0301304 FUNDAMENTAL OF OPERATIONG SYSTEM

UNIT	MODULES	WEIGHTAGE
1	INTRODUCATION TO OPERATING SYSTEM	20 %
2	PROCESS MANAGEMENT	20 %
3	PROCESS COMMUNICATION AND SYNCHRONIZATION	20 %
4	MEMORY MANAGEMENT	20 %
5	FILE MANAGEMENT , DISK MANAGEMENT , SECURITY AND PROTECTION	20 %

UNIT – 5 File Management, Disk Management, Security and Protection

- File System
  - Introduction
  - Files and File System
  - File Structure
  - File Naming and File Type
  - File Access
- Disk Management
  - Introduction
  - Disk Scheduling Algorithm
    - FCFS
    - SSTF
    - SCAN
    - LOOK and C-LOOK

UNIT – 5

File Systems

UNIT – 5 File Systems

- The file **system provides a convenient mechanism to store and retrive the data** and programs from this medium.
- **File are used as a collection of related information**, the meaning of which is defined by its creator.
- These **files are mapped to the disks or other storage media by the Os.**

UNIT – 5 File Systems

- Files, a c**onvenient environment is created that allows one to write, read, save and retrieve** the program and data on any type of store media.
- A Files, thus is a collection of related information that is **mapped on to a secondary storage.**
- The information stored in a file is in bits, bytes, lines or records.
- The **user only sees the logica view** of the file.
- The **sytem views all the work required to map the logical file to the secondary storage.**
- The **benefit of storeing** files on the secondary storage is the facility provided by the file system:
  - **To create, store and retrive the information in the form of files.**

UNIT – 5 File Systems

- The following are the primary constituents of a file system:
  - File Management
    - It manages how the files are stored, referenced, shared and secured.
  - File Allocation
    - It provides the methods to allocate files on the disk space.
  - File Access Methods
    - It provides the methods to access stored files.

UNIT – 5 File Systems – File Structure

- The basic element of data is **Field**, is a single value item.
- When multiple fields are combined to form a meaningful collection, it is known as a **record.**
- When such similar records are collected, it is known as a **file.**
- Os must support a required structure for a certain type of file.

