

TYPES OF SOFTWARE

- **HARDWARE:** It represents the physical and tangible components of the computer that can be seen and touch.

ex. CPU, mouse, keyboard etc.

Software: It is the set of programs that governs the computer and make the hardware run.

It is classified into two categories

1. System Software
2. Application Software

System Software

- The software that controls internal computer operations is called **System Software.**
- It is further classified into two categories :
 1. **Operation System**
 2. **Language Processor**

OPERATING SYSTEM

- An operating system is a program which acts as an interface between a user and the hardware. (i.e. all computer resources).
- It is just like our secretary. As the boss give order the secretary does all the work for his boss. It itself decides How to do and what to do ?

OPERATING SYSTEM

- The primary goal of the operating system is thus to make the computer system convenient to use and secondary goal is to use computer hardware in an efficient manner.

TYPES OF OPERATING SOFTWARE

1. Single Program OS
2. Multiprogramming OS
3. Time sharing OS
4. Real time OS
5. Multiprocessing OS
6. Interactive OS

Single Program OS & Multi Program OS

1. Single program OS: It is single user operating system thus one user program can be supported and executed at a time .
2. Multiprogram OS: It supports multiprogramming so more than one user can be supported by it .

3. Time sharing OS

- This OS uses the time sharing technique. Each active user program is given a fair share of CPU time (&), if the time elapses or an I/O operation is requested, CPU shifts over to the next job waiting and the previous program is put to wait. The active programs are scheduled for execution using certain job scheduling technique.

4. Real Time OS

- In real time OS ,the jobs have fixed deadlines and the jobs have to be completed within their deadlines .The system performance is measured by its ability to complete its jobs within the specified deadlines . If a job cannot be completed within its deadline, this situation is called **Deadline Overrun**. An efficient real Os is that which gives minimum possible deadlines overruns .

5. Multiprocessing Os

- The multiprocessor Os is capable of handling more than one processors as the jobs have to be executed on more than one processor . The multiprocessing Os should be capable of **Loadsharing** in case of identical processors so that the system's efficiency improves. In case of unidentical processors ,the multiprocessing Os should be able to control the super (main) processor and in turn control the working of slave processors .

6. Interactive Os

- These Operating Systems are interactive in nature . These provide GUI interface to facilitate move and easy interaction to the user . You will learn more about GUI interface and a GUI operation system a little later in this chapter .

LANGUAGE PROCESSORS

The Language processor are given below :

1.Assembler

2.Interpreter

3.Compiler

(we use interpreter and compiler because it gives the combination for HLL (high level language)

Application software

An application software is a set of programs necessary to carry out operation for a specified application .

These are the programs by programmers to enable computer to perform a specified task such as processing words , inventory control , handling calculations and figures , medical software , etc.

**It is further subdivided into
three categories :**

1.Packages

2.Utilities

3.Customized software.

Packages

As applications may be numerous (from thousands to millions of them), it is not feasible to design software for each one of them. Rather some general software are designed that may be used by individual users in the manner it suits their needs and requirement . Such general-application software are known as packages.

Some major common categories of packages are:

1. Word Processing Software
2. Spreadsheets
3. Database Management System
4. Desktop Management System
5. Graphics, multimedia, and presentation applications.

1. Word Processing Software

Word Processing Package is a package that processes textual matter and organized and flawless documents .

2. Spreadsheets

An electronic Spreadsheet is a program that accepts data in a tabular form (in rows or columns) and allows users to manipulate/calculate/analyze data in the desired manner.

Database Management System (D B M S)

A database management system (DBMS) is a package that can handle and manage bulk of stored data.

Desktop Publishing Software

The software that handles page layout by combining the function of a traditional typesetter and a layout artist is known as Desktop Publishing Software

Graphic software

The application software that manipulates images is known as Graphic software and the software that incorporates images, text, sound, computer animation and video sequences is known as Multimedia Software.

Presentation Graphic Software

The application software that can create professional looking visual aids is called Presentation Graphic Software

Utilities

Utilities are those application program that assist the computer by performing housekeeping functions like backing up disk or scanning /cleaning viruses or arranging information etc.

