Disk Scheduling Strategies

The strategies are evaluated by the following criteria:
- Throughput: The number of requests serviced per unit time. The maximum number is the better.
- Mean response time: The average time spent waiting for a request to be serviced. The minimum time is the better.
- Variance of response time: The difference between the request waiting time andthe mean response time. The minimum variance is the better.

Here, it is necessary to check the possibility of a request indefinite postponement.

There are many strategies & we shall discuss some of them as follows:

1 First Come First Served (FCFS) Disk Scheduling

This has been already discussed & it suffers from long seek time & hence low throughput especially under heavy loads.

2 Shortest Seek Time First (SSTF)

In this strategy, the next request to be serviced is the one that is closest to the R/W head & thus incurs the shortest seek time.
The main problem is the possibility of indefinite postponement for the innermost & outermost tracks especially under heavy loads i.e. many requests are coming all the time.

3 Scan Disk Scheduling

Here, the disk head moves from the outer track to the inner & then in the opposite direction. The request to be serviced is the one that its track is ahead of the head in the motion direction.
This means that the requests coming in front of the head in the motion direction are serviced first.
The scheduling may suffer indefinite postponement or long waits for requests of innermost and outermost tracks under heavy load.

4 C-Scan Disk Scheduling

C-Scan mean circular scan & it is similar to SCAN but the head doesn't service requests when moving in the opposite direction i.e. it service requests in only one direction & hence decrease the possibility of indefinite postponement of outerside tracks.

5 Other scheduling strategies

There are also other strategies such as:

- Fscan
- N-Step Scan
- Look Scan
- C-Look Scan
- Shortest Latency Time First (SLTF)
- Shortest Positioning Time First (SPTF)
- Shortest Access Time First (SATF)

Caching & Buffering

Many systems maintain a "disk cache buffer", which is a region of main memory that the OS reserves for disk data. In one context, the reserved memory acts as cache, allowing processes quick access to data that would otherwise need to be fetched from disk. The reserved memory also acts as a buffer, allowing the OS to delay writing modified data until the disk experiences a light load or until the disk head is in a favorable position to improve I/O performance.

The disk cache buffer presents several challenges to OS designers such as:

- Size of cache buffer
- Replacement strategy
- Inconsistency of data when power or system fail.

Many of today's hard disk drives maintain an independent high-speed buffer cache (on board cache) of several megabytes it's not related to main memory i.e. not part of it (i.e. can't be addressed by CPU directly).
Also, some hard disk controllers (e.g. SCSI, RAID) maintain their own buffer cache (normal RAM) separate from main memory.

ALL buffers are used to enhance the disk performance i.e. increase the speed of data retrieval.

Redundant Arrays of Independent Disks (RAID)

Previously, we have been discussing non RAID disks that have the following features:

- The disk includes several platters. Each platter has two R/W heads. ALL the heads are mounted on one actuator & hence move together.

- Usually, the OS determines the location of data on which surface of which platter & instructs the proper head to R/W.

- At any one time, only one head is used for reading or writing i.e. it is not possible to make multiple accesses with several heads.

In other words, the disk has multiple heads but only one of them is used at any one time.

- The file is usually stored on one surface of one platter only unless it is very large.
- The only objective of this disk structure is to get large storage volume.

In the RAID structure, the philosophy is completely different from the nonRAID as it has the following features:

- The disk includes several platters & heads as before but each head here has its own actuator and hence can move independently of the other heads. This will enable multiple reads & writes to be carried out at the same time & hence faster disk response.

- The file may be stored on one platter or on several ones & hence it is possible to read/write several parts of the same file at the same time & this means fast R/W.

- Reliability issue is handled here and hence we find out that an error correcting code (ECC) is being used & hence more storage is needed and this is reason for the term "Redundancy". The redundancy will help in correcting errors & hence the RAID system will be "fault tolerant" in this case.

From the above, we conclude that the RAID structure is equivalent to the use of multiple "Independent" disks & therefore we are going to use the word "disk" instead of platter when describing the RAID technology (RAID structure).

There are several methods for using the disks in the RAID system & these methods are identified by the following names: level0, level1, level2, etc.
We are going to discuss some of these levels in a brief way as showing later.
In RAID systems we use the following terms:
- Data Striping: entail dividing data into fixed size blocks called "strips".
Contiguous strips of a file are typically placed on separate disks so that request for file data can be serviced using multiple disks at once, which improves access times.
- Stripe: consists of the set of strips at the same location on each disk of the array.
- Fine grained strips: small size strips & this tend to spread file data across several disks & hence reduce access time.
- Coarse grained strips: large size strips & this enable some files, to fit entirely on one strip & hence the access time is as in the Non-RAID system, for that file, however, several requests for several files can be serviced together (Simultaneously).
Notes: The RAID systems (levels) take into consideration the following factors: Access time (Multiple access for one file), fault tolerance, Multiple accesses (for several files on several disks)

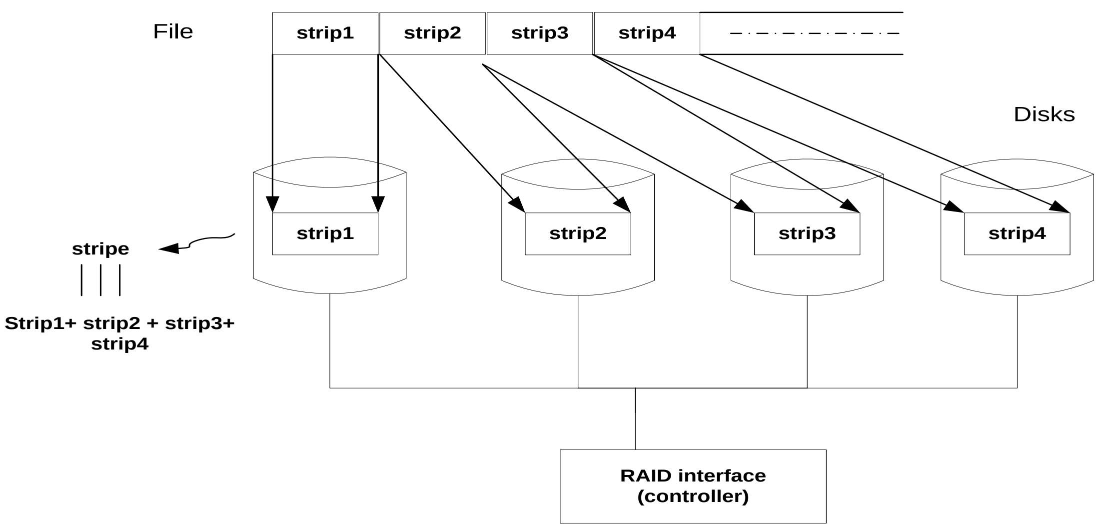

Fig Strips & stripe in RAID systems