UNIT – 5 File Systems – File Structure

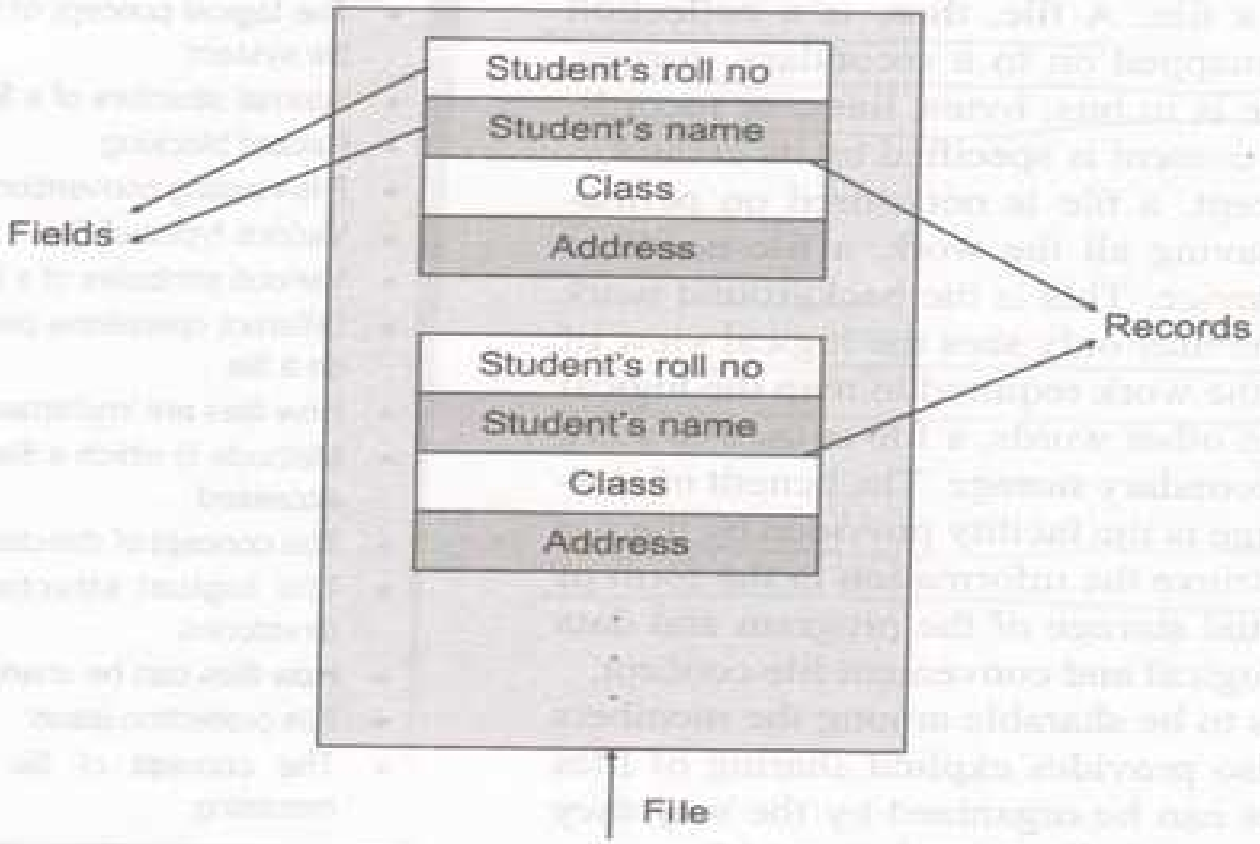


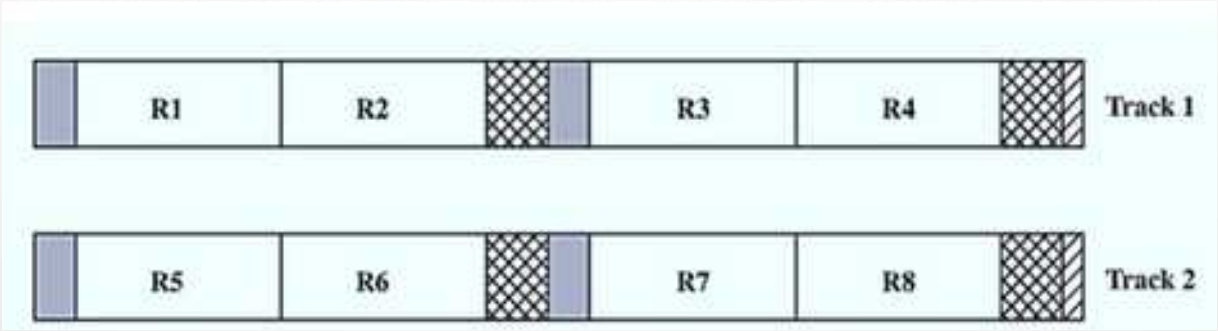
Fig. 12.1 File structure

UNIT – 5 File Systems –Internal Structure & Record Blocking

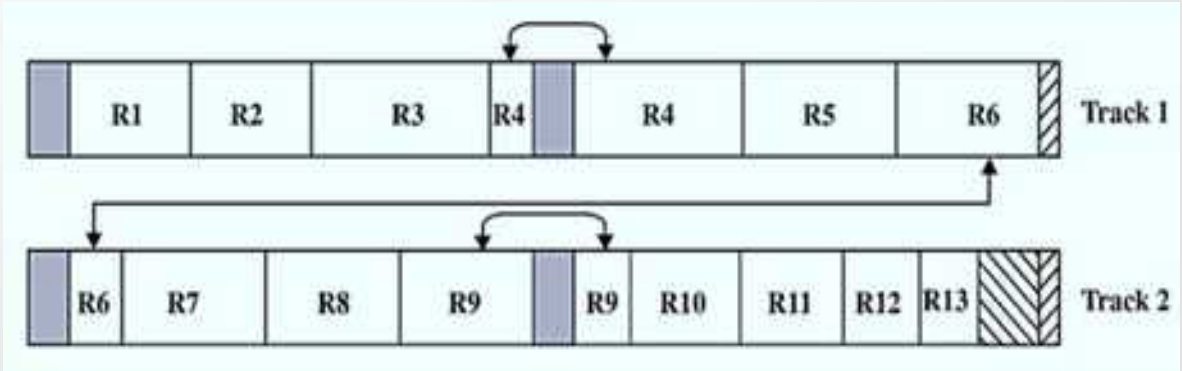
- **Record Blockings**
  - A group of 512 bytes is packed into one block of disk. This is called block, all basic I/O functions are performed in terms of blocks, this is known as **record blockings.** Blocking conserves storage space on a volume by reducing the number of interblock gaps in the data set.
  - **Fixed Blocking**
  - **Variable – length Spanned Blocking**
  - **Varible – length Unspanned Blocking**

UNIT – 5 File Systems –Internal Structure & Record Blocking

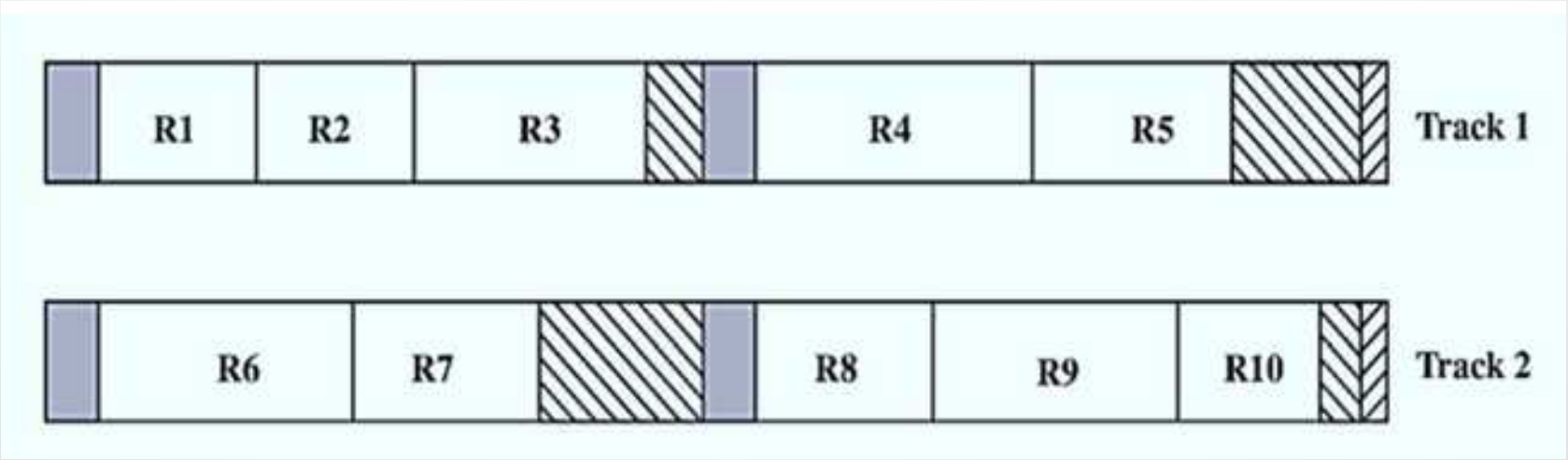
- **Fixed Blocking**
  - In this method, record lengths are fixed.
  - The prescribed number of records stored in a block. Internal fragmentation is stored in a block.
  - Fixed blocking is common for sequential files with fixed-length records.



- **Variable – length Spanned Blocking**
  - In this method, record sizes aren't same, Variable-length records packing into blocks with no unused space. So, some records may divide into two blocks.
  - In this type of situation, a pointer passes from one block to another block. So, the Pointers used to span blocks unused space.
  - It has efficient storage and doesn't limit record size, but it is more complicated to implement. So, the files are more difficult to update.



- **Variable – length Unspanned Blocking**
  - Variable lengths are used, but spanning is not considered in case of small size blocks.
  - A small size block is left unused, causing wastage of memory space and records are allocated to a bigger block.



UNIT – 5 File Systems – File Naming & File Types

- All the file name has two parts, seperated bya period (.).
- First part is the **name of the file**, define by the user.
- Second part is known as **extension.**

UNIT – 5 File Systems – File Naming & File Types

- An OS must recoganize the type of the file, because the operations performed on its depend on its type.
- **Source code file -** .c
- **Object file -** .obj or .o
- **Executable file -** .exe or .com or .bin
- **Text file -** .txt or .doc
- **Batch file -** .bat
- **Archive file -** .zip or .rar
- **Multimedia file -** .jpg or .mp3 or .mov

UNIT – 5 File Systems – File Naming & File Types

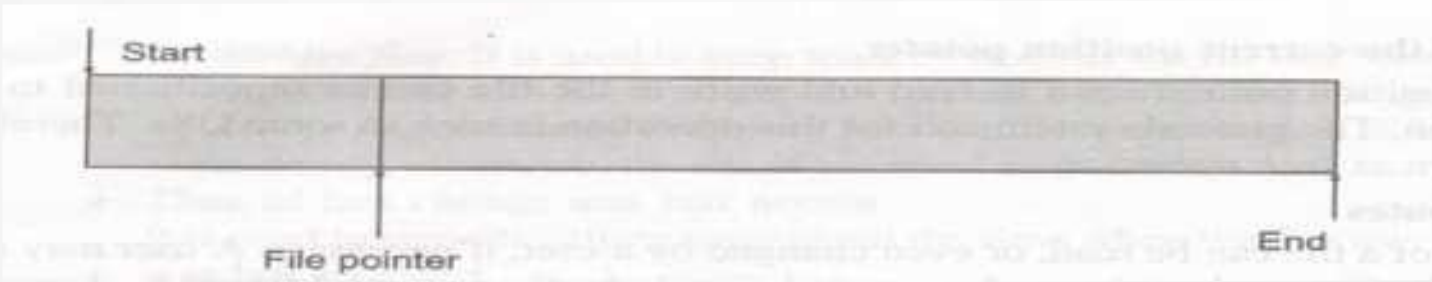
- In general files are the following types:
  - **Regular**
    - Contain the user information
  - **Directory**
    - Is a file type used to orgnize the list of files in a group.
  - **Special**
    - A special file contains no data but provides a mechanism that maps physical devices to file name.