Some important utilities are:

- 1.Text Editor.
 - 2.Backup Utility.
 - 3.Compression Utility.
 - 4.Disk Defragmenter.
 - 5.Antivirus Software.
- Customized Software.

Customized software

This type of software is tailor made software according to a user's requirement. The type of software is developed to meet all the requirements specified by the user.

Operating system

An operating system is a program which acts as an interface between a user and the hardware (i.e. all computer resources)

Types of Services

The operating system provides certain services to programs and to the users of the programs. Some common services provided by operating can be listed as follows:

Types of Service

1. Program Execution
2. Handling Input/output operation
3. Manipulations of file system
4. Error detection and handling
5. Resource Allocation
6. Accounting
7. Information and Resource Protection

1.Program execution

The operating is responsible for execution various programs whether user programs or system programs i.e. special programs required for the machine handling .

2. Handling Input/output Operation

The operating system is responsible for handling various types of inputs (e.g. inputs from keyboard, inputs from mouse etc.) and various types of outputs in the appropriate manner.

For instance if the input is coming from mouse then it is different from that of keyboard and so for others.

3.Manipulations of file system

This task involves the making of decisions regarding the storage of files i.e. where (whether on floppy disk or hard disk etc.) and how a particular file is to be stored .

4. Error Detection and Handling

The Operating system is also responsible for detecting and type of error that occurs and then properly handle it.

5.Resource Allocation

This task aims at proper use of resources available . For example, if multiple files are to be printed then “how and in which order this task will take place ?” will be decided by the operating system.

6.Accounting

The operating system keeps an account of what type of functioning is taking place and what type of error have taken occurred .

7.Information and Resource Protection

The operating system is responsible for ensuring that the information and resources available on machine are used in the correct way . The operating system foils the attempts to use them incorrectly .

Operating System's Function

Operating system functions broadly fall into three categories

- **Essential Functions**
- **Monitoring Functions**
- **Service Functions.**

Major OS Functions

- ✓ Process Management
- ✓ Storage (Memory) Management
- ✓ Information Management

Process Management

Managing a process or processor i.e. the CPU. This is also termed as CPU scheduling.

Multiprogramming, undoubtedly, improves the overall efficiency of the computer system by getting more work done in less time as the CPU may be shared among a number of active programs which are presents in the memory at the same time .

Process Management

While CPU is executing a job , it has to wait for the job ;if the job requires certain I/O operation , the CPU waits for the I/o operation to get over and that wait time is CPU'S idle time . In place of making CPU sit idle , another job takes over the use of CPU , increasing efficiency thereby and reducing CPU idle time .

The benefits of multiprogramming are as follows:

1. Increased CPU utilization
2. Higher total job throughput

Throughput:

It is the amount of work accomplished in a given time interval (e.g. 15 jobs per hour).

Throughput is an important measure of system performance. It is calculated as follows:

$$\text{Throughput} = \frac{\text{The number of jobs completed}}{\text{Total time taken to complete the jobs}}$$

Another important factor that influences through is priority assign to different jobs i.e. job scheduling .

Job scheduling

Job scheduling not only assign to jobs but also admits new jobs for processing at appropriate times . Before we start with job scheduling techniques , let us first understand basic terminology.

