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STORAGE DEVICES SURVEY

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Abstract* — *paper provides information about storage devices used from past to now. All devices used are explained brief in following section. Multimedia storage systems store and retrieve data from storage devices and manage related issues including data placement, file management, scheduling, continuous data delivery, memory buffering, and perfecting.

Keywords- Platter, Storage, Clustering, Storage Devices,

INTRODUCTION

Compared with earlier media, such as clay tablets and wood strips, paper dramatically facilitated reading and writing and improved information density. Due to these beneficial properties, paper is the standard storage media for most societies today. Following are the storage devices. Earliest computers used paper for their information storage. After the pulp papermaking process was invented by Cai Lun, a Chinese official, around A.D. 100, paper became widely used all around the world.

I. STORAGE DEVICES

2.1 MAGNETIC TAPE

The magnetic tape that is common today was invented by the German Fritz Pfleumer in 1928. His original tape was made from ferric-oxide-powder-coated paper designed for sound recording. Based on his idea, AEG, a German electric equipment company, began a business selling the magnetophon, the first magnetic tape recorder for sound recording. Early tape was poor in quality but this was eventually improved by the efforts of many but in particular by the use of acetate plastic tape by BASF, a German chemical company, and the invention of alternate current biasing. Along with phonograph records, magnetic tape was the most popular media for sound recording until they yielded to optical media such as CD not too long ago. All early magnetic tape products placed recording tracks in parallel to the edge of the tape. This technology called linear scan had one problem. It limited recording density and transfer bandwidth but it is still deployed today. In the 1950s, different countries developed yet another technology called helical scan today , which placed recording tracks diagonally at a range to the edge of the tape. Dramatically improving recording density, helical scan technology opened the way to using magnetic tape for video recording and is still widely used today. Magnetic tape technologies have evolved conservatively. In contrast, magnetic disks have achieved dramatic areal density improvements resulting in the reduction of cost per capacity. Magnetic tape’s cost effectiveness is relatively small today. Many vendors have proposed virtual tape libraries (VTLs) (physically made of disk arrays but logically working as tape libraries) and disk-to-disk (D2D) systems (utilizing disk arrays directly for tertiary storage).

2.2 MAGNETIC DISKS / DISK ARRAYS

Magnetic disks, the primary component in modern storage systems, began with the IBM 350 Disk File[3] developed by the IBM team led by Reynold B. Johnson. The IBM 350[3] was incorporated in the IBM 305 RAMAC computer released by IBM in 1956. Its new storage media was composed of 50 24-in-across metal platters coated with magnetic material and two head access arms. The platters could spin at 1200 r/min driven by a spindle motor. The access arms could be dynamically controlled by a servo motor so that the head could move to any desired position and record information by magnetizing the magnetic coating on the platter. Likewise the head could read the recorded magnetic impression. Each side of the platters had 100 recording tracks. The disk could store five million 6-b characters, effectively 3.75 MB of information, and had a transfer rate of 8800 characters per second when disk tracks were accessed sequentially. Random access produced the long latency of around one second to actuate the arm.

2.3 OPTICAL/MAGNETO-OPTICAL STORAGE MEDIA

Optical disks and magneto-optical disks are storage media that can record information by changing photo-physical forms on their recording surfaces and read the recorded information by emitting light beams against the surface and sensing their reflection. Their origin can be traced back to the video recording method invented by David Paul Gregg [4], but their practical use began with the first Laser Disc (LD), announced in 1980. Optical and magnetooptical disks later became very popular media for recording audio and visual content. A number of commercial products have been announced, but they can be roughly categorized into four groups in terms of their recording methods. The first category is read-only optical disks, on which manufacturers provide very small holes, called bits, on a recording surface for recording information when pressing media. Major products are CD and its succeeding media DVD and Blu-ray Disc (BD). The second category is write-once-read-many (WORM) optical disks, on which a disk drive can record information only once by emitting a laser beam to irreversibly burn pigments on a metal recording surface. Major products are CD-R, DVD-R, and BD-R. The third category is rewritable optical disks, on which a disk drive can record multiple times by emitting a laser beam to change the crystal forms of an amorphous recording surface. CD-RW, DVD-RW/RAM, and BD-RE belong in this category. The last category is rewritable magneto-optical disks, on which a disk drive instead emits a laser beam and magnetic field to change optical properties on a recording face.