UNIT – 5 File Systems – File Access

- The following are some file access methods:
  - Sequential File Access
  - Direct File Access
  - Indexed Sequential File Access

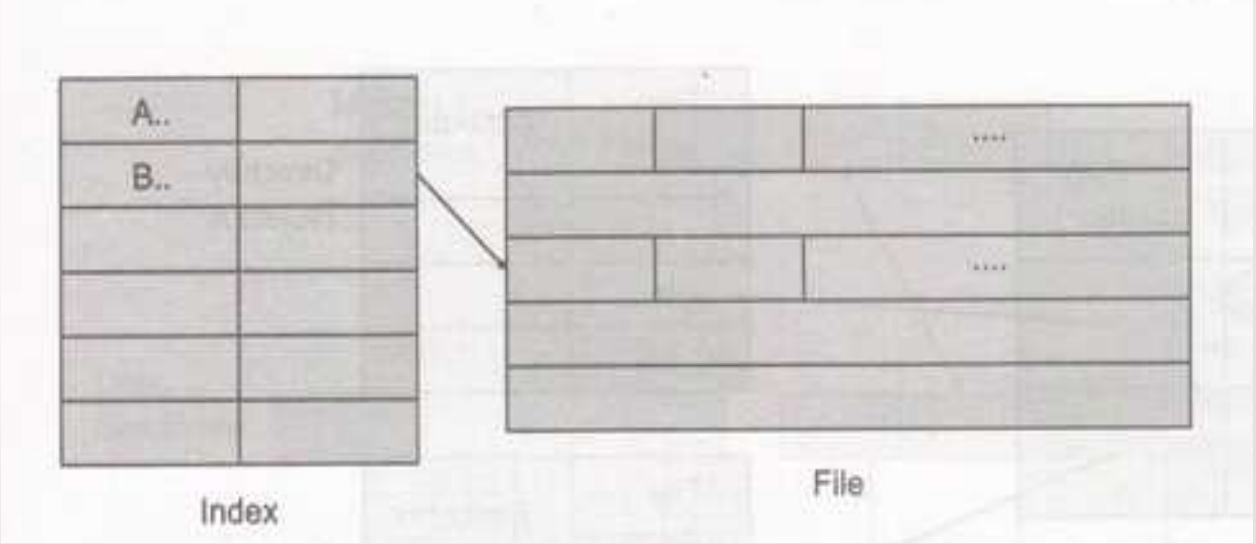
UNIT – 5 File Systems – File Access

- **Sequential File Access -** It is the simplest access method. Information in the file is processed in order, one record after the other. This mode of access is by far the most common; for example, editor and compiler usually access the file in this fashion.



- **Direct Access -** Another method is direct access method also known as relative access method. A filed-length logical record that allows the program to read and write record rapidly in no particular order.

- **Index sequential method –** It is the other method of accessing a file that is built on the top of the sequential access method. These methods construct an index for the file. The index, like an index in the back of a book, contains the pointer to the various blocks. To find a record in the file, we first search the index, and then by the help of pointer we access the file directly.



UNIT – 5

Disk management

UNIT – 5 Disk Management – Disk Scheduling

- There are several reason disk scheduling is important for I/O operations.
  - Many **process may send I/O** request and the processor can service one I/O at a time.
  - Seek time management.
  - When Disk is near to full.
  - Random requests from the user may also need disk scheduling.

UNIT – 5 Disk Management – Disk Scheduling Algorithms

- FCFS (First Come First Serve)
- SSTF (Shortest Seek Time First)
- SCAN (Elevator Algoritm)
- LOOK and C-LOOK

UNIT – 5 Disk Management – Disk Scheduling Algorithms - FCFS

- Consider a disk queue with I/O request

  54, 97, 73, 128, 15, 44, 110, 34, 45

- The disk head is assumed to be at Cylinder 23

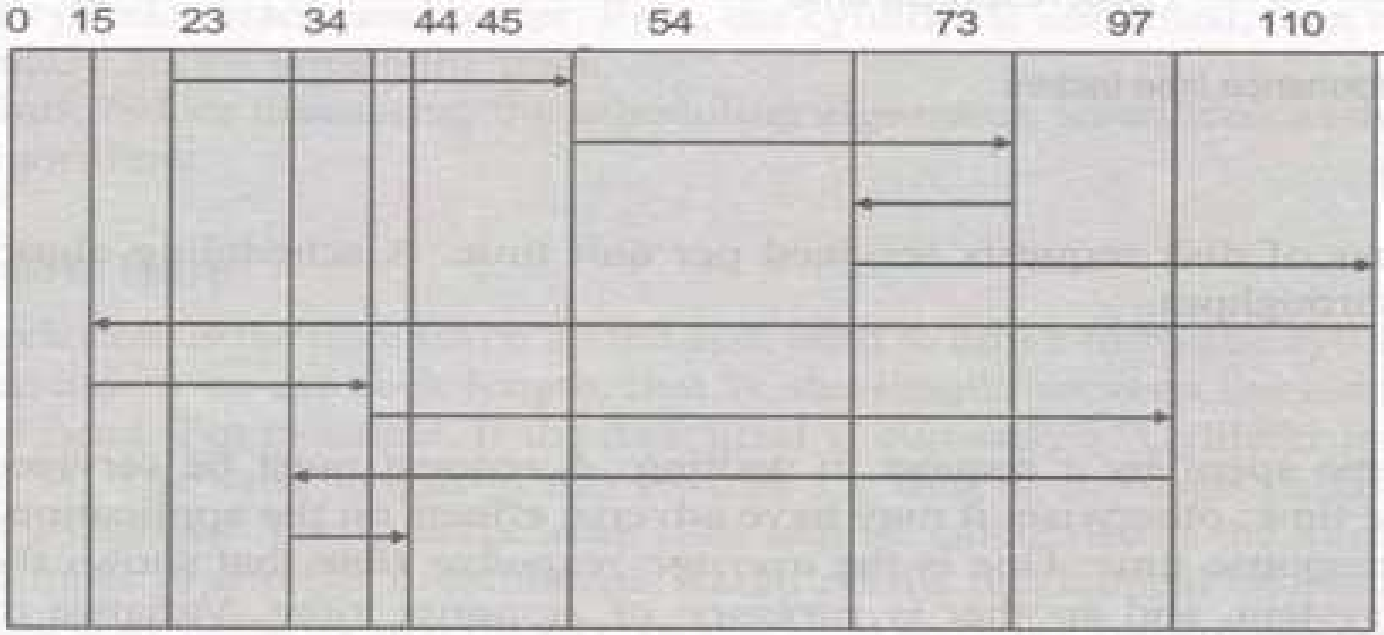


Fig. 15.2 FCFS disk scheduling for Example 15.1

Table 15.1 FCFS head movement for Example 15.1

UNIT – 5 Disk Management – Disk Scheduling Algorithms - FCFS

I/O request for cylinder	Head movement	Total head movement for the request
54	23–54	31
97	54–97	43
73	97–73	24
128	73–128	55
15	128–15	113
44	12–44	32
110	44–110	66
34	110–34	76
45	34–45	11
Total head movement = 451		