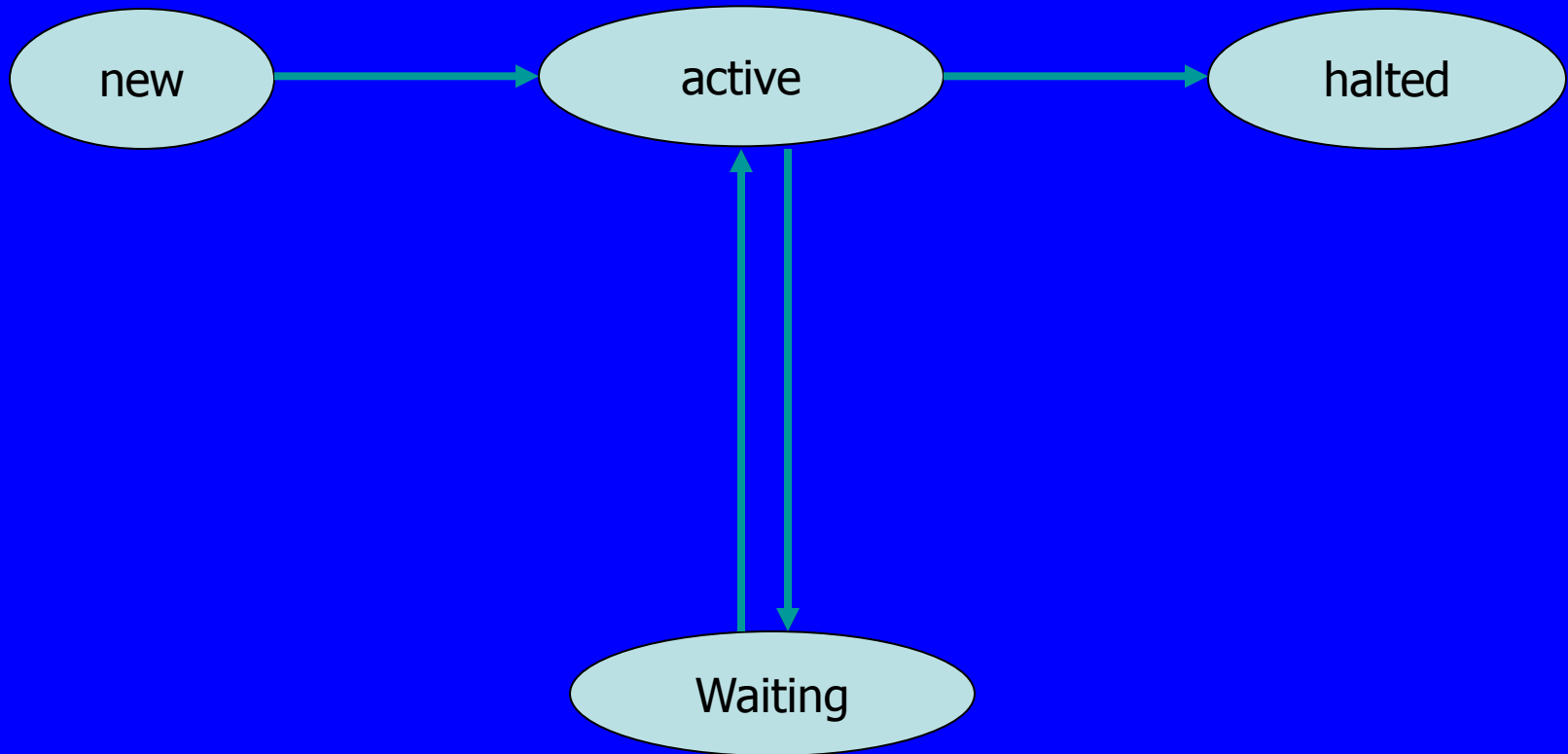
Program

It is a set of instructions submitted to computer . Process is a program in execution. Job and process are the terms which are almost used interchangeably.

Process State

A process is a program in execution . During execution , the process changes its current activity . A process can have these states : *new* , *active* , *waiting* or *halted* (*fig*).

Process States



Process Control Block

Each process in the OS by a data block called Process Control Block.

A PCB contains following information (fig)

- 1.Process state
- 2.Program counter : It indicates the address of next instruction to be executed .
- 3.CPU register
- 4.Memory limits
- 5.List of open files

Process Control Block

Pointer	process state
process number	
process counter	
register	
memory limits	
list of open files	

Scheduling Techniques

Many factors determine which scheduling technique should be used in order to have the best possible results .

The criteria are as follows :

- (a) CPU Utilization: There should be maximum possible CPU utilization.
- (b) Turnaround time: There should be minimum possible turnaround time .
- (c) Waiting time : System should give fastest responsible time .
- (d) Throughput: Throughput should be maximum possible .

There are two type of scheduling

- 1.Non-preemptive scheduling.
- 2.Preemptive scheduling.

1. Non-preemptive scheduling

In this type of scheduling , a scheduled job always completes before another scheduling decision is made .Therefore ,finishing order of the jobs is also same as their scheduling order .

