BASIC CONCEPTS
(REVISION OF OS AND NETWORKING CONCEPTS)

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SOME IMPORTANT TERMS

1. Computer
2. Computer System
3. Some important terms
   - Multi Programming
   - Multi Tasking
   - Multi Processing
   - Multi Threading

4. Network

1. COMPUTER

- A computer is an **electronic device**, operating under the control of instructions **(software)** stored in its **own memory unit,** that can **accept data (input), manipulate data (process),** and **produce information (output)** from the processing. Generally, the term is used to describe a collection of devices that function together as a system.

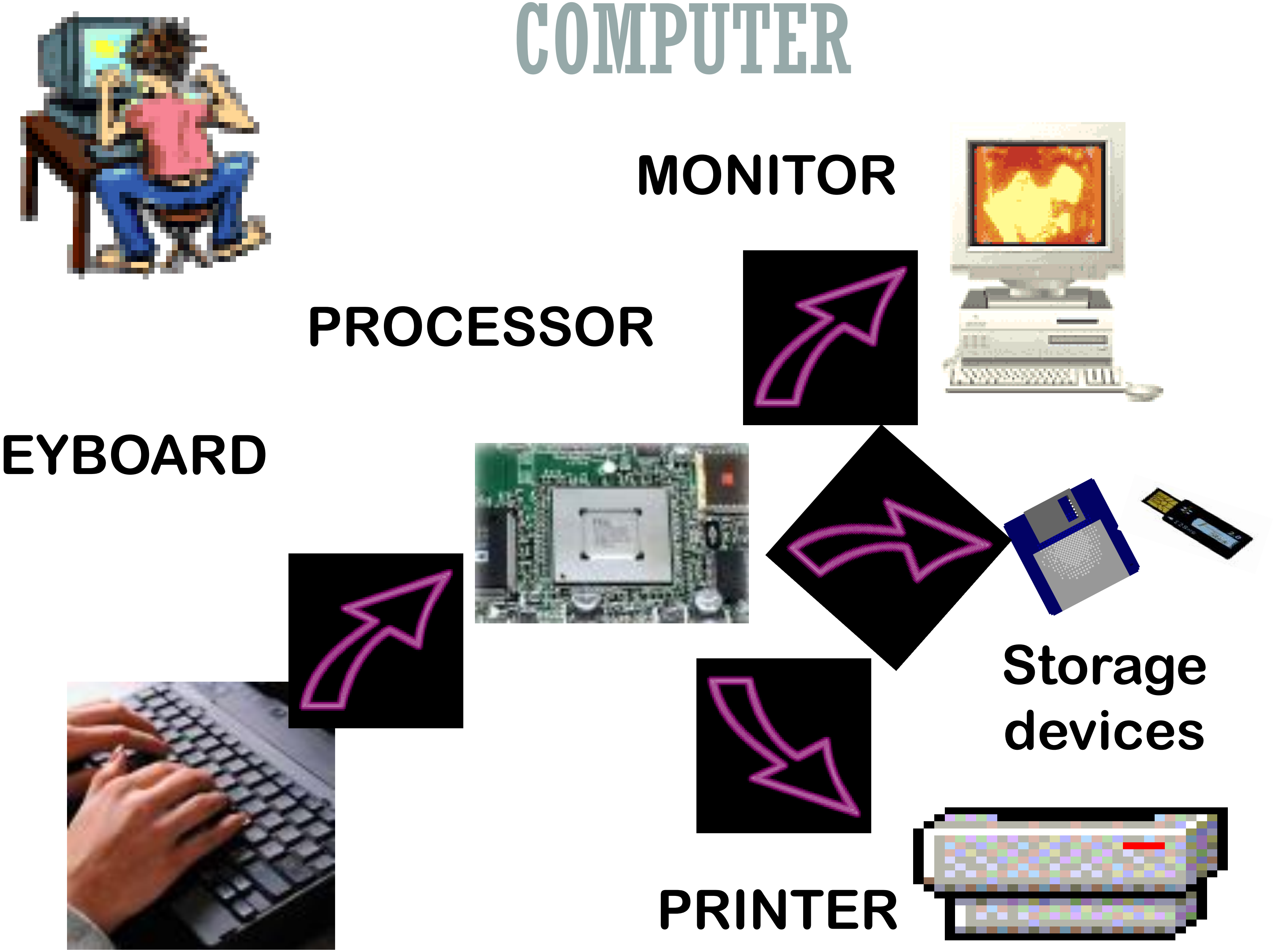
- A computer consists of three primary units:

  Input units – accept data

  Processor unit – processes data by performing comparisons and calculations

  Output units – present the results

COMPUTER



MONITOR

PROCESSOR

KEYBOARD

Storage devices

PRINTER

1.1. INPUT DEVICES

- Data are facts, numbers and characters that are entered into the computer via keyboard.
- Other types of input devices are mouse, joystick, light pens, scanners, camera, etc.

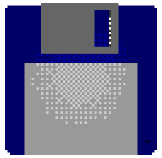
1.1.COMPUTER INPUT DEVICES

- Keyboard
- Mouse/Trackball
- Joystick
- Light pen
- Pointing Stick
- Touchpad
- Touch screen
- Bar code reader
- Scanner
- Microphone
- Graphics Tablet
- Digital Cameras

1.2. PROCESSOR UNIT

Two main parts:

- **CPU** – where the actual processing takes place; and
- **Main memory** – where data are stored.



The contents of main memory can be transferred to auxiliary storage devices such as hard disks, floppy diskettes, zip disks, compact disks, or USB flash disk.

1.2. CENTRAL PROCESSING UNIT

- The MICROPROCESSOR, the brains of the computer. Referred to a CPU or processor.

- Housed on a tiny silicon chip

- Chip contains millions of switches and pathways that help your computer make important decisions.

- CPU knows which switches to turn on and which to turn off because it receives its instructions from computer programs (software).

- CPU has two primary sections:

    - Arithmetic/logic unit
    - Control unit

1.2.1. ARITHMETIC LOGIC UNIT(ALU)

- Performs arithmetic computations and logical operations; by combining these two operations the ALU can execute complex tasks.

  - Arithmetic operations include addition, subtractions, multiplication, and division.

  - Logical operations involve comparisons.

1.2.2. CONTROL UNIT(CU)

- Control Unit: is the “boss” and coordinates all of the CPU’s activities.

- Uses **programming instructions**, it controls the flow of information through the processor by controlling what happens inside the processor.

- We communicate with the computer through programming languages. Examples: COBOL, C++, HTML, Java Script or VisualBasic.net

1.3. MEMORY

Found on the motherboard

- **Short term**

  Random Access Memory (RAM)

- **Long term**

  Read Only Memory (ROM)

1.3.1. RANDOM ACCESS MEMORY(RAM)

- Memory on the motherboard that is short term; where data, information, and program instructions are stored temporarily on a RAM chip or a set of RAM chips. Known as the main memory.

- This memory is considered volatile.

- When the computer is turned off or if there is loss of power, what ever is stored in RAM disappears. “Temporary Memory” – Short Term

- The computer can read from and write to RAM.

1.3. 2. READ ONLY MEMORY(ROM)

- Memory on the motherboard that is long term; where the specific instructions that are needed for the computer to operate are stored.

- This memory is nonvolatile and your computer can only read from a ROM chip.

- The instructions remain on the chip regardless if the power is turned on or off.