15.4.2 SSTF

UNIT – 5 Disk Management – Disk Scheduling Algorithms - FCFS

- Consider a disk queue with I/O request

  54, 97, 73, 128, 15, 44, 110, 34, 45

- The disk head is assumed to be at Cylinder 23

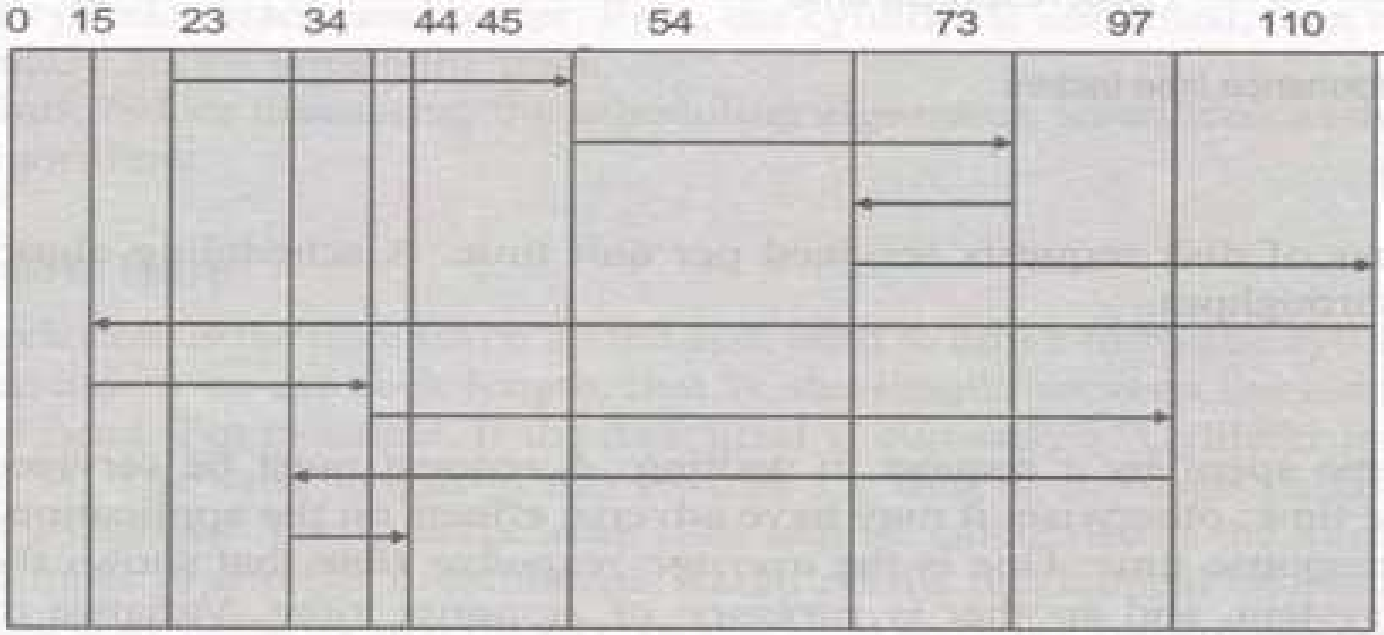


Fig. 15.2 FCFS disk scheduling for Example 15.1

Table 15.1 FCFS head movement for Example 15.1

UNIT – 5 Disk Management – Disk Scheduling Algorithms - SSTF

- Consider a disk queue with I/O request

  54, 97, 73, 128, 15, 44, 110, 34, 45

- The disk head is assumed to be at Cylinder 23

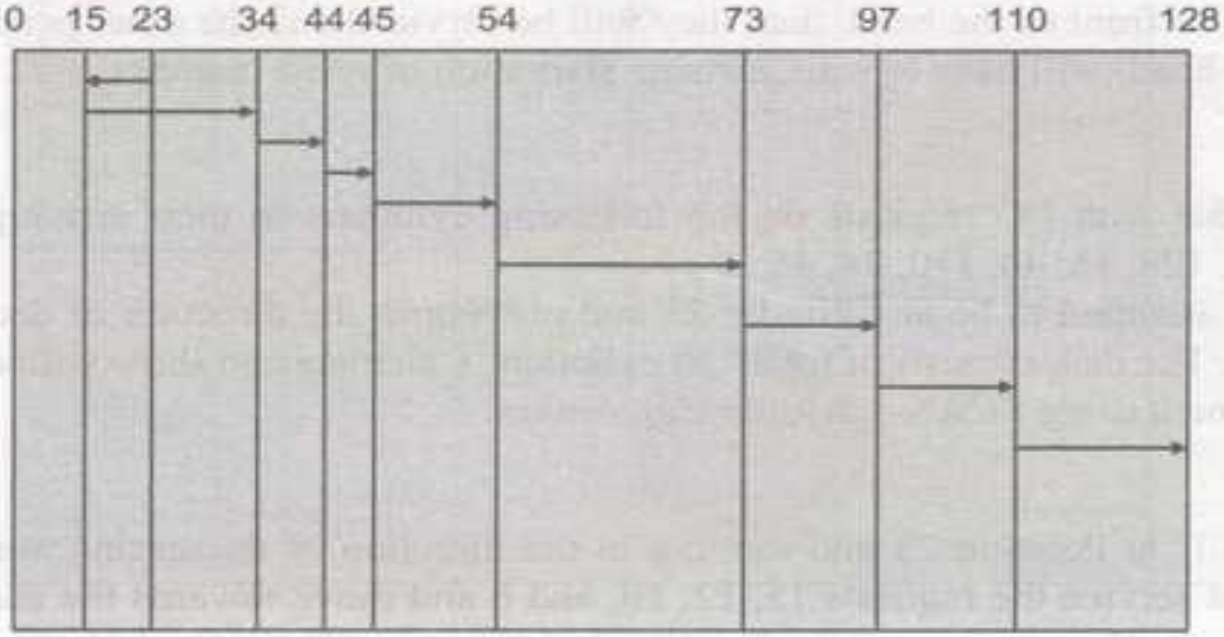


Fig. 15.3 SSTF disk scheduling for Example 15.2

UNIT – 5 Disk Management – Disk Scheduling Algorithms - SSTF

distance that a head needs to move. From the current posit
distance is the shortest is serviced, as shown in Table 15.2

Table 15.2 SSTF head movement for Example 15.2

Head movement	Total head movement for the request
23–15	8
15–34	19
34–44	10
44–45	1
45–54	9
54–73	19
73–97	24
97–110	13
110–128	18
Total head movement = 121	

UNIT – 5 Disk Management – Disk Scheduling Algorithms - SCAN

- Consider a disk queue with I/O request

  6, 10, 12, 54, 97, 73, 128, 15, 44, 110, 34, 45
- The disk head is assumed to be at Cylinder 23 and moving in the direction of decreasing number of cylinder.
- **The total head movement in this 23 + 150 = 173**