Its type are:

- 1.First come first served (FCFS) scheduling
- 2.Shortest job next (SJN) scheduling .
- 3.Deadline scheduling

1. First Come First Served (FCFS) scheduling

This is the simplest scheduling technique which is managed by FIFO (First in first out). That is, the process, which requests the CPU first, is allocated the CPU first. A queue is maintained called ready queue in which all the processes, that want CPU time is entered. The CPU executes the jobs in the ready queue one by one. Batch processing is one obvious example of FCFS scheduling in which all the jobs in the batch are executed one by one. But turnaround time for the very first job in the batch is the best and for the very last job, it is worst. (Turnaround time is the delay between job submission and job completion).

Shortest Job Next (SJN) scheduling

- In SJN scheduling , whenever a new job is to be admitted , the shortest of the arrived jobs is selected and given to CPU time . Throughput remain the same as in FCFS scheduling but waiting time improves . SJN associates with each job the length of its next CPU burst. (CPU burst is the CPU time requires by a job to execute its continuous executable part.)

Deadline Scheduling

In deadline scheduling, the job with the earliest deadline is selected for scheduling . Deadline of a job is the time limit within which a job must be over. If a job overshoots its deadline , it is said to be Deadline over run . Deadline over run is calculated as

$$\underline{k = c - d}$$

Where k is deadline overrun ;c is a job completion time and D is deadline for a job. Erratic behavior might result if reliable deadline data is not available .

Preemptive Scheduling

In contrast to non-preemptive scheduling , a scheduling decision can be made even while the job is executing whereas in non-preemptive scheduling , a scheduling decision is made only after job completes its execution. Therefore , preemptive scheduling may force a job in execution to release the processor , so that execution of other job can be undertaken , in order to improve throughput considerably . The techniques which use preemptive scheduling are:

- 1.Round robin scheduling***
- 2.Response ratio scheduling***

Round Robin Scheduling

Round robin (RR) scheduling is aimed at giving all programs equal opportunity to make progress . This is implemented by ensuring that no program gets a second opportunity to execute unless all other programs have had at least one opportunity . A small unit of time , called a *time quantum* or *time slice*, is defined. The *ready queue* (queue of programs waiting for CPU time) is treated as a circular queue . The programs in the ready queue is processed for the defined time slice , one by one.

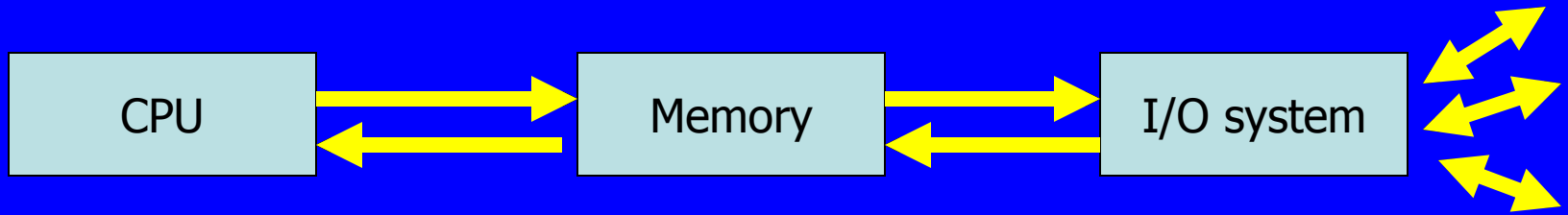
2. Response Ratio Scheduling

✓ Response ratio is calculated as follows:

✓ Response Ratio = $\frac{\text{Elapsed Time}}{\text{Execution time received}}$

The job with highest response ratio is preferred over others. When a short job arrives, its response ratio is high, so it is scheduled for execution immediately. A longer job would achieve high enough ratio only after a subsequent wait.

STORAGE MANAGEMENT



- ✓ Memory is a large array of words or bytes, each with its own address. The CPU reads from & writes to specific memory address.
- ✓ A program must be assigned some memory area & loaded into memory in order to be executed. When program terminates, its memory space is declared free.

Contiguous Storage Allocation

Each problem that is to be executed is allocated a contiguous storage memory. Each job step is considered as a single independent entity for allocation of a contiguous storage area. At every job step initiation, OS has to ensure that enough contiguous area is available to accommodate it.

