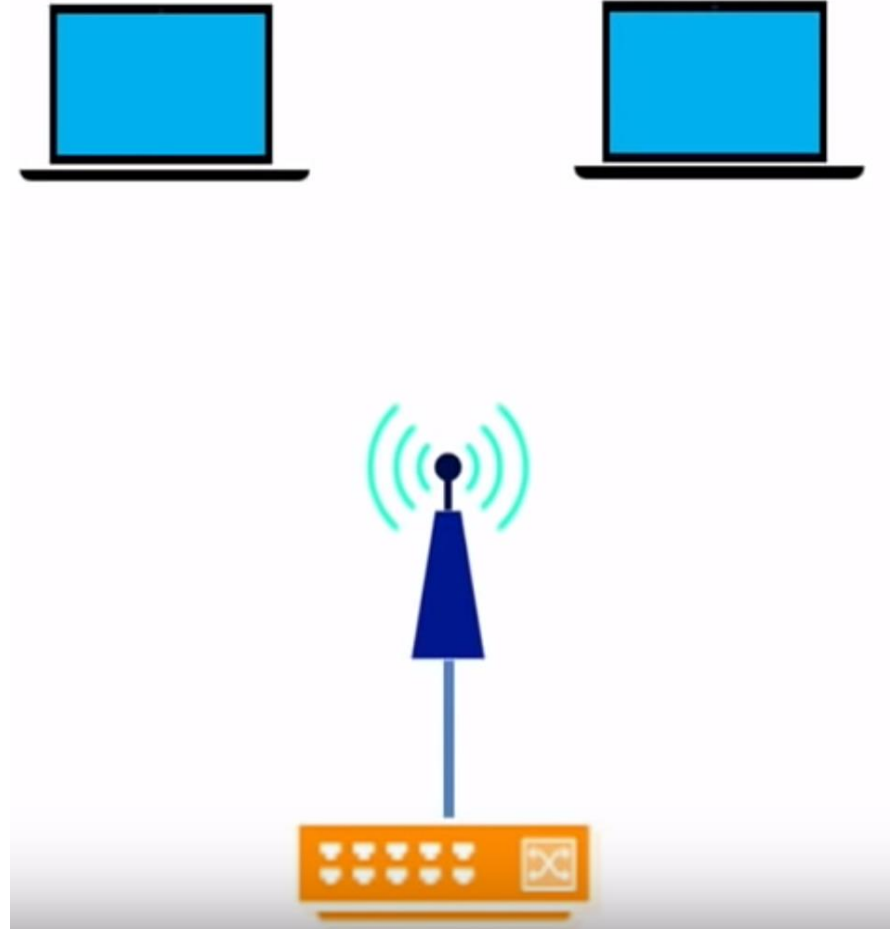


The Internet Protocol (IP)

- It is the protocol/language used by devices to communicate with each other.
- IP address are used to help devices send and receive data across networks
- Internet Protocol Versions
 - IPv4 : uses addressing space of 32 bits
 - Four groups of octet of the address expressed individually in decimal numbers and separated by periods.
 - Example : **192.42.197.51**
 - IPv6 : uses addressing space of 32 bits
 - Eight groups of 4 hexadecimal numbers separated by colon
 - Example : **3ffe:1900:4545:3:200:f8ff:fe21:67cf.**

Wireless Devices

- For wireless network to work, all devices must have wireless network adapter
 - Connects to wireless access point (WAP) that is capable of sending and receiving data wireless
- Wireless access points then transmit data over a **wire**, such as an Ethernet cable, through a network to its final destination



Wireless Network Adapters

- Wireless network adapters enable connectivity between devices and a WAP
- Wireless network adapters work by translating bits into radio signals, which are then sent to a WAP
- Wireless network adapters can come in many forms :
 - USB
 - Internal adapter cards
 - External adapter cards
 - Onboard adapters