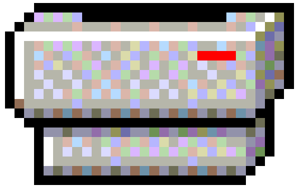
- Most common is the **BIOS ROM**; where the computer uses instructions contained on this chip to boot or start the system when you turn on your computer.

- “Permanent Memory” – Long Term

1.4. OUTPUT UNIT

- After the data has been processed, the results are output in the form of useful information.

- Output units such as monitors and printers make the result accessible for use by people
- Examples.
  - Monitor: screen that display information such as text, numbers, and pictures-softcopy.
  - Printer: gives you information from the computer in printed form – hardcopy
  - Speakers: allow you to hear voice, music, and other sounds from your computer.
  - Modem: allows you to use your computer to communicate with other computers.



2. COMPUTER SYSTEM

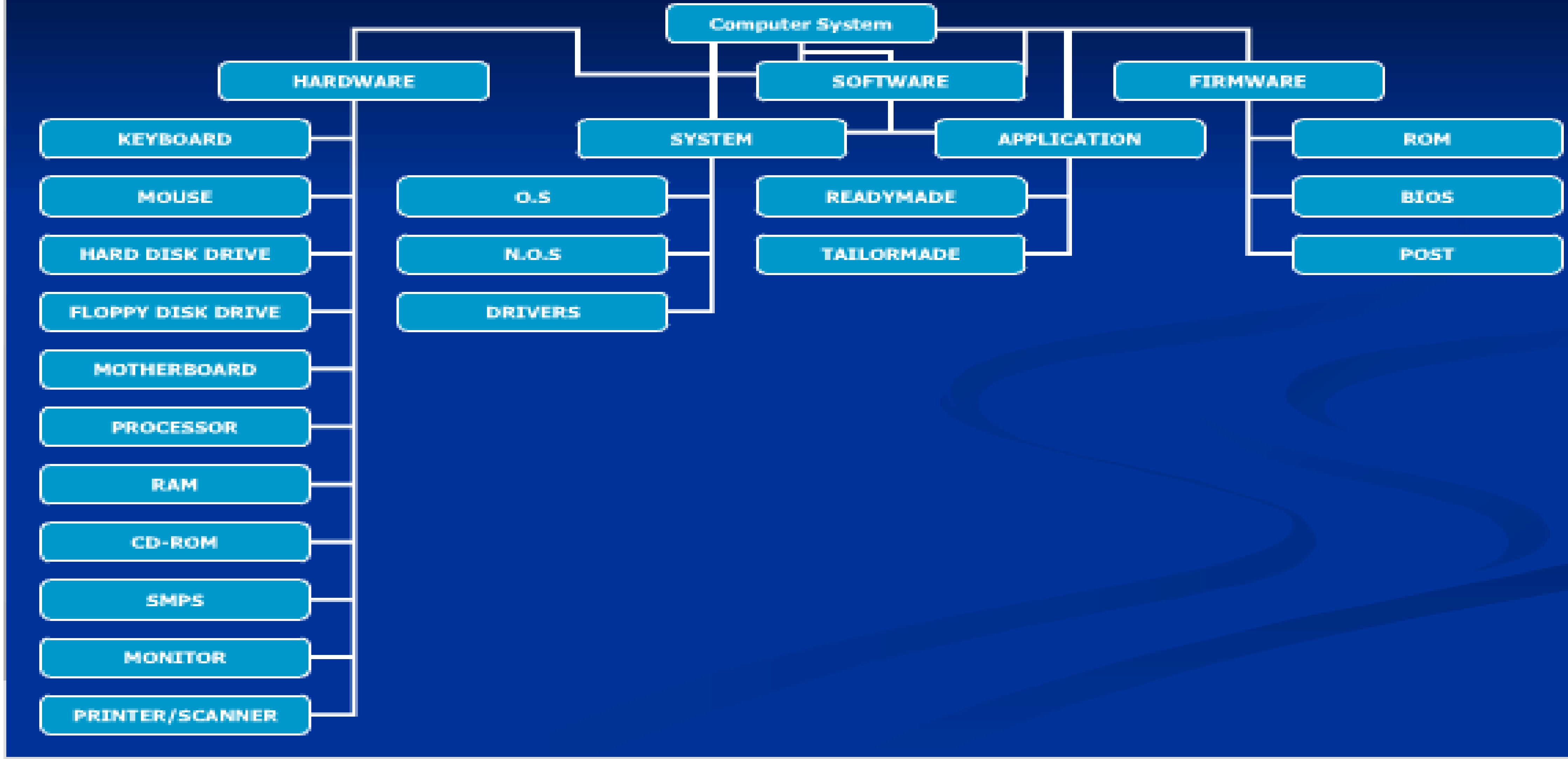
- ***Hardware + Software***
- ***Bringing the Machine to Life – What is Software?***

  - Software is a set of electronic instructions that **tells the computer how to do certain tasks.** A set of instructions is often called a program.

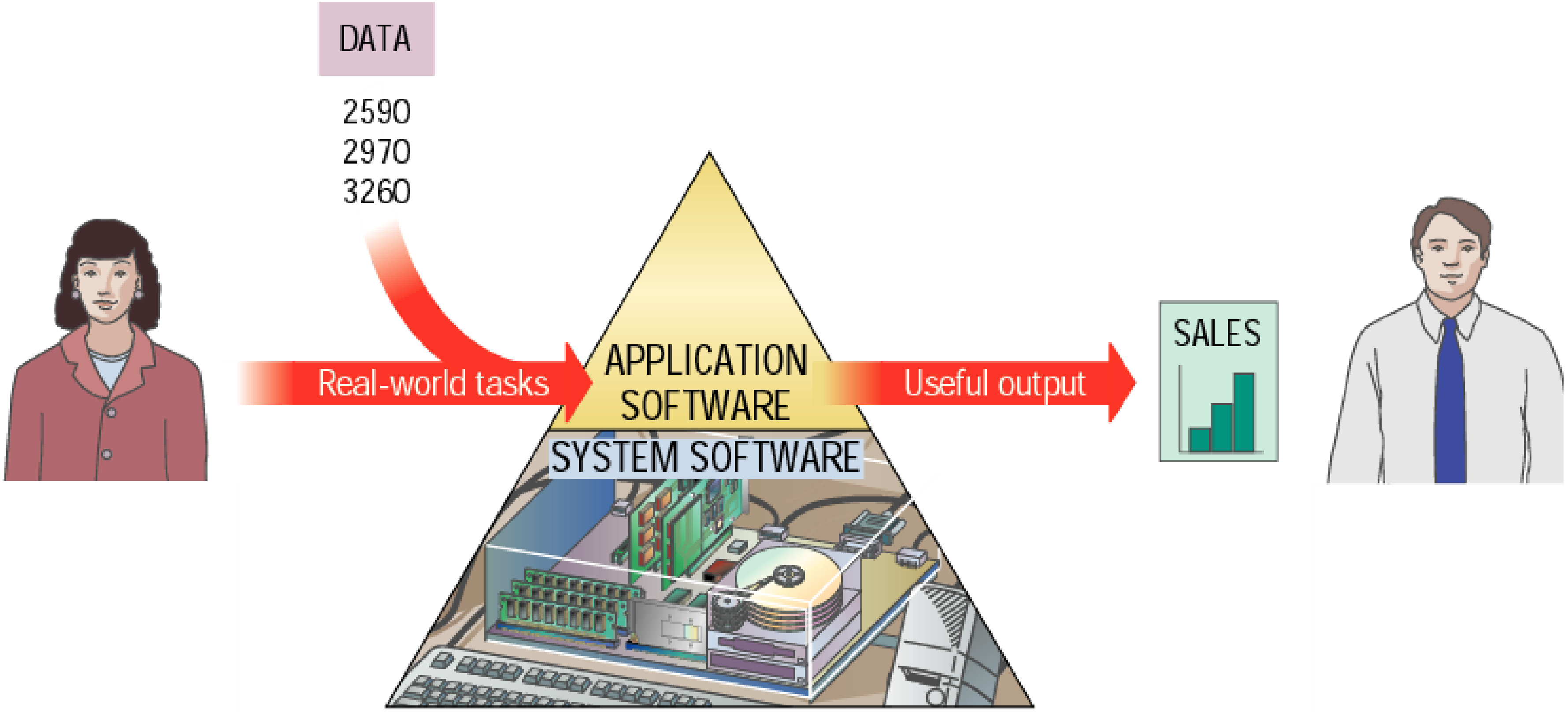
  - When a computer is using a particular program, it is said to be running or executing the program.