Non Contiguous Storage Allocation

- ✓ A program is divided into smaller components of equal sizes. One or more components can be stored in non contiguous memory areas. Each component in that particular memory area is provided addresses $0, 1, 2, \dots, n$
- ✓ Say a program that requires $90k$ is divided into smaller components of $10k$. Then we store 4 components in 1st free memory area & 5 in next free memory area.

Non Contiguous Storage Allocation

- ✓ Virtual storage is a technique that helps to execute a program even if all of it is not loaded in memory. 2 main approaches to it are:-
 - ✓ Program-paging
 - ✓ Program-segmentation

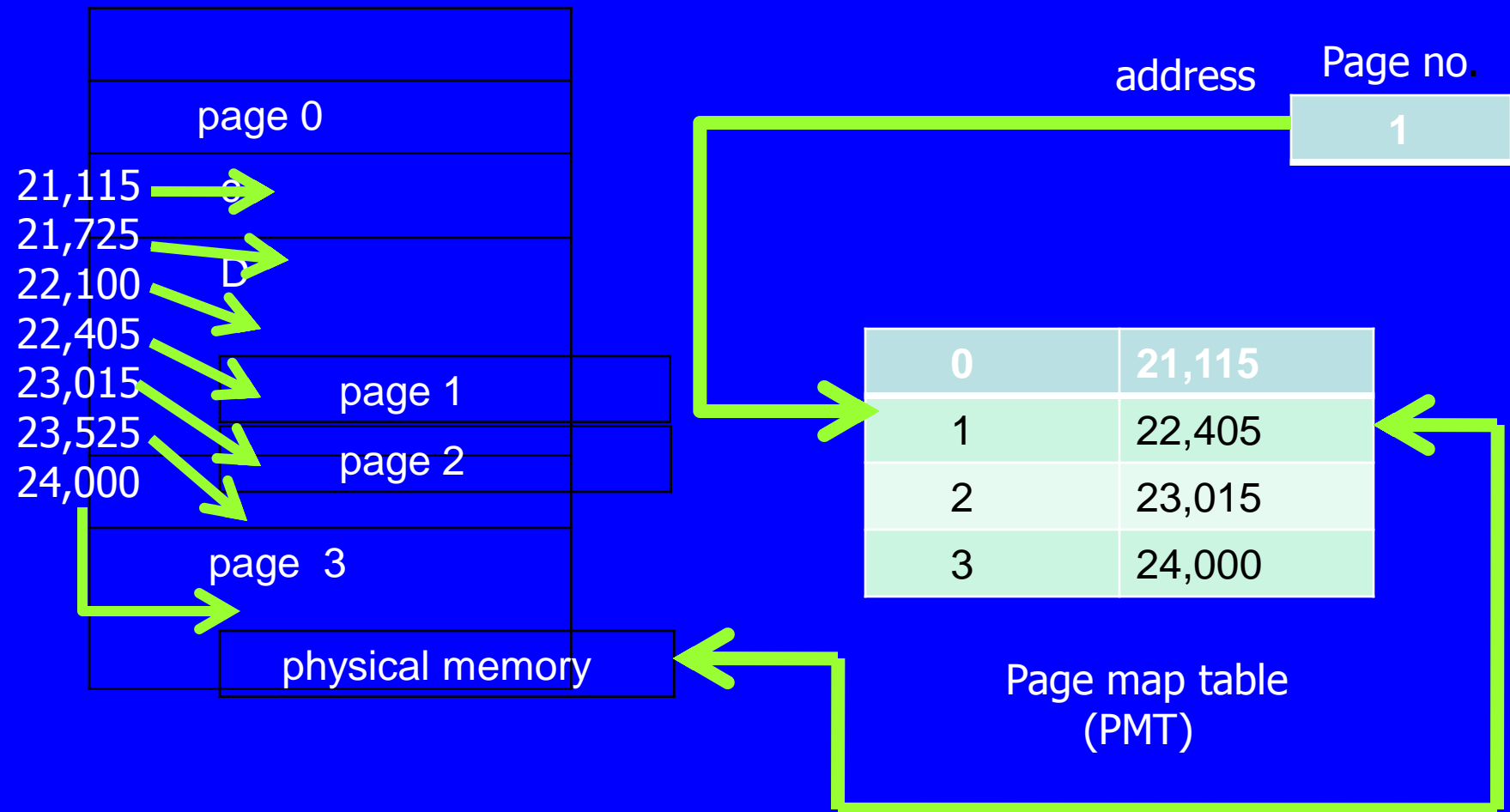
Virtual Storage Using PAGING

- ✓ Each program is split into fixed size program components called *pages*. Pages in a program & words in a page, both are numbered from 0.....n ,their logical address.
- ✓ Range of logical address is called as *virtual address space* or *logical address space*.
- ✓ Range of main storage address is referred to as *physical address space*.
- ✓ The physical or main memory is broken into fixed-size blocks called "frames"
- ✓ For a program execution, its pages are loaded into any available frames & the page table (also called page map table (PMT)) is defined to translate from user pages to memory frames .
- ✓ PMT stores on entry for every program page which contain the frame (storage block) number where the page presently resides .

Virtual Storage Using PAGING

In order to execute a program , some pages of it are loaded in the main memory depending upon the storage availability . During its execution, the program generation page number which is mapped to find its physical location and then the page is accessed .

Virtual Storage Using PAGING



Explanation

- ✓ When a required page is not in the main storage , an interrupt , known as missing page interrupt is raised.
- ✓ This fault is popularly called a page fault. The Os now takes action by bringing the required page from the secondary storage into an empty page block , this operation is called page in.
- ✓ After page in , PMT entry is modified and new entrant page's physical address is also stored in it and then the execution resumes .