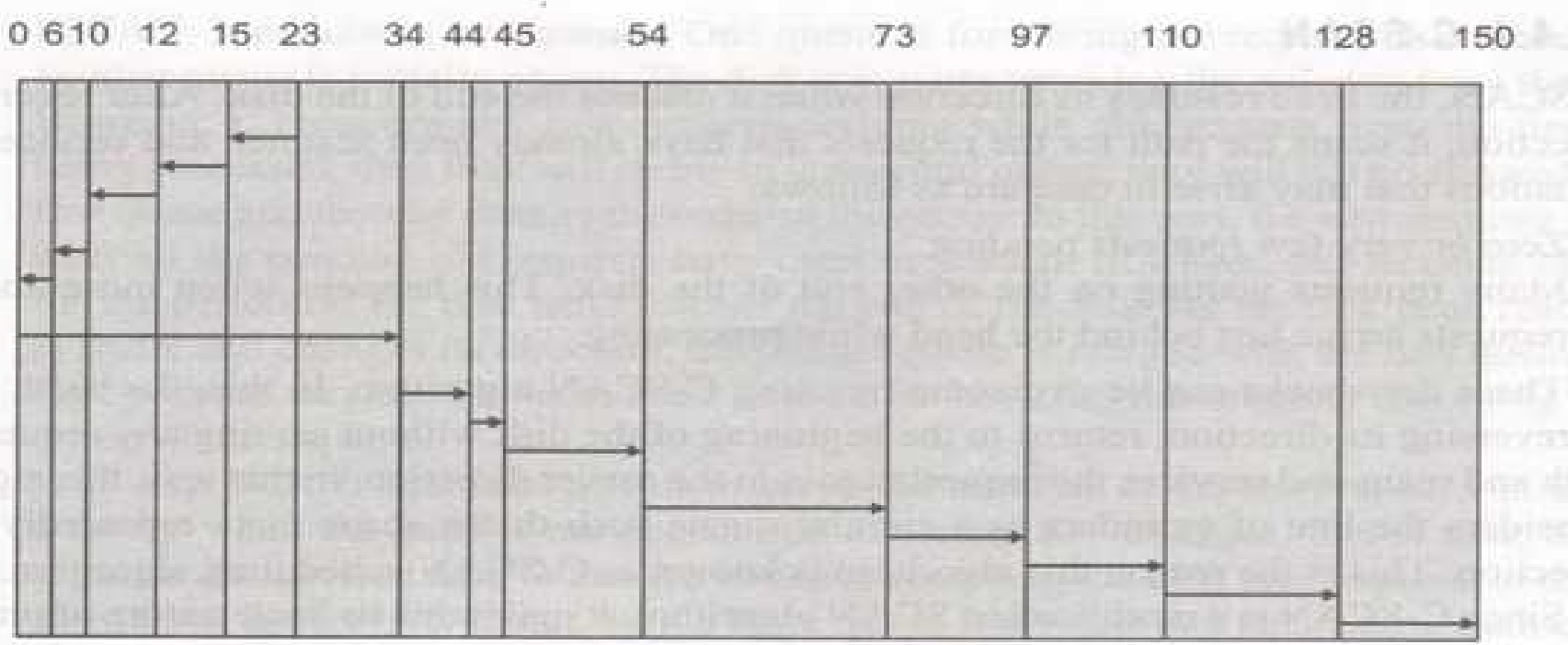


Fig. 15.4 SCAN disk scheduling for Example 15.4

UNIT – 5 Disk Management – Disk Scheduling Algorithms – SCAN

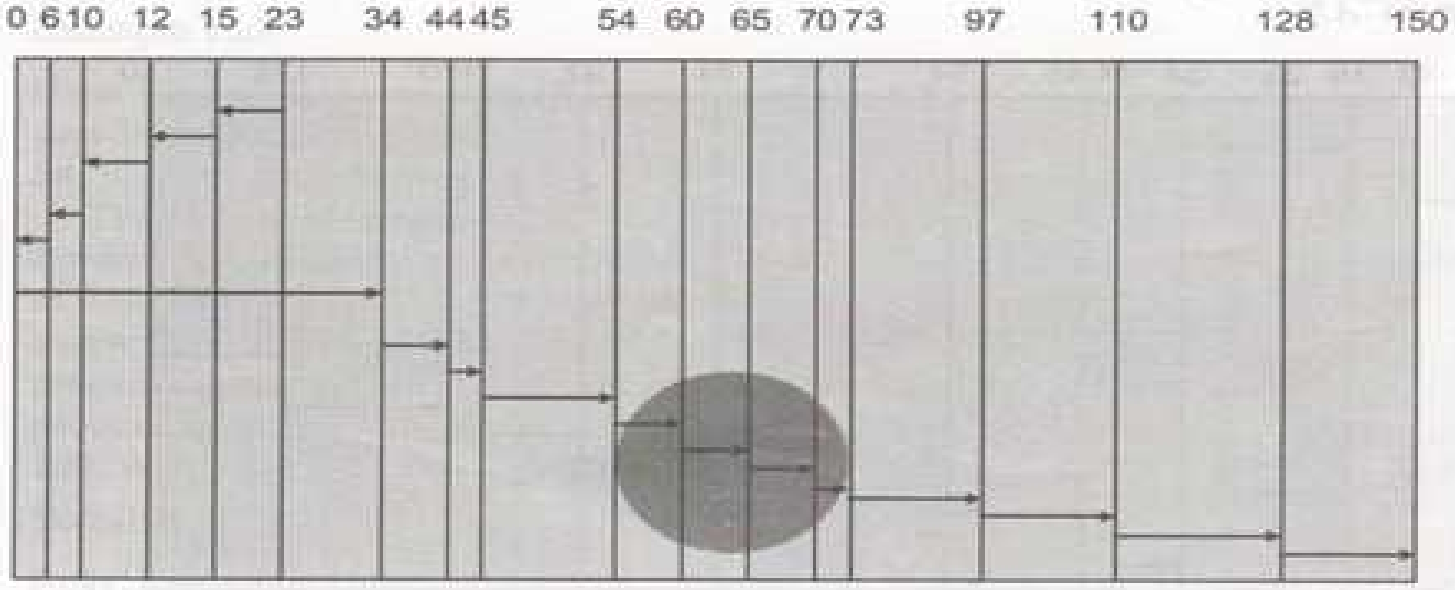
Cylinders 128 to 150 are unnecessary as there are no requests in these paths.

Example 15.5

In Example 15.4, suppose some new requests arrive at Cylinders 60, 65, and 70 while the disk head is processing Cylinder 54. What will happen to these new requests according to the SCAN-scheduling algorithm?

Solution

Since the new requests arrived are in the preferred direction of disk-head movement, all these requests will be serviced just after the processing at Cylinder 54 as shown in the highlighted portion in Fig. 15.5. However, due to arrival of these new requests, the waiting time of pending requests in the queue increases.



UNIT – 5 Disk Management – Disk Scheduling Algorithms – Look & C-Look

- Consider a disk queue with I/O request

  6, 10, 12, 54, 97, 73, 128, 15, 44, 110, 34, 45
- The disk head is assumed to be at Cylinder 23 moving the direction of decreasing cylinder number.
- **The total head movement in this 17 + 122 = 139**

The total head movement in this algorithm is 139.

