Digital Storage

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Punched paper cards, cinema film, and magnetized metal wire have all been used to store digital information in the past. None of these methods are popular today, but there are several forms of digital storage that one is still likely to use with a typical desktop or server computer. Here’s a rundown of the more common types:

.01 Hard drives (return to index)

Hard disks or hard drives are composed of rigid magnetized platters sitting inside a metal case, distinguishing them from the soft “floppy” disks that were formerly in common use. The hard disk has grown in capacity by stunning leaps and bounds in recent years. Prices per unit of storage have fallen as fast as absolute capacities have increased, so that today one may easily purchase hard drive storage at $1-$2 U.S. per gigabyte. This inexpensive storage represents the low end of hard drive performance, with disks that spin relatively slowly and physical interfaces that are not optimized for demanding use. Nevertheless, apart from video editing, heavy server work, and a few other niche tasks, inexpensive IDE drives offer perfectly adequate performance at prices that are hard to beat.
For tasks that need more performance than ordinary IDE drives can deliver, there are a couple of choices. The first is build a RAID system from multiple IDE drives. RAID stands for “Redundant Array of Inexpensive Disks,” and it can indeed use two or more inexpensive hard disks, yoked together through a RAID controller, to offer user-tuneable combinations of higher read performance, higher write performance, and improved disaster-recovery abilities. A RAID array can give you the disk bandwidth to edit uncompressed video without dropping frames or breaking the bank. It can also offer increased peace of mind to system administrators who need rock-solid data integrity. Decent RAID controllers can be had for under $100 U.S. and are even integrated with some motherboards. RAID does have its disadvantages, though. It still won’t improve system performance when it comes to reading and writing many files close together in time, as may happen on a heavily loaded server. Depending on the operating system and support software, RAID may also be more trouble to configure than an ordinary hard drive.

If performance is a must and money is a secondary concern, high-performance SCSI (Small Computer Systems Interface, often pronounced “scuzzy”) drives are the way to go. The best SCSI disks offer superior data transfer rates and seek times for truly demanding tasks, and tend to be more reliable as well. SCSI disks can also be bound into RAID arrays, for even higher performance and reliability. Unfortunately, this edge comes at a high price. Premium SCSI drives can cost several times as much as standard IDE units, gigabyte for gigabyte. Most motherboards do not have built-in SCSI controllers and will need controller cards installed at additional expense.

If portability strikes you as more attractive than raw power, there are a number of options available. Removable hard drives use a sliding caddy plus an ordinary IDE or SCSI hard drive to provide storage as fast and capacious as any internal drive, but the case must have a free bay to accept the drive. Firewire hard drives use an IEEE 1394 serial connection coupled with (usually) an ordinary IDE drive to offer unspectacular but reasonably performing storage. Firewire drives can be chained together and do not need space within your computer. They are especially well suited for Macintoshes or other computers that already have Firewire communication ports built in. USB-connected hard drives are perhaps the most convenient of all, since USB ports are ubiquitous on any PC manufactured in the last few years and no drive bay is required. But unless both the drive and the host machine support the relatively new USB 2.0 standard, you will be stuck with achingly data transfer rates. Finally, all of these portable devices cost somewhat more than plain internal hard drives with similar specifications.

.02 **CD-R and CD-RW** (return to index)

Recordable and re-writable CD storage are the least expensive storage currently available. If your computer is not already equipped with a CD-RW drive, they can be had for well under $50 U.S. CD-R and CD-RW drives sport a variety of interfaces, just like hard drives. There are fast internal SCSI drives, slow external USB drives, and everything in between. It’s possible to buy 650 MB CD-R disks in bulk for about $0.15 each, or CD-RW disks for $0.40. This works out to about $0.24/$0.63 per gigabyte of storage.
Because of their one-use nature, CD-R disks are best suited to long-term storage of information or the transfer of especially large files. They are so inexpensive that they are often used somewhat like disposable floppy disks, especially since a number of computers no longer have the once-universal 1.44 MB floppy drive. As hard drives have grown in capacity, CD media that seemed very spacious in previous years now feels cramped. It may take a stack of 60 or more CD-R disks to fully archive the contents of a large hard drive. Such backups are inexpensive, but tedious to produce and restore.

CD-RW disks are slightly more flexible than CD-R disks, since they can be erased and recorded upon many times instead of just once. But apart from the higher price, there are still limitations to the disks. They will not properly read on all CD-ROM drives, especially older ones. This is true of CD-R as well, but CD-R tends to be more compatible. Some CD-RW drives come with software to make CD-RW media behave like ordinary removable storage. Using this software can also make it more difficult for other computers to read the disks. In addition, no software is going to make a CD-RW drive perform as well as hardware that was designed for random access in the first place.