- ✓ What if no entry storage block is available ? In such a situation , a storage block is vacated by moving out a page from main storage to secondary storage (process called page out). The reading and writing of pages determines page traffic.

Virtual Storage Using Segment

- ✓ It differs from paging because it makes the use of program segments.
- ✓ Program segment : It is a logical unit of a program as defined by a programmer or it is a piece of program logic which performs a specific task.
- ✓ Responsibility lies on the programmer only for determining how many segments a program should have or which program units should comprise a segment.
- ✓ For accessing a particular word in the segment , its logical address consists of two parts:
 - 1.segment number
 - 2.word number

Virtual Storage Using Segment

- ✓ This segment number is mapped on to 'segment table' to get physical address of the segment and by the word's identification number , physical or actual address of the word is found out.
- ✓ Address Transformer Unit , is responsible for generation of actual address of the required word within the segment .
- ✓ In the same way (as that of paging) , segments in the memory are processed and if a segment is not available in then memory , segment missing fault interrupt is raised. So there is a similarity between the both .

Virtual Storage Using Segment

- ✓ To increase the efficiency of a system sometimes paging and segmentation is combined. A large segments can be broken into pages. A segment obviously would be stored in contiguous area.
- ✓ Now within this paging can be implemented, making 'swapping' possible.

Information Management

- ✓ Information Management Component :
It manages the information which is an important task of OS .
- ✓ This information management component of Os is structured as follows :

1. Physical IOCS (input-output control system)

- ✓ It is responsible for DEVICE MANAGEMENT and for ensuring DEVICE INDEPENDENCE. It provides a basic capability for the programs to perform their own IO, without involving themselves with the intricacies of device handling.

2. Logical IOCS

- ✓ It is responsible for efficient organization and access of data on IO devices. It provides basic capabilities for file definition, choice of data organization and access methods.
- ✓ File system: It is responsible for protection and controlled sharing of files.