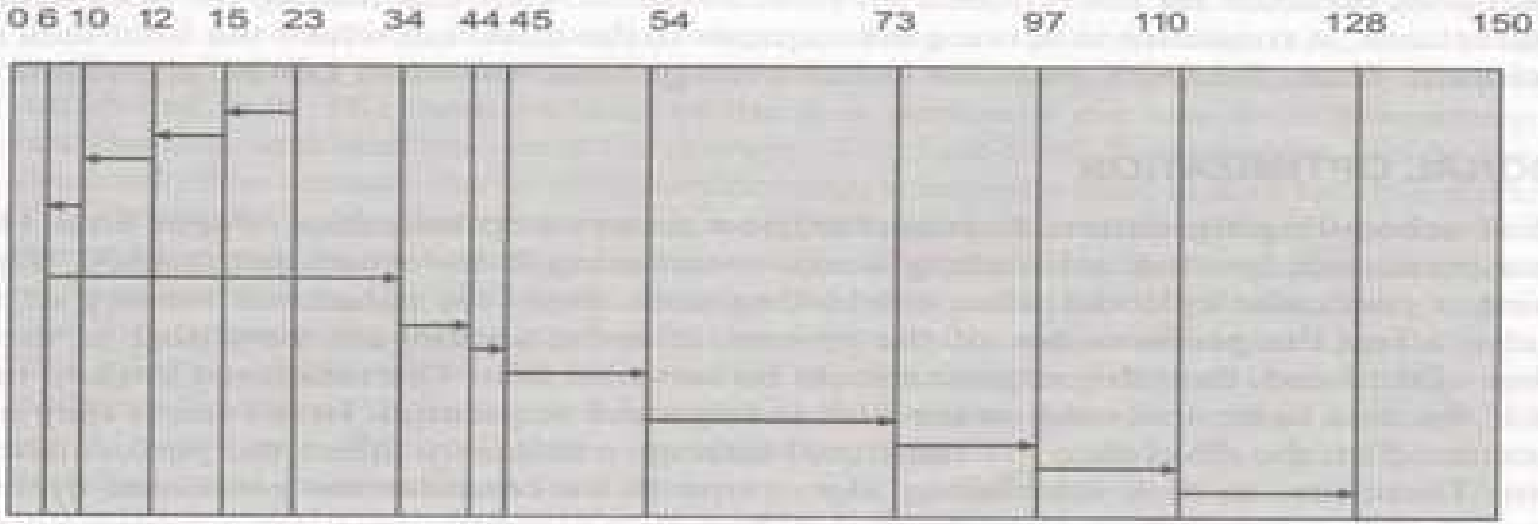
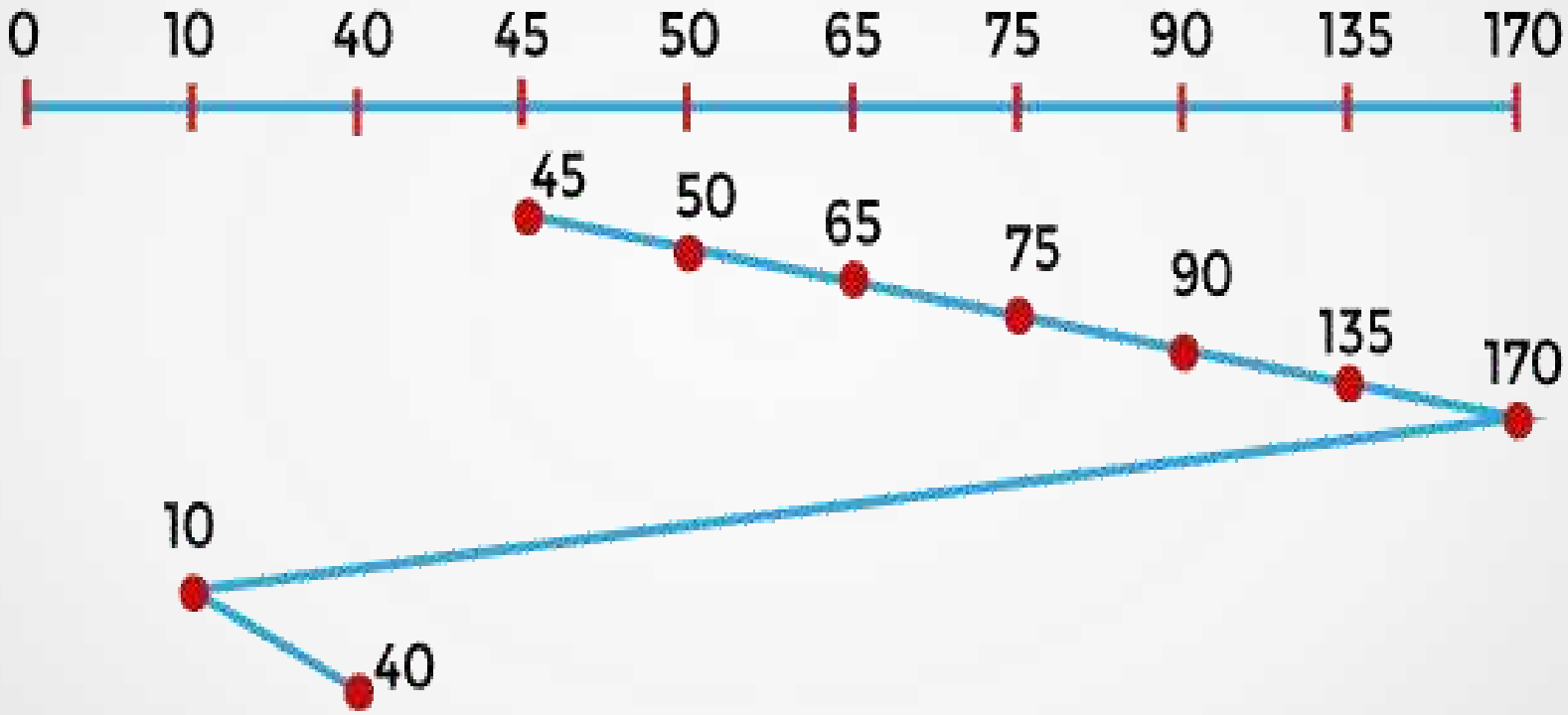


Fig. 15.13 LOOK disk scheduling for Example 15.9

C-Look Disk Scheduling Algorithm

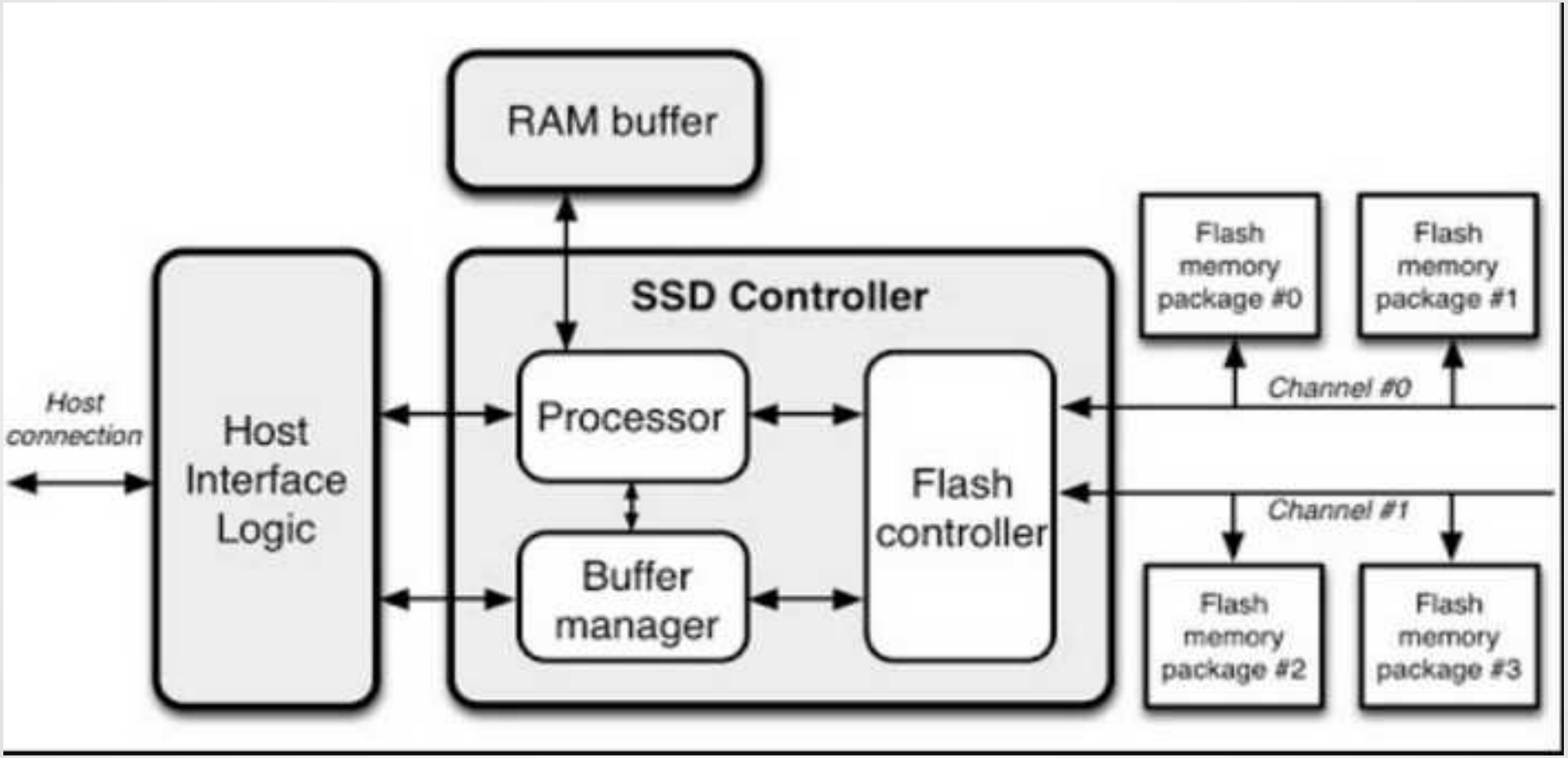


C-Look Disk Scheduling Algorithm

SSD -Solid State drive

- The SSD (Solid State Drive) : sometimes improperly referred to as “Solid State Disk or an electric disk” is a data storage device.
- SSDs do not employ any moving mechanical components, which distinguishes them from traditional magnetic disks such as hard disk drives (HDDs) or floppy disks, which are electromechanical devices containing spinning disks and movable read/write heads.
- Compared with electromechanical disks, SSDs are typically less susceptible to physical shock, are silent, and have lower access time.