2.4 STORAGE CLASS MEMORY

Nonmechanical storage media, such as flash memory, are currently deployed for secondary storage in computer systems. Those storage media have recently been named storage class memory (SCM). But the use of such storage media is not limited to recent systems. Vacuumtube computers of the 1950s allowed external memory units made of nonvolatile magnetic core memory to be attached. Some later systems also used magnetic bubble memory and battery backed-up memory. However, the use of storage class memory only became popular for secondary storage after flash memory, invented by Toshiba engineer Fujio Masuoka in the 1980s, became widely commercialized. Flash memory is a sort of electrically erasable programmable read-only memory (EEPROM)[5]. The memory controller can program/erase information by putting/removing an electron to/from a solid-state cell made of a floating gate and read information by measuring voltage of the floating gate. To manipulate an electron to the floating gate requires tunnel electron transfer called Fowler–Nordheim effect; as more electron manipulations are conducted, an oxide layer on the floating gate eventually degrades. Product lifetime is limited by this phenomenon. Two design options for connecting multiple floating gates, nor and nand, are known; out of these the nand design is commonly used because it easily improves integration density. Information can be programmed and read in a unit of page (often several kilobytes long).

A page once written cannot be programmed again and has to be erased in advance. Erasing is usually allowed in a unit of blocks (often hundreds of kilobytes long) thus consuming relatively longer time than programming and reading. Early products deployed only a single-level cell (SLC) design, which could record only a bit in each cell. Later improvement enabled a multiple-level cell (MLC) design, which could record more than a bit in each cell. SLC memory is often deployed in systems requiring high performance and high reliability, whereas MLC is usually found in systems requiring large capacity. In contrast to magnetic disks that take latencies of several milliseconds even in high-end products, flash memory has dramatically reduced latencies between tens to hundreds of microseconds and holds much better balances between power consumption and access throughput. Early flash memory products found their way into consumer electronics like compact flash and SD cards.

From the 2000s, large-capacity products became available in the market and they came to be used as secondary storage in computer systems, even though flash memory is far behind magnetic disks in terms of per-capacity cost. In many cases, flash memory is used in solid-state drives (SSDs), where flash memory chips and a controlling circuit are packed. The controlling circuit has the emulating capability of making attached flash memory work like a magnetic disk. This emulation enables computer systems to use SSDs via existing interfaces such as SATA and has led to SSDs popularity. Early SSD products had limited controlling capabilities, but some recent products have sophisticated functions such as wear leveling to extend product life by balancing programming times over cells and deferred write scheduling to absorb long erasing latencies by using large buffer memory. In other uses, existing interconnects were designed to connect magnetic disks but not always optimized for flash memory. The market is witnessing new types of flash memory products like so-called PCI Express SSDs that can be connected via PCI Express to provide much smaller access latency and external flash memory arrays made of a number of flash memory chips and strong controlling circuits.

II. CLUSTERING

For tertiary storage systems in which the device's positioning time is high, clustering is important. The main goal is to minimize the number of search and media load operations and reduce the access time of clusters read from the tertiary storage system when subsets are needed. Clustering exploits the spatial neighborhood of tiles in data sets. Clustering tiles according to spatial neighborhoods on one disk or tertiary storage system proceeds one step further in preserving spatial proximity. This is important for the typical access patterns of array data because users often request data using range queries, for which the spatial-neighborhood concept is suitable. The importance of clustering through a worst-case scenario: storing data sets on tertiary storage media without managing clustering. In this scenario, super tiles are randomly distributed on magnetic tapes, and tiles are randomly combined with super tiles. Now let's say that one user requests data using a range query with a result containing 23 tiles. Without clustering, all the tiles could be included in different super tiles. So, 23 super tiles would have to be loaded from magnetic tape. Thus, many seek, rewind, and load operations would have to occur because the super tiles are scattered on the tape. With clustering (which exploits the spatial-neighborhood concept) all tiles are included in one or two contiguous super tiles on the magnetic tape. So, loading is considerably faster. Consequently, the access time for these two cases varies significantly.

III. CONCLUSION

Magnetic tape's cost effectiveness is relatively small today. The magnetic tape is common today. Optical disks and magneto-optical disks are storage media that can record information by changing photo-physical forms on their recording surfaces and read the recorded information by emitting light beams against the surface and sensing their reflection, Nonmechanical storage media, such as flash memory, are currently deployed for secondary storage in computer systems. Those storage media have recently been named storage class memory.

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