  - The two most common types of programs are **System software** and **Application software.**

Computer System



- Computer System
  - HARDWARE
    - KEYBOARD
    - MOUSE
    - HARD DISK DRIVE
    - FLOPPY DISK DRIVE
    - MOTHERBOARD
    - PROCESSOR
    - RAM
    - CD-ROM
    - SMPS
    - MONITOR
    - PRINTER/SCANNER
  - SOFTWARE
    - SYSTEM
      - O.S
      - N.O.S
      - DRIVERS
    - APPLICATION
      - READYMADE
      - TAILORMADE
  - FIRMWARE
    - ROM
    - BIOS
    - POST


DATA
2590
2970
3260
Real-world tasks
APPLICATION SOFTWARE
SYSTEM SOFTWARE
Useful output
SALES

2.1 SYSTEM SOFTWARE

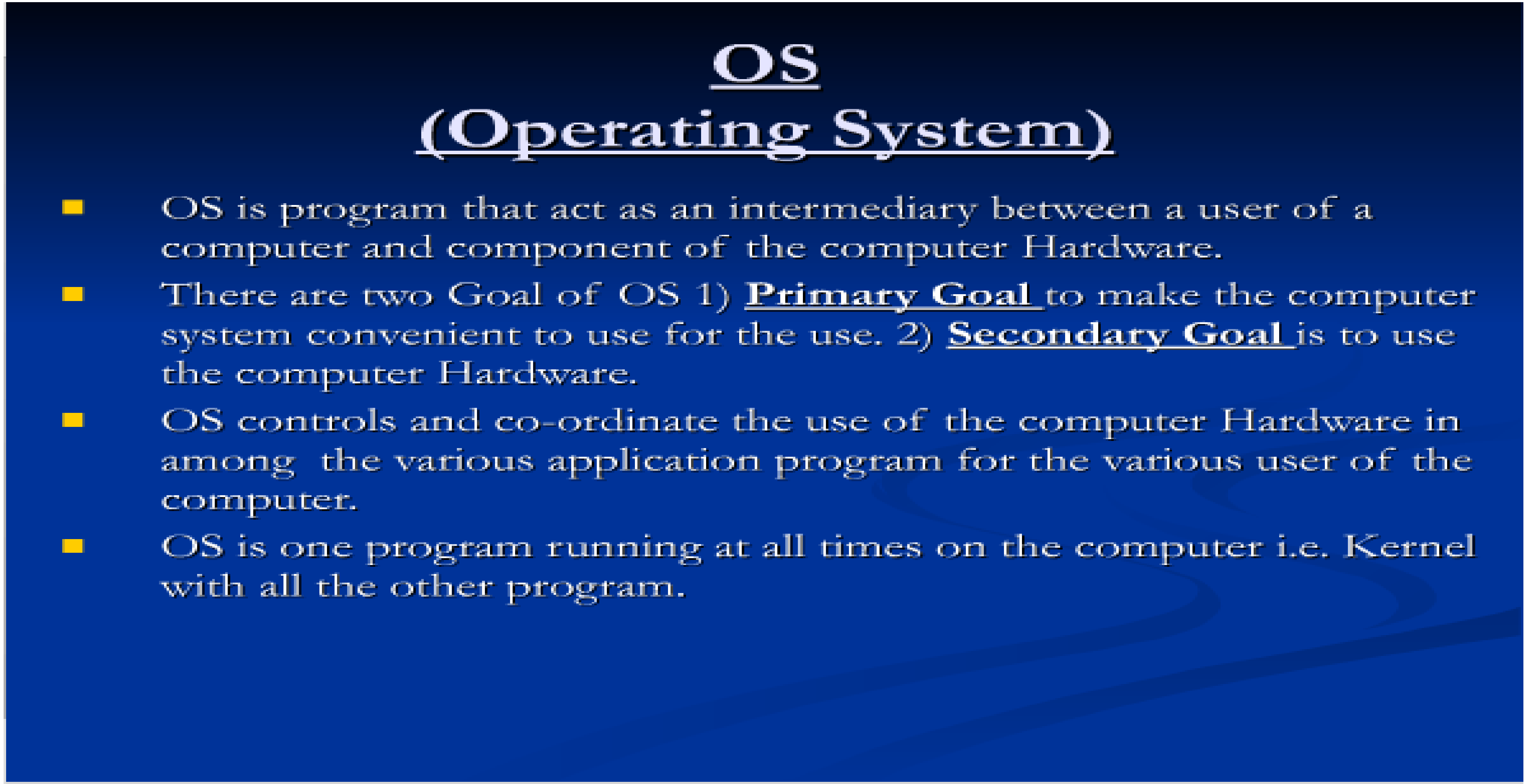
- System software exists primarily **for the computer itself**, to help the computer perform specific functions.

- One major type of system software is the **operating system (OS).** All computers require an operating system.

- The OS tells the computer how to interact with the user and its own devices.

- Common operating systems include **Windows, the Macintosh OS, OS/2, and UNIX .**