Wireless Access Points

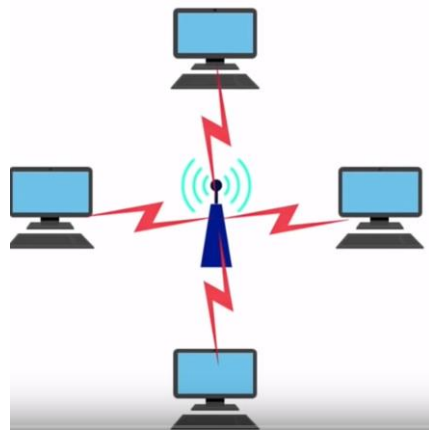
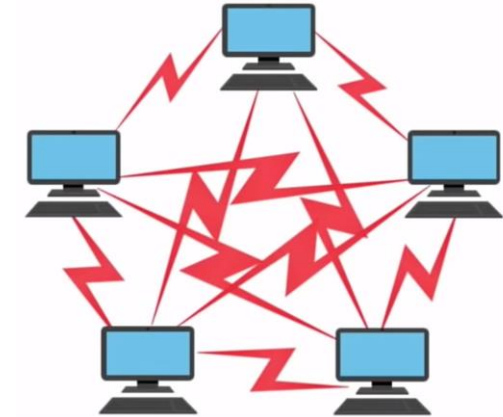
- Wireless access point can also come in many forms
 - SOHO routers
 - Dedicated WAPs connected to switches
- Wireless access points also work by translating bits into radio signals, which are then sent to or received from devices on a network



Wireless Network Topologies

- Ad-hoc mode

- similar to a mesh topology in a wired network
- Client communicated directly with one another
- This is called a peer-2-peer network

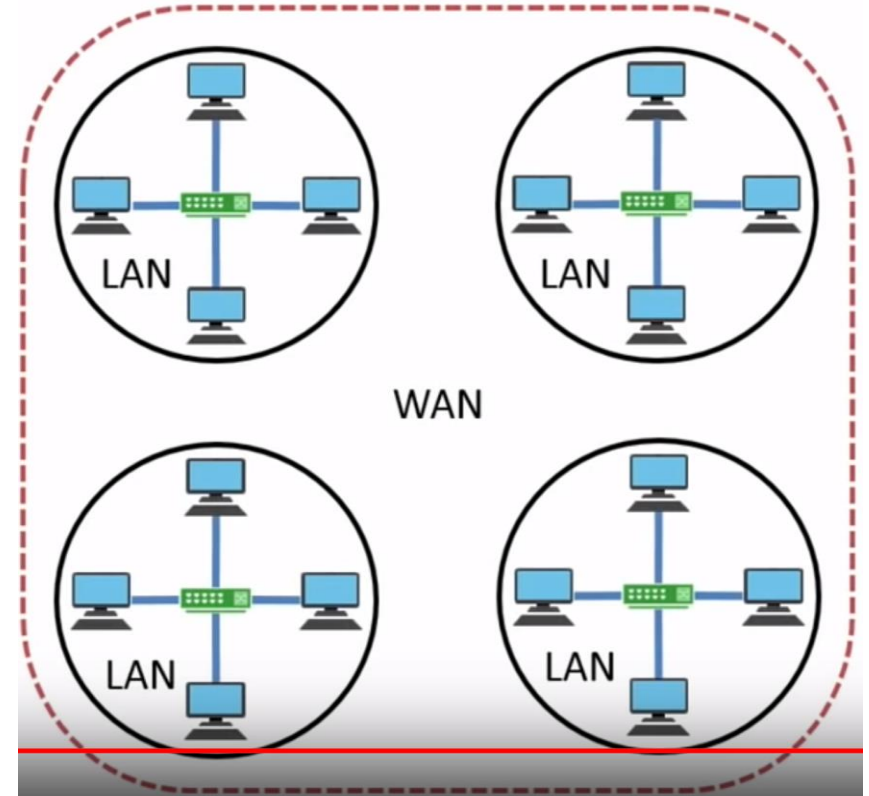


- Infrastructure mode

- The most common way to connect devices wirelessly
- Wireless clients connect to a WAP
- When clients want to connect, they use the **service set identifier (SSID)**, for user authentication purpose.