The Physical IOCS and IO Organization

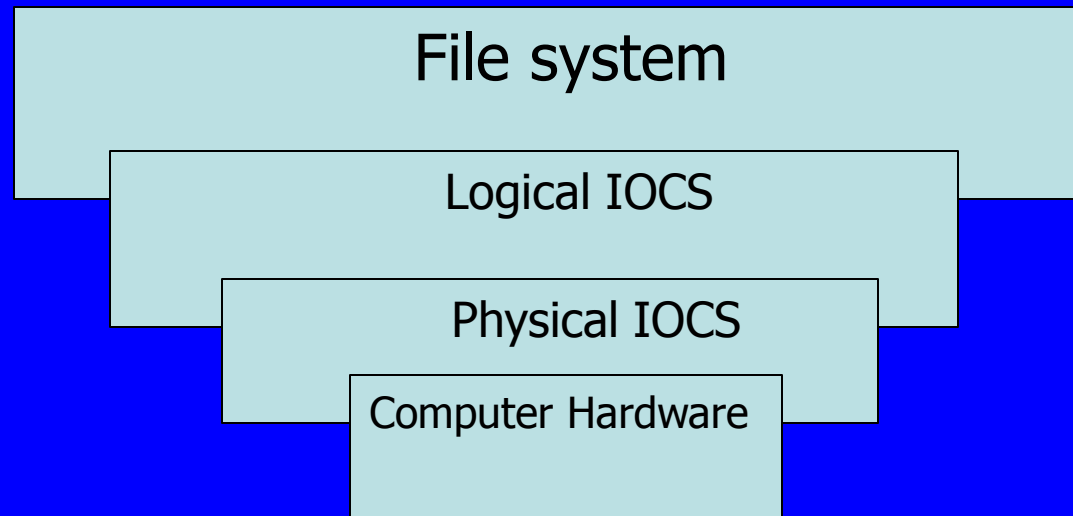


Figure: Hierarchy of information management modules

The Physical IOCS and IO Organization

- ✓ Each I/O channel, its control units and devices on them in the system are given unique codes recognized by the hardware. Thus a device is uniquely identified by a device address which consists of three addresses: for I/O channel, control unit and devices , (CH, CU, Dev). Steps in the execution of an I/O operation are as follows:

I/O Initiation

- ✓ It starts with issuing of a CPU instruction called 'start IO'. This 'start IO' instruction provides the device address (ch, cu, dev) for the required device.
- ✓ The CPU identifies the concerned channel, control unit of the devices and the device through the component address (ch,cu,dev)

Device Selection

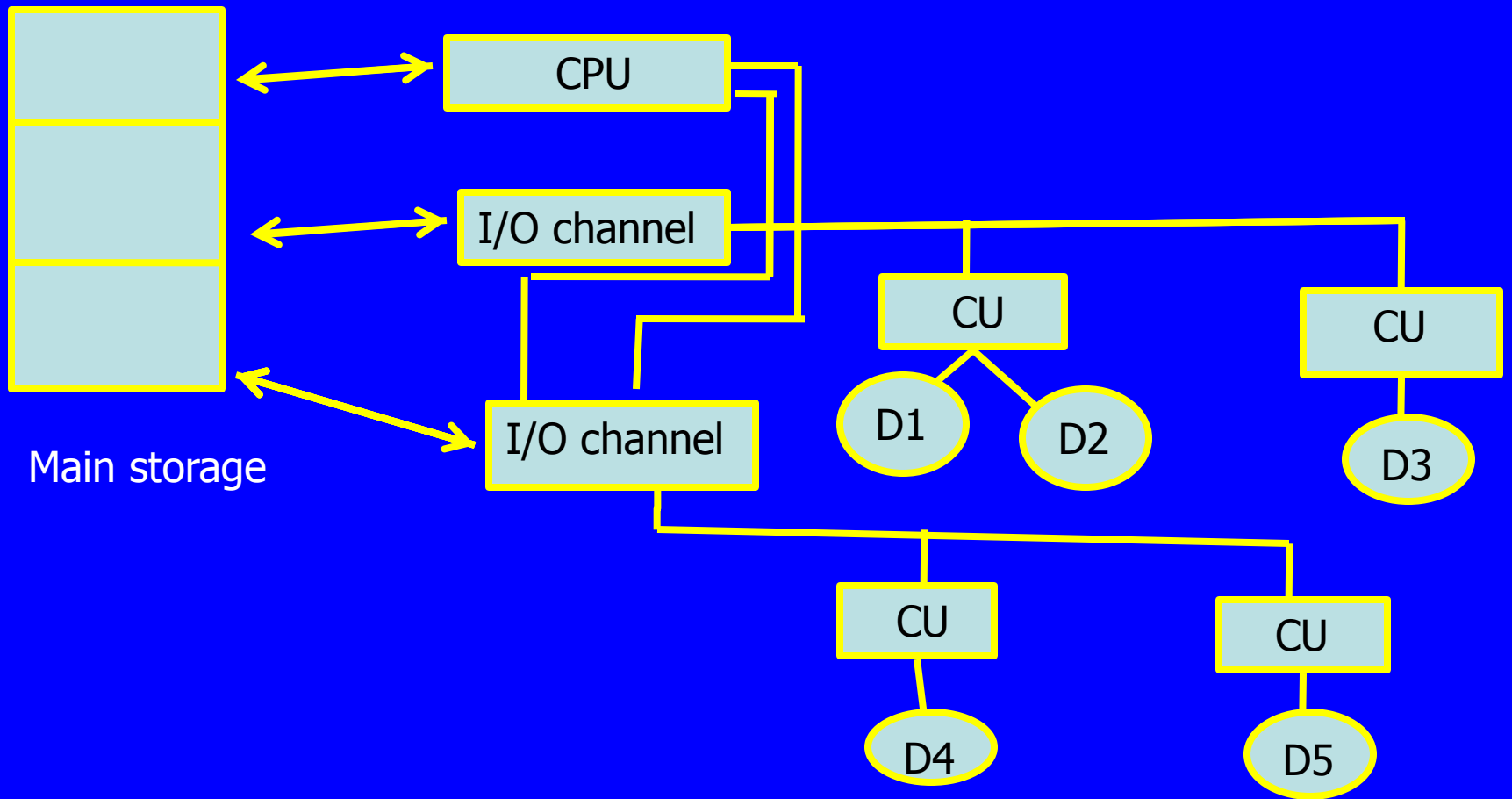
- ✓ The concerned channel then checks the device to see whether it is available or not . This process is called device selection. If device selection is successful, success condition code is set in PSR (register that stores CPU state) and IO instruction's execution starts
- ✓ If device selection fails (because of device's non availability if it is busy doing some other operation ,or hardware malfunction), 'start IO' is terminated and 'failure' condition code is set in PSR . CPU now determines which action should be taken viz. retry the operation , cancel the program which want IO, or switch to execution of another program.