SSD Structure



SSD Structure

- A solid-state drives (SSD) is a flash-memory based data storage device. Bits are stored into cells, which are made of floating-gate transistors. SSDs are made entirely of electronic components, there are no moving or mechanical parts like in hard drives.
- Voltages are applied to the floating-gate transistors, which is how bits are being read, written, and erased.
- The types of cells currently present in the industry are:
- Single level cell (SLC), in which transistors can store only 1 bit but have a long lifespan
- Multiple level cell (MLC), in which transistors can store 2 bits, at the cost of a higher latency and reduced lifespan compared to SLC
- Triple-level cell (TLC), in which transistors can store 3 bits, but at an even higher latency and reduced lifespan.

SSD Structure

- Host interface - Commands come from the user through the host interface. The processor in the SSD controller takes the commands and pass them to the flash controller. SSDs also have embedded RAM memory, generally for caching purposes and to store mapping information.
- Controller - The controller of SSD is an embedded microchip (such as CPU in computer) with the function of issuing all operation requests ranging from reading and writing data to collecting garbage and depletion equalization algorithm to ensure the speed and cleanliness of SSD. So the controller is the brain center of SSD. There are major controllers available today such as Marvell, SandForce, Samsung, Indilinx.

SSD Features

1. **Fast Speed**

SSDs have 100 times greater throughput and instantaneous access times for quicker bootups, faster file transfers, and overall snappier performance than hard disk drives. HDDs can only access data faster the closer it is from the read/write heads, while all parts of the SSD can be accessed at once.

2. **Ultra Light Weight**

With no moving parts, SSDs are able to run quieter in ultra-light weight mobile systems at only 77g vs. 752.5g for HDDs.

3. **Great Durability**

Solid state drives feature a non-mechanical design of NAND flash mounted to circuit boards, shock resistant up to 1500g. Hard drives consist of various moving parts making them susceptible to shock and damage.

4.**Sound of Silence**

With no moving parts, SSDs run at near-silent operation and never disturb your computing experience during gaming or movies, unlike loud whirring hard disk drives.

5.**Low Power Consumption**

SSDs use significantly less wattage at peak load than hard drives, less than 2W vs. 6W for an HDD. This low-power requirement can deliver longer battery life in notebooks, less power strain on systems, and a cooler computing environment.

6.**Cool Running**

SSDs serve as energy-efficient storage upgrades to your desktop or laptop. They require very little power to operate, which translates into significantly less heat output by your computer.

7.**Excellent Cost-Efficiency**

Though still higher price/gigabyte than HDD, SSDs offer cost savings in the long run with lower energy usage and greater productivity with higher IOPS (Input/Output Operations Per Second) with one SSD compared to a bank of hard drives for businesses.

File system in SSD

- Typically the same file systems used on hard disk drives can also be used on solid state drives.
- It is usually expected for the file system to support the TRIM command which helps the SSD to recycle discarded data (support for TRIM arrived some years after SSDs themselves but is now nearly universal).
- This means that the file system does not need to manage wear leveling or other flash memory characteristics, as they are handled internally by the SSD.

SSD File Systems on Linux

- **Ext4 -** Extended4 (aka Ext4) is the file system of choice for most distributions on Linux as it is a vast improvement upon Ext3. It's reliable, trusted, and it offers up some excellent SSD-specific features like TRIM (necessary for the health of your drive,) and the ability to disable journaling which can vastly improve the longevity of a solid-state hard drive.
- **BtrFS -** BtrFS, by Oracle Corp, is a new kind of file system.
- It improves system performance, and make repair simple.
- BtrFS has an SSD defragmentation feature that allows users to clean up the data on their drive. BtrFS doesn't have journaling on by default, so unlike Ext4, you won't need to turn it off if you don't want file system journals eating into your read/write rate. BtrFS is highly unstable and has the potential to crash and corrupt your data if something goes wrong.

SSD File Systems on Linux

- **XFS -** The XFS file system is well-known for its high-performance and speed. So, if you have a lot of data, need to access it fast and plan to store it on an SSD, XFS is a great choice.The performance advantages of XFS on an SSD mean that you'll be able to transfer and access files and data much quicker than other file systems. XFS is a journaling file-system, and it's not possible to disable this feature. Not being able to disable journaling is something to be wary about if you're worried about the SSD read/write limit.
- **F2FS -** The Flash-Friendly File System (F2FS) is a file system intended for NAND-based storage devices on Linux and other operating systems that support it. F2FS is explicitly designed for SSDs and other flash storage devices, so your OS will run efficiently and fast. F2FS is modern and relatively new, so it will most likely get new features as time goes on.

Applications of SSD

Initially Solid State Drives (SSDs) were designed for consumer devices. With the increased speed and power, various other sectors also came with a huge demand for them. Some are discussed below:

- Business – Companies depending on programming environments or data analysis often rely on SSDs, as access times and file-transfer speeds are critical.

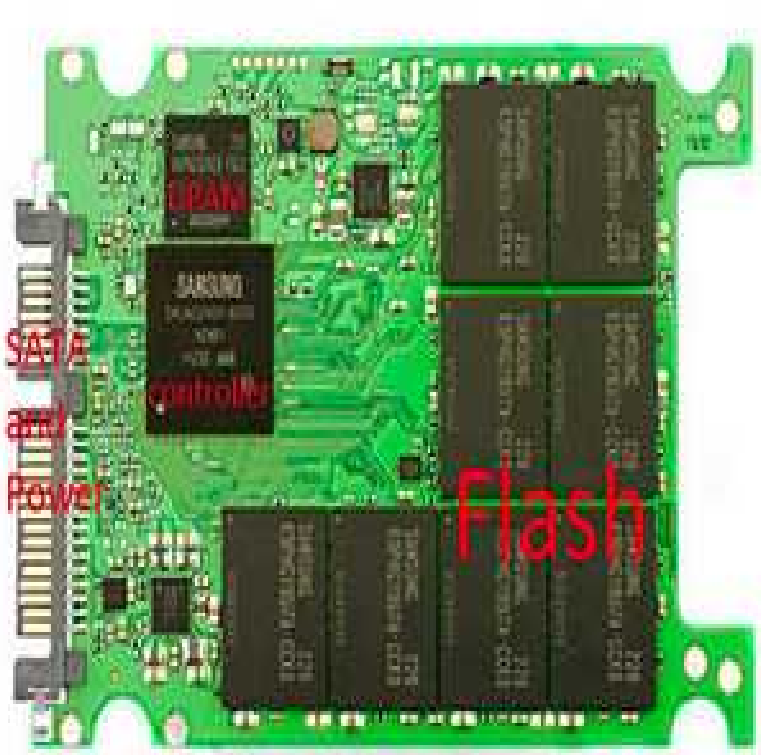
  Gaming – For every gaming program the computer requires a faster data access speed enabling a faster load time which is provided by the SSD.