What is a Wide Area Network ?

- Wide area networks (WANs) connect multiple LANs over large geographical areas
- WANs are networks of networks
- The Internet is the largest WAN in the world



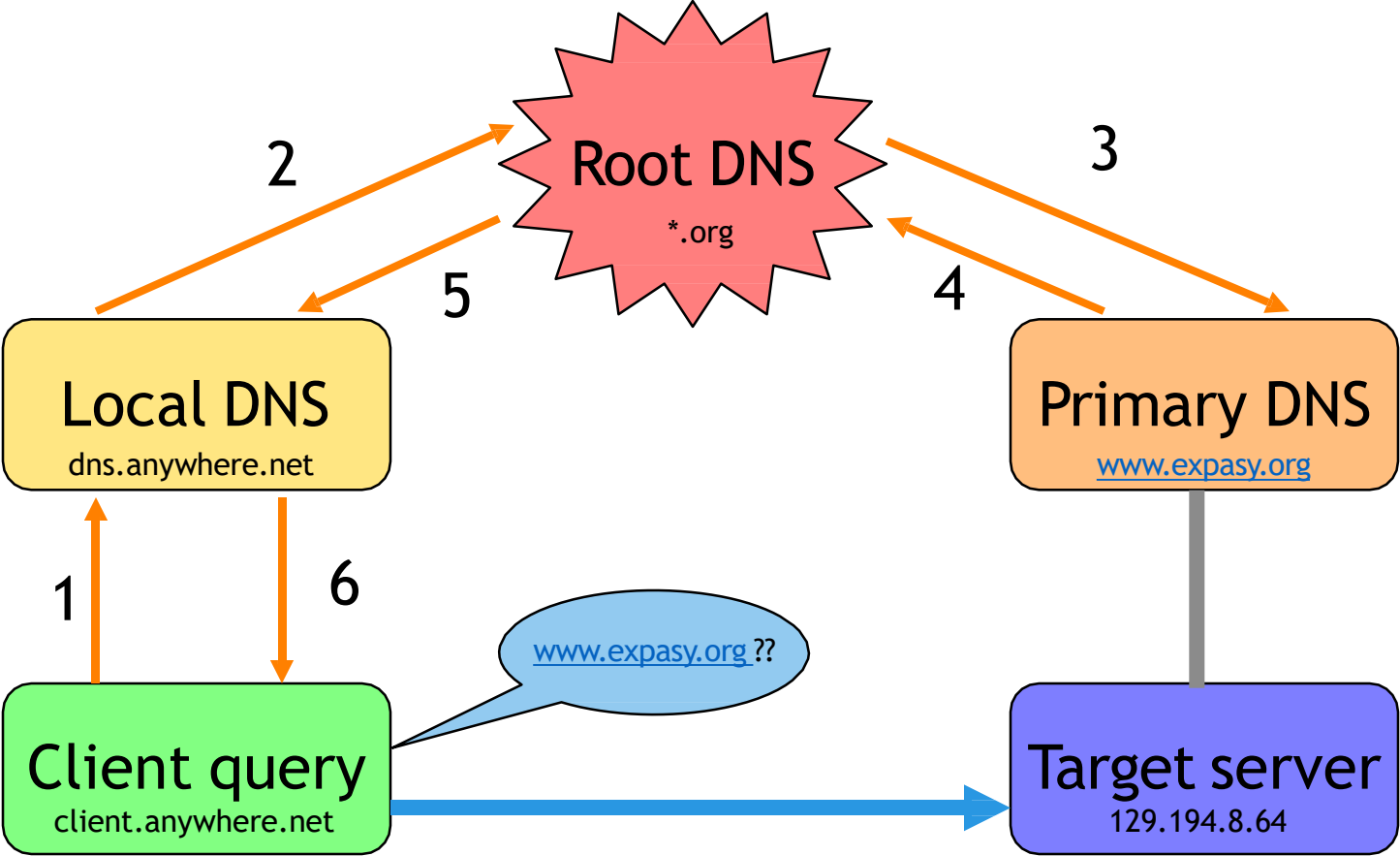
How does data travel on a WAN ?