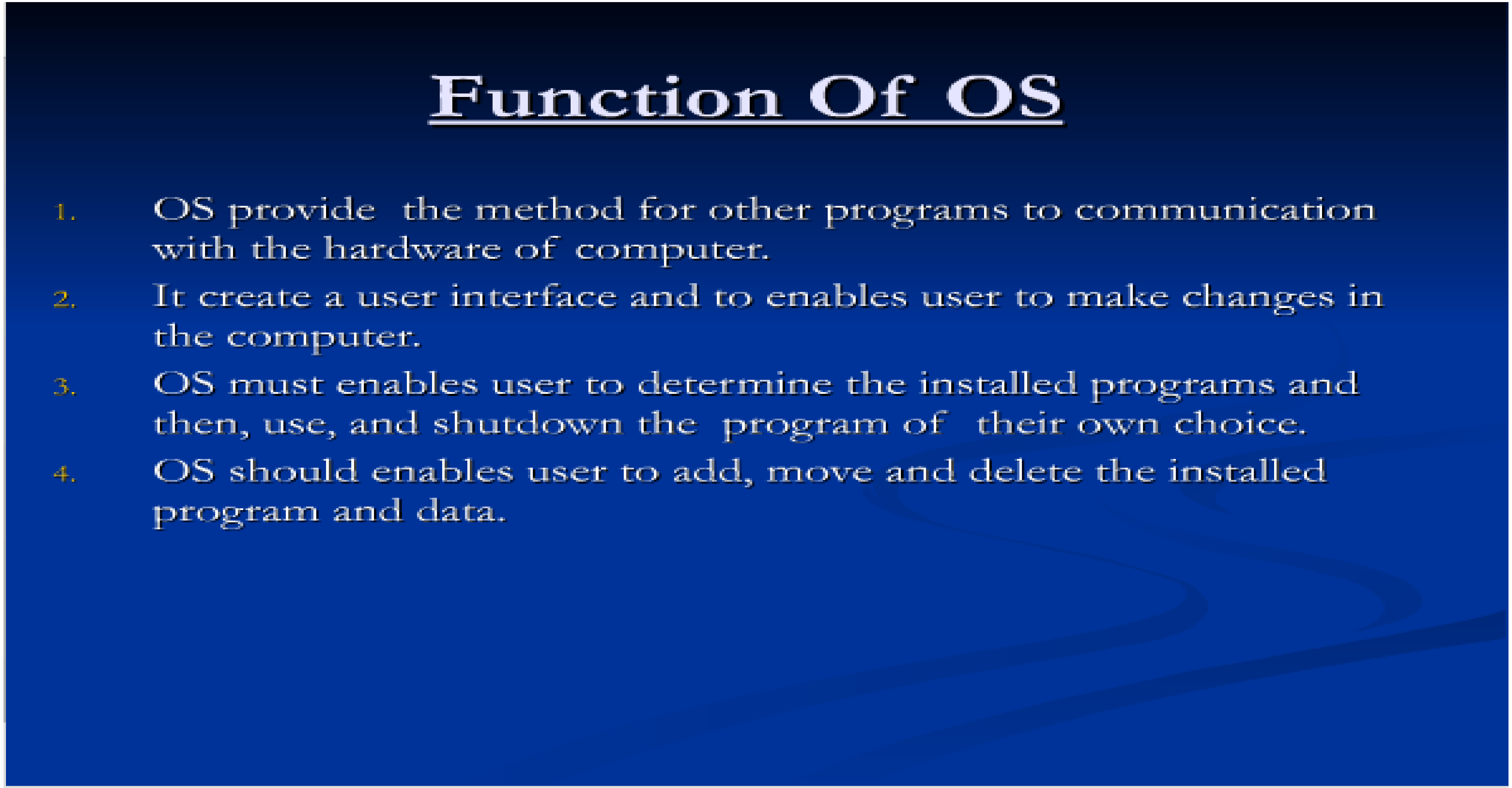
2.1.1 OPERATING SYSTEM



OS
(Operating System)

- OS is program that act as an intermediary between a user of a computer and component of the computer Hardware.
- There are two Goal of OS 1) **Primary Goal** to make the computer system convenient to use for the use. 2) **Secondary Goal** is to use the computer Hardware.
- OS controls and co-ordinate the use of the computer Hardware in among the various application program for the various user of the computer.
- OS is one program running at all times on the computer i.e. Kernel with all the other program.

2.1.1 OPERATING SYSTEM



Function Of OS

1. OS provide the method for other programs to communication with the hardware of computer.
2. It create a user interface and to enables user to make changes in the computer.
3. OS must enables user to determine the installed programs and then, use, and shutdown the program of their own choice.
4. OS should enables user to add, move and delete the installed program and data.

2.2 APPLICATION SOFTWARE

- Application Software consists of programs that **tell a computer how to produce information**
- Application software tells the computer how to accomplish tasks the **user requires,** such as creating a document or editing a graphic image.
- Some important kinds of application software are:

Word processing programs

Database management

Graphics programs

Web design tools and browsers

Communications programs

Entertainment and education

Spreadsheet software

Presentation programs

Networking software

Internet applications

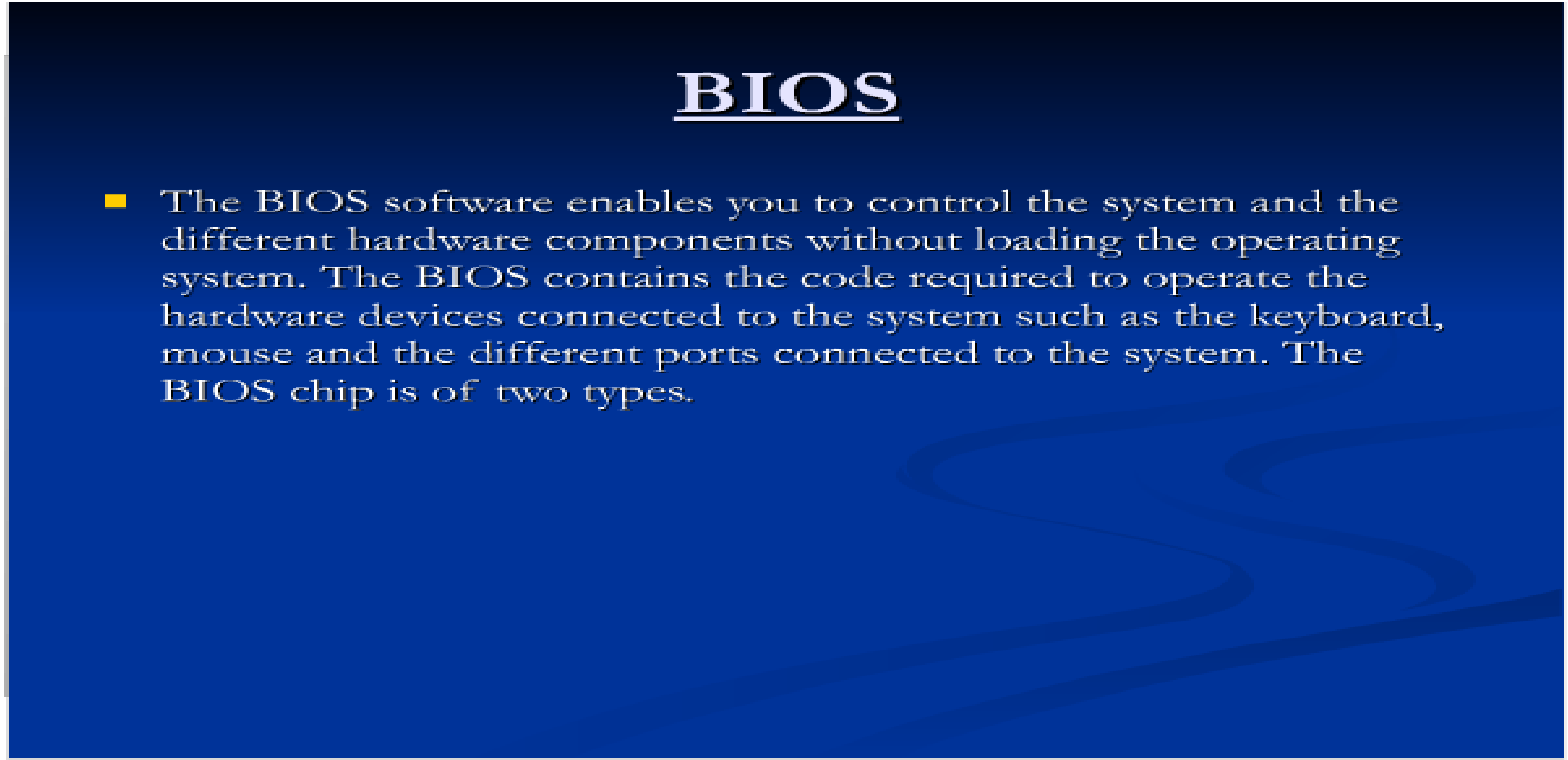
Utilities

Multimedia authoring

2.3. FIRMWARE

- Firmware are programs that are **permanently written and stored in memory**

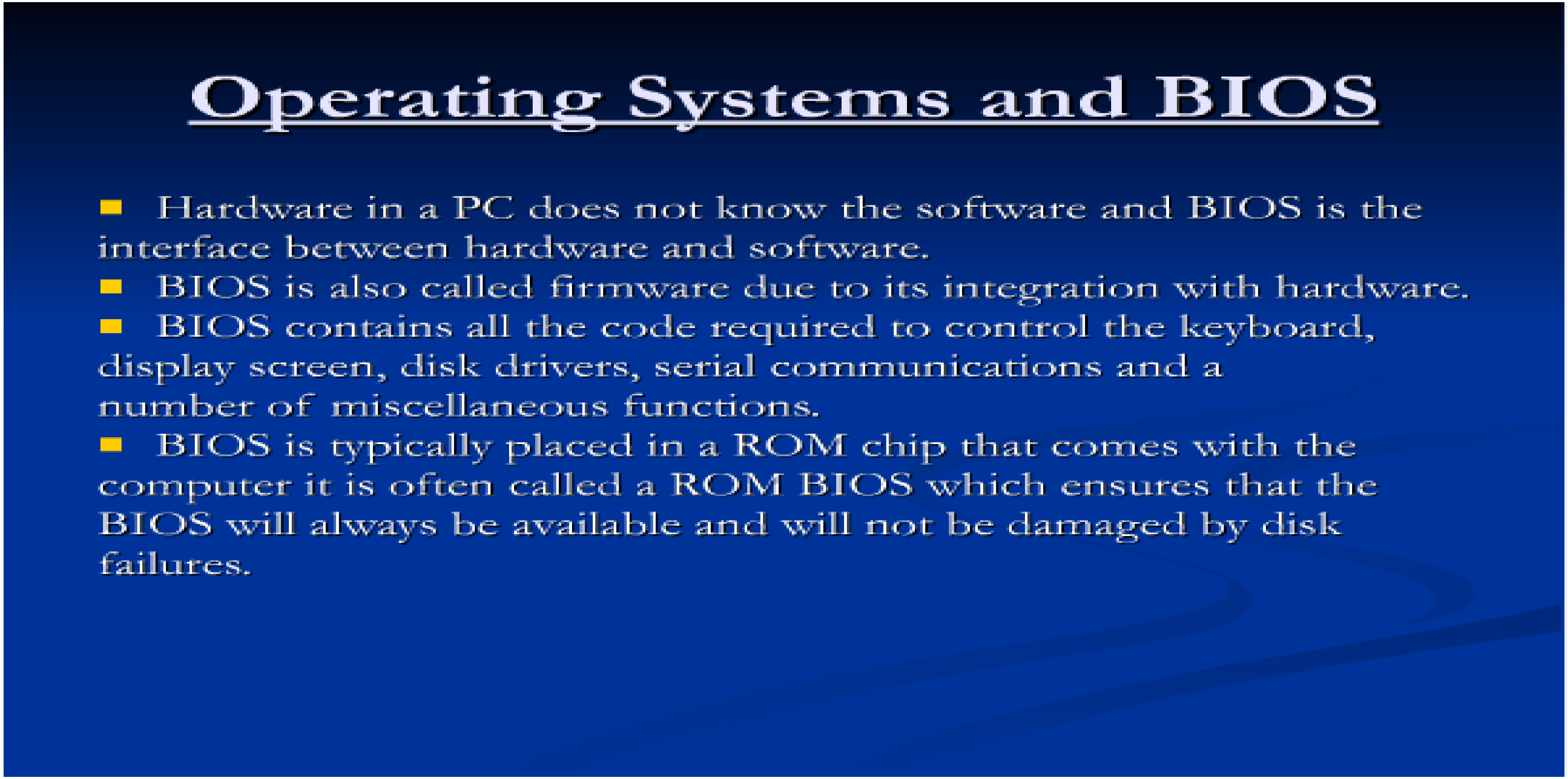
2.3.1. BIOS



BIOS

- The BIOS software enables you to control the system and the different hardware components without loading the operating system. The BIOS contains the code required to operate the hardware devices connected to the system such as the keyboard, mouse and the different ports connected to the system. The BIOS chip is of two types.

2.3.1. BIOS



Operating Systems and BIOS

- Hardware in a PC does not know the software and BIOS is the interface between hardware and software.
- BIOS is also called firmware due to its integration with hardware.
- BIOS contains all the code required to control the keyboard, display screen, disk drivers, serial communications and a number of miscellaneous functions.
- BIOS is typically placed in a ROM chip that comes with the computer it is often called a ROM BIOS which ensures that the BIOS will always be available and will not be damaged by disk failures.

3. IMPORTANT TERMS

3.1. MULTI PROGRAMMING

- In a multiprogramming system there are one or more programs loaded in main memory which are ready to execute.
- Only one program at a time is able to get the CPU for executing its instructions (i.e., there is at most one process running on the system) while all the others are waiting their turn.
- The main idea of multiprogramming is to maximize the use of CPU time.
- Note that in order for such a system to function properly, the OS must be able to load multiple programs into separate areas of the main memory and provide the required protection to avoid the chance of one process being modified by another one.
- Finally, note that if there are N ready processes and all of those are highly CPU-bound (i.e., they mostly execute CPU tasks and none or very few I/O operations), in the very worst case one program might wait all the other N-1 ones to complete before executing.

3.2. MULTI TASKING

- Multitasking has the same meaning of multiprogramming but in a more general sense, as it refers to having multiple (programs, processes, tasks, threads) running at the same time.
- This term is used in modern operating systems when multiple tasks share a common processing resource (e.g., CPU and Memory). At any time the CPU is executing one task only while other tasks waiting their turn.
- The illusion of parallelism is achieved when the CPU is reassigned to another task (i.e. *process* or *thread context switching*).
- There are subtle differences between multitasking and multiprogramming.
  - A *task* in a multitasking operating system is not a whole application program but it can also refer to a "thread of execution" when one process is divided into sub-tasks.
  - Each smaller task does not hijack the CPU until it finishes like in the older multiprogramming but rather a fair share amount of the CPU time called quantum.
- Just to make it easy to remember, both multiprogramming and multitasking operating systems are **(CPU) time sharing** systems. However, while in multiprogramming (older OSs) one program as a whole keeps running until it blocks, in multitasking (modern OSs) time sharing is best manifested because each running process takes only a fair quantum of the CPU time.

3.3. MULTI PROCESSING

- Multiprocessing sometimes refers to executing multiple processes (programs) at the same time. This might be misleading because we have already introduced the term “multiprogramming” to describe that before.

- In fact, multiprocessing refers to the *hardware* (i.e., the CPU units) rather than the *software* (i.e., running processes). If the underlying hardware provides more than one processor then that is multiprocessing.

- Several variations on the basic scheme exist, e.g., multiple cores on one die or multiple dies in one package or multiple packages in one system.