  Smartphones – With the continuous developments in Smartphone industry, the need for small sized fast memory is best fulfilled by SSD.

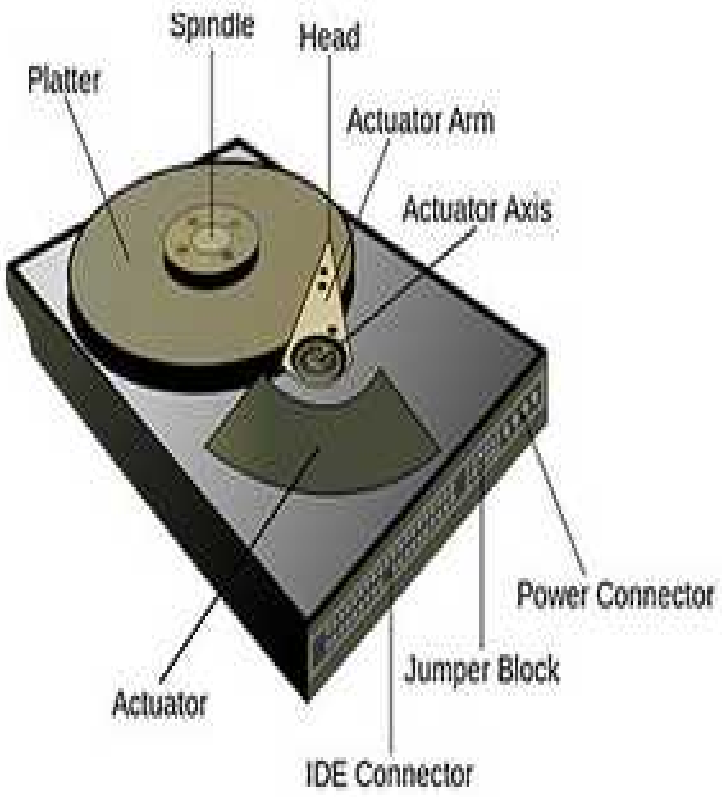
  Servers – SSDs can improve the server's response time due to its speed. They are suitable for faster read and write operations.

  Smart Wearable & Gadgets – The lesser space requirement, low power consumption and high speed makes it an indispensable part of Smart Wearable and Gadgets.

SSD VS HDD



SSD



HDD

SSD vs. HDD

	HDD	SDD
Stands for	Hard Disk Drive	Solid State Drive
Speed	HDD has higher latency, longer read/write times, and supports fewer IOPs (input output operations per second) compared to SSD.	SSD has lower latency, faster read/writes, and supports more IOPs (input output operations per second) compared to HDD.
Heat, Electricity, Noise	Hard disk drives use more electricity to rotate the platters, generating heat and noise.	Since no such rotation is needed in solid state drives, they use less power and do not generate heat or noise.
De - fragmentation	The performance of HDD drives worsens due to fragmentation; therefore, they need to be periodically defragmented.	SSD drive performance is not impacted by fragmentation. So defragmentation is not necessary.
Components	HDD contains moving parts - a motor-driven spindle that holds one or more flat circular disks (called platters) coated with a thin layer of magnetic material. Read-and-write heads are positioned on top of the disks; all this is encased in a metal cas	SSD has no moving parts; it is essentially a memory chip. It is interconnected, integrated circuits (ICs) with an interface connector. There are three basic components - controller, cache and capacitor.
Weight	HDDs are heavier than SSD drives.	SSD drives are lighter than HDD drives because they do not have the rotating disks, spindle and motor.
Dealing with vibration	The moving parts of HDDs make them susceptible to crashes and damage due to vibration.	SSD drives can withstand vibration up to 2000Hz, which is much more than HDD.

Mobile Operating System

- We are living in a world of mobile devices such as smartphones, laptops, and tablets.
- These mobile devices are different as compared to general desktop systems. These are designed and run in very restricted environment/resources.
- Therefore, the OSs, for these devices cannot be the same as those for desktop systems. The mobile OSs have been designed for each category of mobile devices.
- Since the mobile devices are different as compared to conventional desktop systems, they need different OSs too. These are known as mobile OSs.
- Depending on the capabilities of the mobile devices and what they support, mobile OSs may also differ. For example, the mobile OS for a PDA is different from that of a smartphone.

Roles of OS in Mobile Devices

- 1.Power Management (BIOS)
- 2.System Power Management(Working, sleeping)
- 3.Battery Management
- 4.Thermal Management
- 5.Memory Management
- 6.Shortening Boot-up Time
- 7.Scheduling
- 8.File System
- 9.Security

Constraints and Requirements of Mobile OS

1. Screen size, sensors and interactions
2. Storage and cache sizes
3. Latencies :

Latency is the time it takes for data to be transferred between its original source and its destination, measured in milliseconds.

4. Network issues
5. Data use requirements
6. Fonts, language and tone of voice
7. Corner cases for product usage(eg : International Roaming, 5G support)

Types of Mobile Operating System

- 1. Windows Mobile : Windows mobile is a compact mobile operating system developed by Microsoft.
- The current version is called Windows Mobile 6.5.
- It is based on the Windows 5.2 kernel, and features a suite of basic applications developed using the Microsoft Windows API.
- It is designed to be similar to desktop versions of windows, feature-wise and aesthetically. 3rd party software development is available for Windows Mobile.
- Windows Mobile currently holds a 8.8% share in the worldwide smartphone market.

Types of Mobile Operating System

2. Palm Os : Palm OS is the computer operating system that provides a software platform for the Palm series of handheld personal digital assistants (PDAs) made by Palm Inc.

- According to Palm, Palm OS was designed from the beginning to fit into a palm-size device of a specific size and with a specific display size.
- Microsoft's Windows and Symbian (originated by Psion) are also operating systems for handheld devices, but are designed to serve a broader range of devices.
- Palm OS uses multitasking, but only one task is for applications. The user uses one application at a time.

Types of Mobile Operating System

3. Embedded Linux OS: Embedded systems are based on non x86 processor architecture such as ARM, MIPS, PowerPC etc.

- Embedded systems boot from flash instead of hard drives and support flash filesystems.
- Embedded systems don't support BIOS unlike desktop PC.
- Embedded systems are resource constrained and hence can't run bulky OS.
- Embedded systems are battery operated and low power devices in general.
- Embedded systems may be based on different processors and support different peripherals based on customer requirements and hence the hardware is not generic like desktop PC.
- Embedded systems require real time performance.

Types of Mobile Operating System

- 4. IOS : is a mobile operating system created and developed by Apple Inc. exclusively for its hardware.
- It is the operating system that powers many of the company's mobile devices, including the iPhone and iPod Touch. It also powered the iPad until the introduction of iPadOS, a derivative of iOS, in 2019. It is the world's second-most widely installed mobile operating system, after Android.
- It is the basis for three other operating systems made by Apple: iPadOS, tvOS, and watchOS. It is proprietary software, although some parts of it are open source under the Apple Public Source License and other licenses.
- Major versions of iOS are released annually. The current stable version, iOS 16, was released to the public on September 12, 2022.

Types of Mobile Operating System

- 5. Android : Android is a software stack including mobile OS that has been primarily designed for touch screen-based mobile devices. It was originally developed by Android Inc. and was later sold to Google in 2005.
- It has Linux kernel.
- The first commercial version, Android 1.0, was released on September 23, 2008. Android is continually developed by Google and the Open Handset Alliance (OHA), and it has seen several updates to its base operating system since the initial release.
- The latest version of android is called Tiramisu (Android 13) released on August 15, 2022.