- It relies on a technology called **packet switching**
- Data is broken into small segments, then addressing information is added to make each segment a packet
- Packets are then transmitted to LAN's router, which uses the addressing information to send it to another LAN
 - These packets are reassembled at their destination

Domain Name System, (DNS)

- **DNS** is a worldwide service that resolve host names to IP addresses
- DNS architecture is a hierarchical **distributed database** and an associated set of protocols that define
 - A mechanism for querying and updating the database
 - A mechanism for replicating the information in the database among servers

Domain Name System, (DNS)



Domain Naming System, DNS

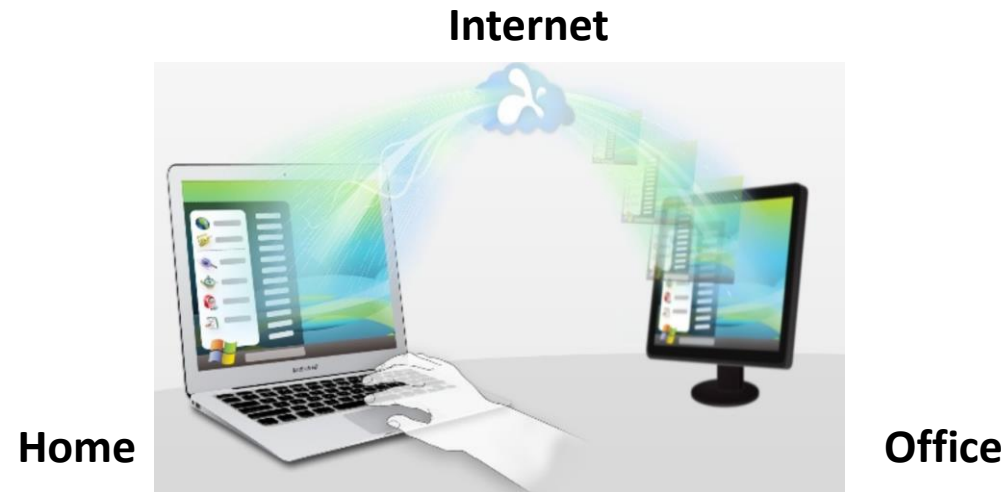
- It is a distributed directory that resolves human-readable hostnames, into machine-readable.

www.dyn.com → 50.16.85.103

- DNS is like a phone book for the internet.
- Without DNS websites can only be accessed directly by IP address.
- The directory is **distributed around the world**, stored on domain name servers
- More than 332 million domain names listed at the end of 2017,
- DNS information is shared among many servers, but is also cached locally on client computers.
- Caching DNS information takes place
 - Local computers
 - At DNS of local ISP
 - Routers

Remote Desktop

- Remote Desktop is about
 - Controlling the desktop of a computer from another machine entirely
 - Using the data, applications, files and network resources
 - Allows to access computers remotely across a network



Remote Desktop

- Incorporate environment, we need both VPN and Remote Desktop at the same time
- But, for our desktop sharing between friends one can use commercial or free internet based desktop sharing
 - Examples
 - Teamviewer
 - Chrome Remote Desktop
 - Splashtop
 - Microsoft Remote Desktop
 - Apple Remote Desktop

Accessing Company Data

- A company can present information to different groups
 - Intranet : for internal employees
 - Extranet : for partners
 - Web Server : for the public
- A Virtual Private Network (VPN)
 - Is a virtual connection between two or more private networks
 - Allows users to access resources remotely