- Anyway, a system can be both multiprogrammed by having multiple programs running at the same time and multiprocessing by having more than one physical processor

3.4. MULTI THREADING

- Up to now, we have talked about multiprogramming as a way to allow multiple programs being resident in main memory and (apparently) running at the same time. Then, multitasking refers to multiple tasks running (apparently) simultaneously by sharing the CPU time. Finally, multiprocessing describes systems having multiple CPUs.

- ***So, where does multithreading come in?***

- Multithreading is an execution model that allows a single process to have multiple code segments (i.e., *threads*) **run concurrently within the "context" of that process.**

- Threads as child processes that share the parent process resources but execute independently.

- Multiple threads of a single process can share the CPU in a single CPU system or (purely) run in parallel in a multiprocessing system

3.4. MULTI THREADING

CONTD…

Why should we need to have multiple threads of execution within a single process context?

- Well, consider for instance a GUI application where the user can issue a command that require long time to finish (e.g., a complex mathematical computation).
- Unless you design this command to be run in a separate execution thread you will not be able to interact with the main application GUI (e.g., to update a progress bar) because it is going to be unresponsive while the calculation is taking place.

- Designing multithreaded/concurrent applications requires the programmer to handle situations that simply don't occur when developing single-threaded, sequential applications.
- For instance, when two or more threads try to access and modify a shared resource (*race conditions*), the programmer must be sure this will not leave the system in an inconsistent or deadlock state. Typically, this **thread synchronization** is solved using OS primitives, such as **mutexes** and **semaphores**.

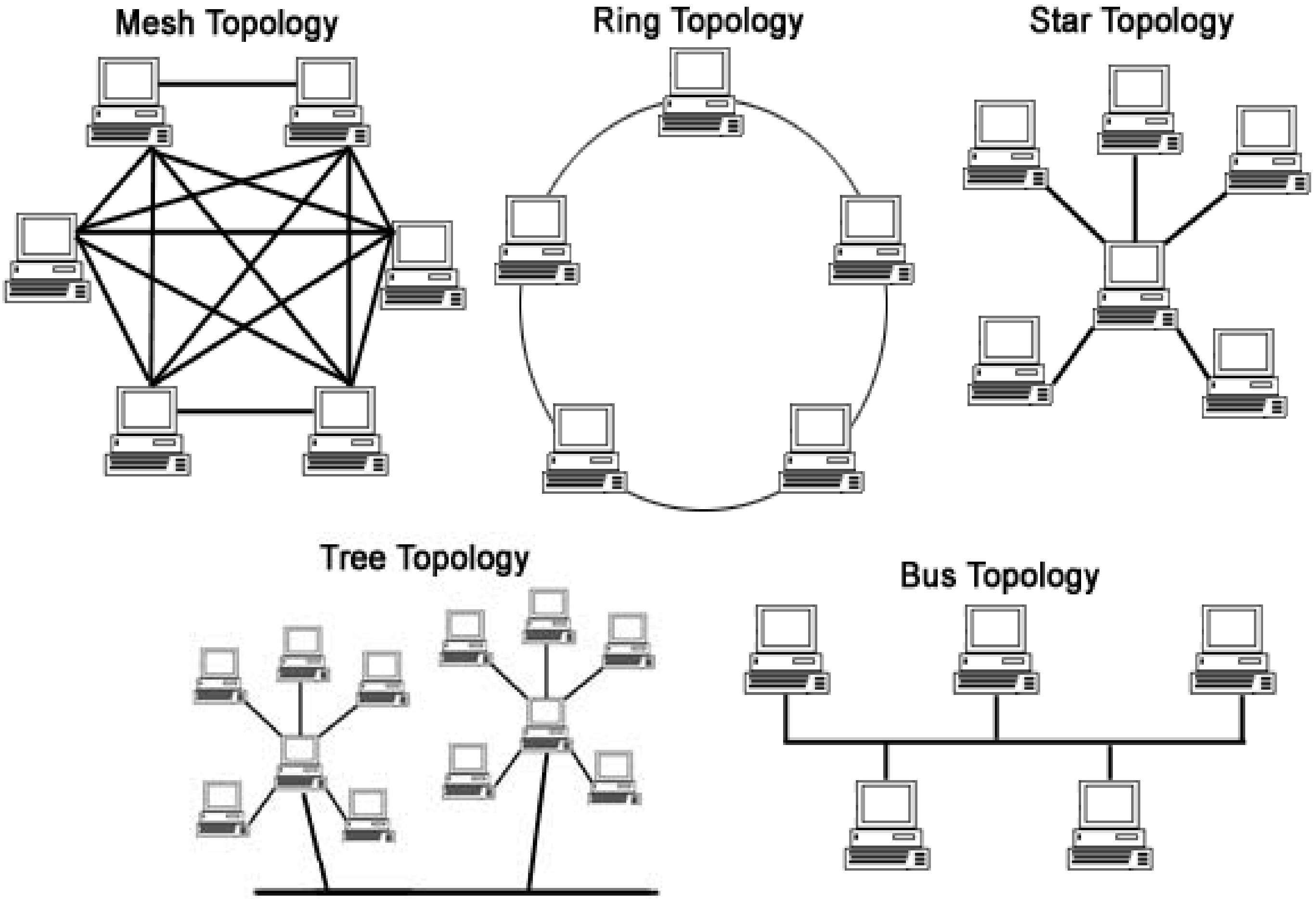
4. NETWORK

4.1 NETWORK

- A computer network is simply a collection of computer equipment that's connected with wires, optical fibers, or wireless links so the various separate devices (known as **nodes**) can "talk" to one another and swap **data** (computerized information).
- An excellent example of a network is the Internet, which connects millions of people all over the world.

- **Examples of network devices**
  - ✓ Desktop computers, laptops, mainframes, and servers
  - ✓ Consoles and thin clients
  - ✓ Firewalls
  - ✓ Bridges
  - ✓ Repeaters
  - ✓ Network Interface cards
  - ✓ Switches, hubs, modems, and routers
  - ✓ Smartphones and tablets
  - ✓ Webcams

4.2. NETWORKS TOPOLOGY



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4.3. TYPES OF NETWORKS

- **Local-area network (LAN)** A network that connects a relatively small number of machines in a relatively close geographical area
- Various configurations, called topologies, have been used to administer LANs
  - **Ring topology** A configuration that connects all nodes in a closed loop on which messages travel in one direction
  - **Star topology** A configuration that centers around one node to which all others are connected and through which all messages are sent
  - **Bus topology** All nodes are connected to a single communication line that carries messages in both directions

    A bus technology called **Ethernet** has become the industry standard for local-area networks

4.3. TYPES OF NETWORKS CONTD…

Wide-area network (WAN)

- A network that connects two or more local-area networks over a potentially large geographic distance.
- Often one particular node on a LAN is set up to serve as a **gateway** to handle all communication going between that LAN and other networks
- Communication between networks is called internetworking

  The **Internet,** as we know it today, is essentially the ultimate wide-area network, spanning the entire globe

Metropolitan-area network (MAN)

The communication infrastructures that have been developed in and around large cities

SO, WHO OWNS THE INTERNET?

