TEMPLATE FOR DEFINITIONAL ENTRY

Disk

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SYNONYMS

Hard disk, Magnetic disk, Disk Drive

DEFINITION

In disk storage, data is recorded on planar, round and rotating surfaces (disks, discs, or platters). A disk drive is a peripheral device of a computer system, connected by some communication medium to a disk controller. The disk controller is a chip, typically connected to the CPU of the computer by the internal communication bus. Main implementations are hard disks, floppy disks and optical discs, of which the first is the usual interpretation.
Recently, Solid State Disks have been introduced; though the term 'disc' is a misnomer for these devices, as internally they consist of NAND Flash memory chips. Similarly, the term RAM Disk is used for a storage device consisting of volatile DRAM memory. Both offer the same data storage abstraction as a hard disk at the operating system level, though their price, size, performance and persistence characteristics are very different from a hard disk.

MAIN TEXT

The history of the hard disk started at IBM in San Jose, California, when Rey Johnson created a rotating drum that was coated in a magnetically polarizable film that could be used to store data by changing and sensing magnetic polarization.
Hard disks nowadays consist of a number of **platters** connected by a single axis, spinning at a fixed number of **rotations per minute** (rpm). Data is on a platter organized by **track** (distance from the center) and **sector** (angular region on a track). The disk **head**, one for each platter, mounted on a disk **arm** that moves in and out, therefore cover more distance per unit of time on an outer track than on an inner track. To read or write data, the head must be moved to the correct position above the track (**seek time**), and then wait until the region of interest spins past it (**rotational delay**). Therefore, the average random access latency of hard disks is seek time plus rotational delay divided by two. The **bandwidth** of a disk, is determined by both communication infrastructure with the controller as well as rotation speed and **data density**, which determine the amount of bits that pass the head per second. Data density is closely related to **disk capacity** and has increased enormously, surpassing the historical development of any other performance factor in computer architecture (i.e. orders of magnitude faster than latency and quite a bit faster than CPU MHz as well as disk bandwidth). The historical development of disk performance parameters is shown in the below table. For comparison, the last columns shows characteristics of a solid state drive.

The consequence of these developments is that relatively speaking, disk latency currently is much slower with respect to all other performance factors than it was a few decades ago, which means that fast and scalable algorithms involving I/O must focus more on sequential bulk

access than fine-grained random access. Managing and optimizing I/O access is one of the primary tasks of a database system. In order to counter the trend of expensive random disk access latency, modern database systems (should) make use of asynchronous I/O to amortize disk arm movemements over multiple requests, multi-disk or RAID systems to increase the I/O operation throughput, larger page sizes, as well as compression, clustered indices and efficient cooperative scan techniques to profit more from efficient sequential I/O.

RPM	3600	5400	7200	10000	15000	Solid state
Disk model	**CDC wrenl 94145-3**	**Seagate ST41600**	**Seagate ST15150**	**Seagate ST39102**	**Seagate ST373453**	**Samsung MCBOE**
Year	**1983**	**1990**	**1994**	**1998**	**2003**	**2008**
Capacity (GB)	**0.03**	**1.4**	**4.3**	**9.1**	**73.4**	**32**
Seq. bandwidth (MB/s)	**0.6**	**4**	**9**	**24**	**86**	**80**
Read Latency (ms)	**48.3**	**17.1**	**12.7**	**8.8**	**5.7**	**0.3**
Write Latency (ms)						**40**

CROSS REFERENCES
CPU
RAID
Primary Storage (RAM)
Tertiary Storage (tape)
Non-volatile memory (Flash)