I/O instruction execution

- ✓ If the required device is available ,I/O channel reads the I/O instructions from the program in the main storage and then sets up the execution of I/O operation on the designated device.

I/O Termination

- ✓ At the end of the I/O operation's) , the designated device raises an interrupt for the both type of ends: Successful and unsuccessful . IO termination interrupt provides following information on the CPU:
- ✓ (i) device address of the device raising the interrupt condition ,
- ✓ Status flags indicating :
 - (a) IO termination type
 - (b) error message if any.
- ✓ The interrupt handling routine then takes action by analyzing status and by invoking error recovery procedure (if required).



CU-control unit
D's-Devices

Role of the Physical IOCS

Physical IOCS integrates all the Os responsibilities like making IO sequence fort a problem by taking over device management functions.

Physical IOCS provides device- level error recovery routines which can be easily invoked when a recoverable error occurs. Thus , the problem has only to issue an I/O request and rest would be handled by Physical IOCS.

Role of the Physical IOCS

When an I/O operation is requested by a program (process), physical IOCS initiates IO in the above explained manner , marks the process state as blocked and frees the CPU for other computations , thus makes multiprogramming feasible .Physical IOCS also ensures protection to the programs from undue interference during I/O operation is being carried out.

Role of the Physical IOCS

- ✓ Thus Physical IOCS makes the entire I/O sequence operation 'transparent' to the problem program.
- ✓ **Transparency:** It means that the only thing to be issued by the program is the request /order/command for it and rest all internal operations are done by the control program (physical IOCS in the case) without making it visible to the problem program.

Logical IOCS

- ✓ The creation and access of the files are facilitated by the logical IOCS through file level commands viz. Open a file , read a record, delete a record, etc. Three – wayed help is provided for the user.
- ✓ 1. The programmer need not know physical IOCS intricate details of I/O device, channel , control unit of the device.
- ✓ 2.The programmer need not know physical IOCS interface, its details and handling.
- ✓ 3. The programmer need not know how an I/O is to be performed.

File System

- ✓ File system's function is to facilitate easy creation, storage and access of files in order to enable easy sharing of files between programs and their protection against illegal access.

The Major Function of a FILE SYSTEM are given below:

- ✓ It provides file naming freedom to the users and permits controlled sharing of files (protection).
- ✓ Provides long and short term storage of files .
- ✓ Provides security against loss of information due to system failure(security).

THANK

YOU