Well, nobody does. **No single person or company owns the Internet or even controls it entirely.**

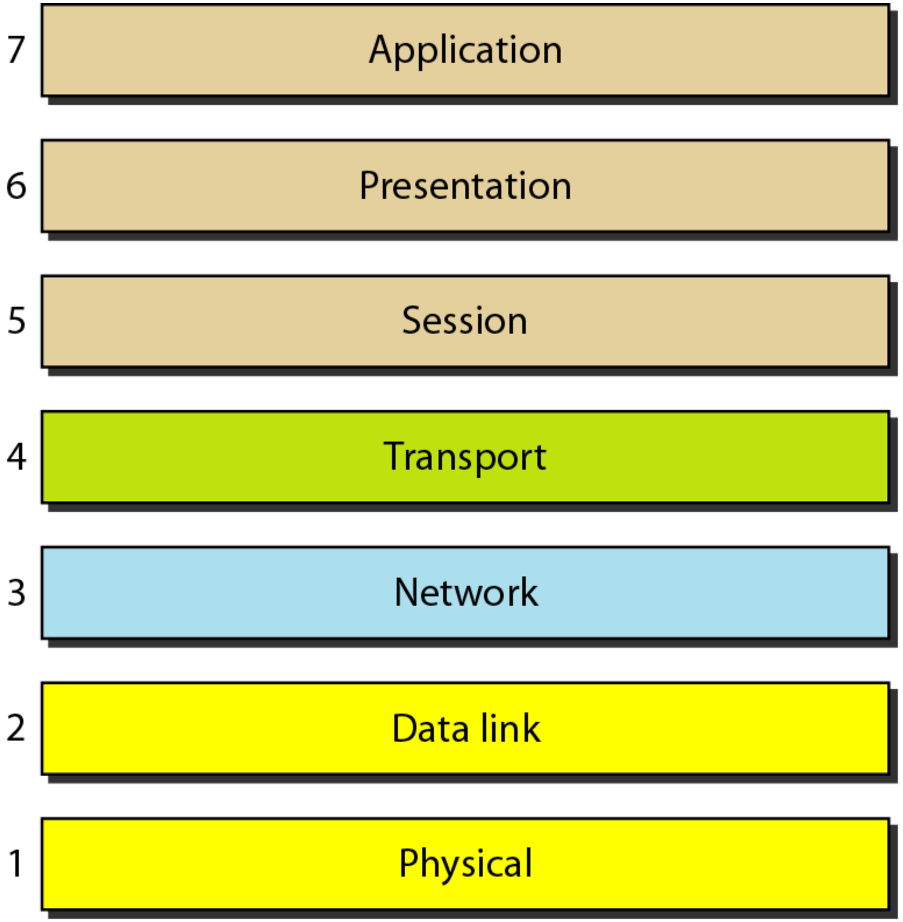
As a wide-area network, it is made up of many smaller networks. **These smaller networks are often owned and managed by a person or organization**. The Internet, then, is **really defined by how connections can be made between these networks.**

Back

2-2 THE OSI MODEL

Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards. An ISO standard that covers all aspects of network communications is the Open Systems Interconnection (OSI) model. It was first introduced in the late 1970s.