03 DVD-R, DVD-RW, DVD-RAM et al (return to index)

When recordable DVD media and drives first appeared there were many incompatible storage formats, expensive drives, and expensive media. Today, at least the prices have dropped. Recordable DVD drives of various sorts can be had for under $200 U.S. at the low end, and disks for under $1 each. The least expensive disks are actually more economical, per gigabyte, than CD-R and CD-RW media.

Don’t expect the same near-universal compatibility found with recordable CD media in the DVD world, though. If you want to use writeable DVD of some sort to transfer information between different systems, do your homework beforehand to find out if the target machine can read disks produced by the source and vice-versa. The compatibility situation has been steadily improving with time, but it is still easy to be taken by surprise, especially with lower-priced and older drives. Compatibility issues aren’t a problem when you are using the same drive to read and write, so recordable DVD is a convenient alternative to CD-R/CD-RW when it comes to backups. You can use just a handful of disks instead of dozens and still archive your entire hard drive.

04 Removable storage: Zip drives (return to index)

The term “removable storage” covers a staggering variety of devices produced over the past 15 years. Most of them never saw widespread acceptance, at least in the U.S. The still-popular Zip drive and now-discontinued Jaz drive (much like a high-capacity Zip drive) are two of the more prominent members of this class. Millions of computers today sport Zip drives, which support 100, 250, or 750 megabyte removable disks that work much like floppy disks. The Zip disk has been a convenient de facto replacement for the floppy disk. Zip disks are good for holding many small files or a few larger ones, and for shuttling documents, images, programs, and sounds.
between computers. Their relatively high price and low storage capacity make them ill-suited for backup duties, although they have been used for backup in the past, when hard drives were much smaller. Reading and writing small files (and even large files, depending on the drive model) is relatively fast, and there are no special software or compatibility issues to worry about.

.05 **Tape drives** (return to index)

Tape drives were once the most common archival devices. They are still popular today for servers and other machines that need to regularly back up large quantities of data. Unfortunately for the ordinary PC user, tape drives and tape media are somewhat expensive or very expensive. You would be hard-pressed to find a 20 GB per tape (uncompressed) drive for less than $300 U.S. Tapes for the drive run about $2 per GB unless you find a bargain or buy in bulk. Fast, high-capacity tape units may cost thousands of dollars each. On the upside, tape units can produce archives that span just one or two tapes instead of a handful of DVDs or a heap of CDs. Tapes can be rewritten many times and have decades of proven use as backup and archival media, unlike CD-R or recordable DVDs. If you want the reliability and convenience of tape archival, you may want to visit auction sites instead of just computer retailers. Be aware, though, that many older tape drives had low storage capacities and will offer few convenience advantages over recordable optical media.

.06 **Solid state storage: USB pen drives** (return to index)

In recent years there have appeared various low-capacity drives based on solid state storage (like flash RAM) that sport USB interfaces. These drives are totally unsuited for large file archives, but they offer some unique benefits. They do not need external power supplies or cables, they can connect to any machine with a USB port, they have no moving parts and are resistant to mechanical shock, and they are totally silent. They are also more expensive, per megabyte, than any other storage medium. But they do offer reasonable capacities on each drive. These compact drives are well-suited to carrying around personal documents that always need to be accessible or that you would not be comfortable placing on a potentially vulnerable desktop machine.

.07 **Floppy drives** (return to index)

The glory days of the humble floppy disk are long gone. Software no longer arrives on one, two, or twenty of the plastic squares. Floppy disks can barely hold one medium-size image, let alone an entire MP3 collection. But thanks to the allure of backward compatibility and the need for a simple emergency boot medium, millions of recent PCs come equipped with 1.44 megabyte floppy drives. The story in the Macintosh world is different. Apple hasn’t included floppy drives in its computers for some time now. Since Macintoshes have been able to boot from CD-ROM for a decade, there has been no need to retain the vestigial organ. Eventually all PC makers will follow suit, and the corpse of the floppy will finally stop twitching.
Floppy drives and disks are error-prone, low-capacity, and not very economical. The quest for backward compatibility has prolonged the floppy long beyond its natural lifespan, but anyone with important information on floppy disks should be transferring the data to new media. It is possible to buy external USB floppy drives if you don’t currently have access to a floppy drive. Once transferred onto a desktop machine, floppies’ contents can be whisked across a LAN or archived on CD-R, Zip disk, or any of the other storage media already discussed. But if you have an older PC or PC peripherals, saving the disk contents may not be enough. Some driver installation and firmware revision procedures still require the machine to be booted into DOS from a floppy disk.

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