Figure *Seven layers of the OSI model*



7 Application

6 Presentation

5 Session

4 Transport

3 Network

2 Data link

1 Physical

Figure *The interaction between layers in the OSI model*

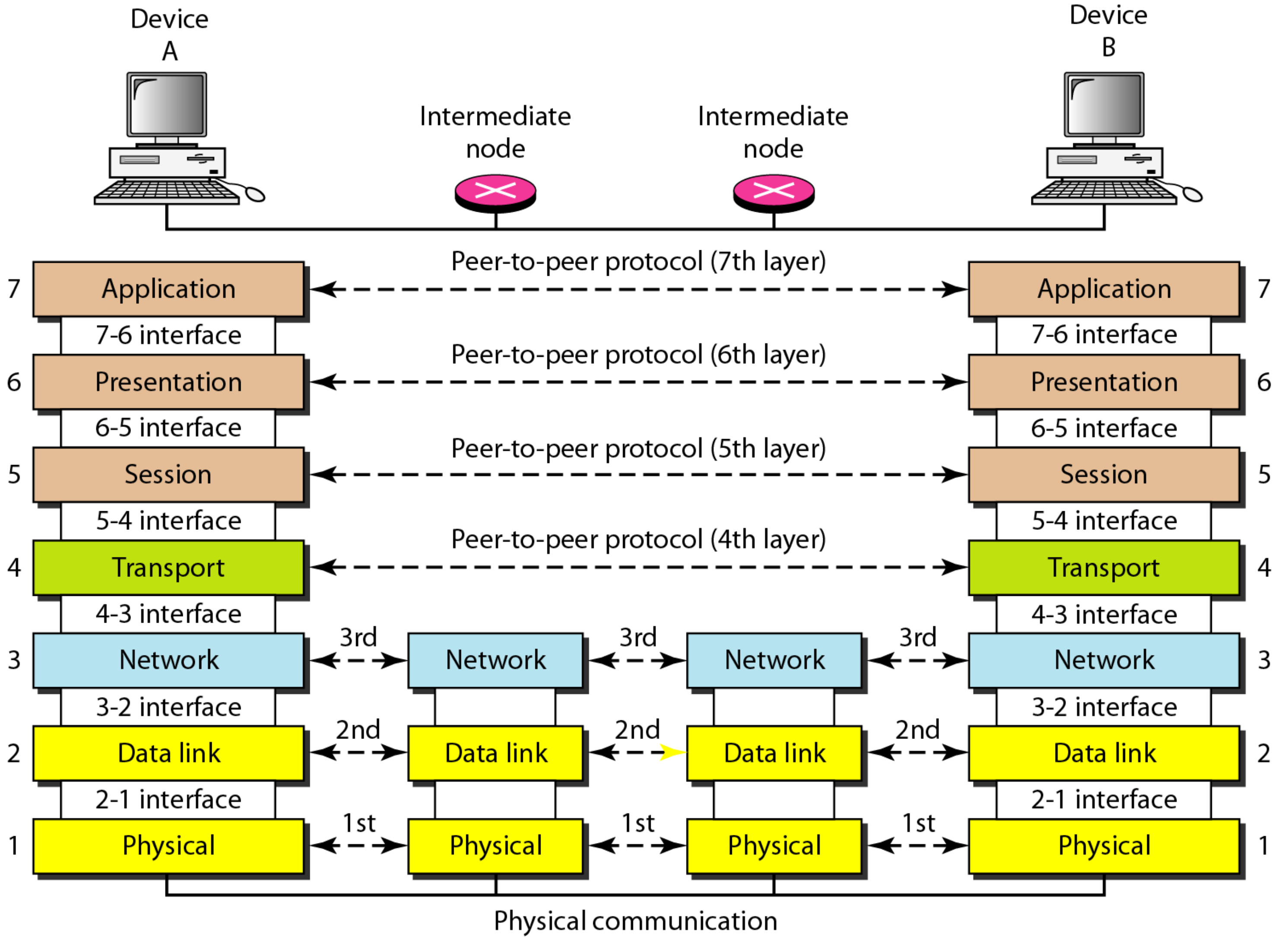
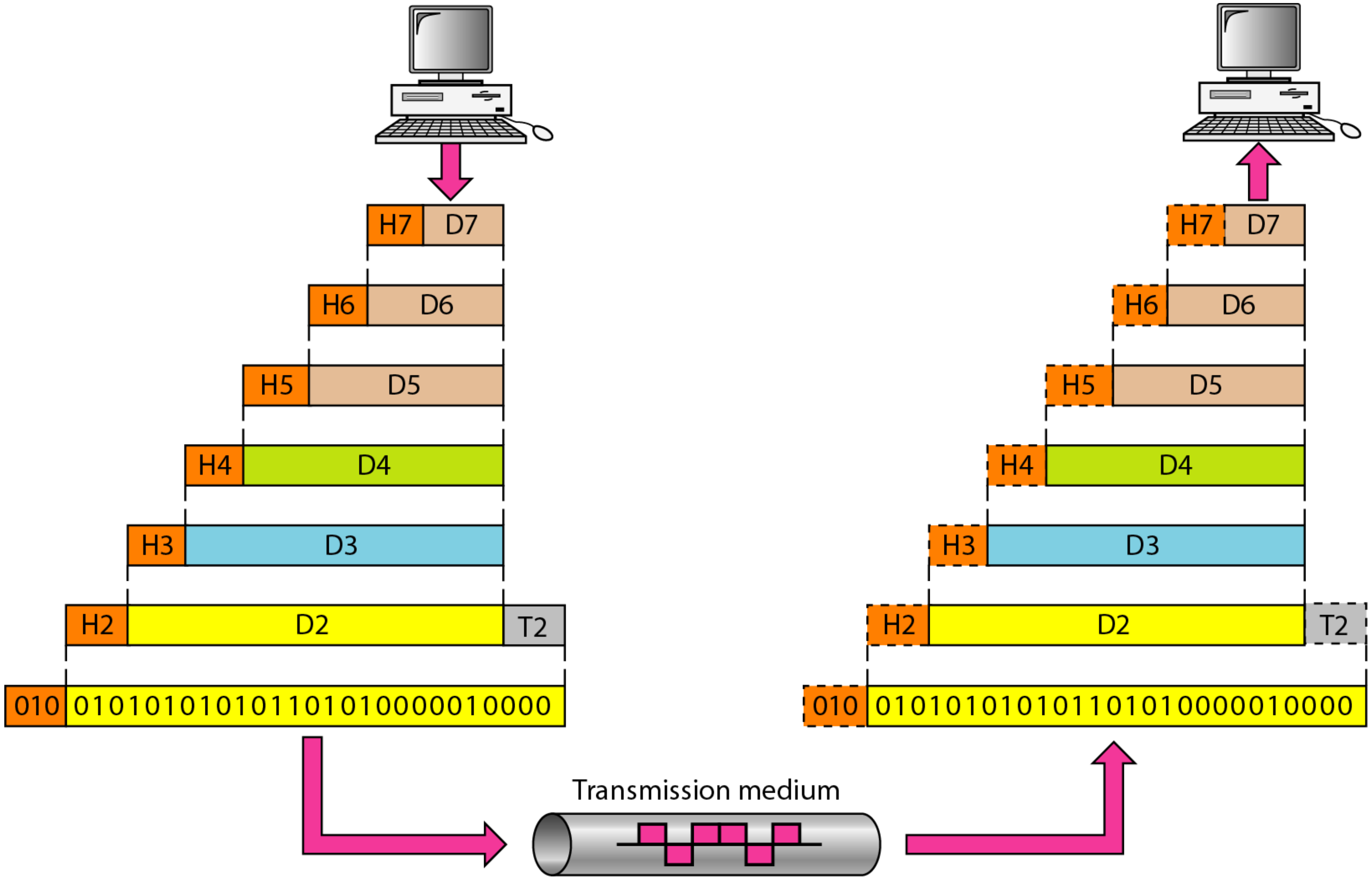
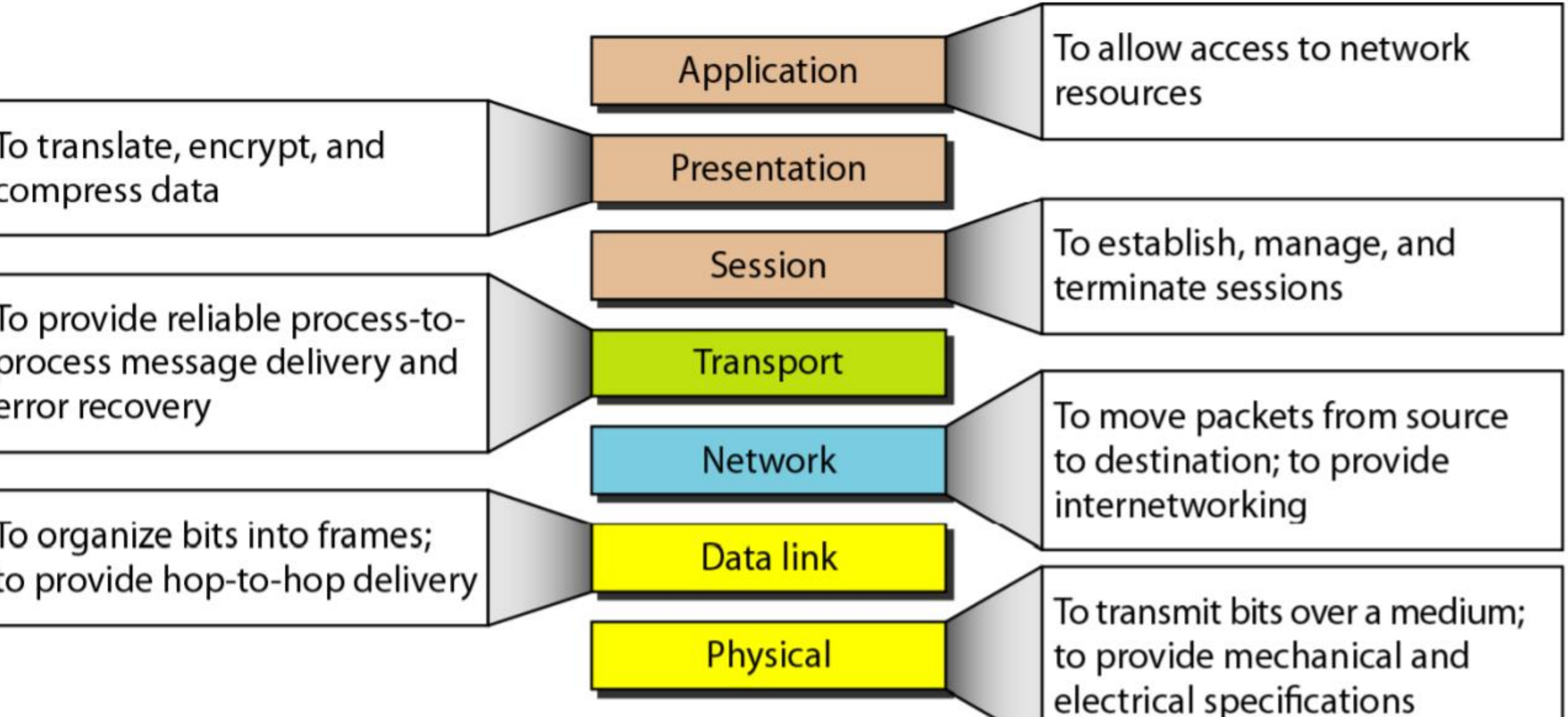


Figure *An exchange using the OSI model*





Application

To allow access to network resources

Presentation

To translate, encrypt, and compress data

Session

To establish, manage, and terminate sessions

Transport

To provide reliable process-to-process message delivery and error recovery

Network

To move packets from source to destination; to provide internetworking

Data link

To organize bits into frames; to provide hop-to-hop delivery

Physical

To transmit bits over a medium; to provide mechanical and electrical specifications