

What Can You Do With a Terabyte?

Consumers Will Have No Problem Finding Uses for Storage



The hard-disk drive is one of the unsung heroes of the personal-computer revolution. Although disks get relatively little attention, their progress has been truly remarkable. For every PC microprocessor, at least one hard disk is sold—and each disk is an assembly of dozens of components, including a mechanical system with extraordinarily tight tolerances.

Even more amazing is that this electromechanical contraption has matched semiconductor devices in density improvement. Until a few years ago, running out of disk space was a common occurrence for ordinary PC users. Now, multimedia files gobble up space at an astounding rate, and program suites of 100M or larger are routine—but the growth in capacity still has outpaced the needs of most users.

Today, the very cheapest disk drives (which cost about \$90 in high volume) have a 2.1G capacity; 4G drives are commonplace, and 10G disks cost less than \$300. By 2001, 10G disks will be the entry level.

What happens beyond this point is less clear, since fundamental physical limits for conventional magnetic recording will be reached, perhaps as early as 2001 and almost surely by 2003. According to disk industry analyst Jim Porter of Disk/Trend, however, a hybrid optical/magnetic approach shows great promise of enabling the industry to stay on its historical curve of 60% per year density increases for some time to come. If this approach pans out, disks with 100G could reach mainstream PCs around 2005, and terabyte disks should be available around 2010.

As everyone in the PC and microprocessor industries has noticed, it isn't obvious how to deliver value from the continuing boosts in processor performance. Using up larger amounts of storage, however, is going to be a piece of cake. As with CPU power, consumers will be the biggest driver.

Today, storing everything a person can write in his or her entire life—even for a prolific writer—doesn't begin to tax a single hard disk. At 10,000 words a week, a prolific writer would create 35 million words in 70 years. Even if every character takes 100 bytes for overhead, this worst-case estimate comes to only 3.5G.

As we start using disk drives as photo libraries, the requirements increase dramatically. Assuming a generous 2-Mpixel image with 24 bits/pixel, each photo takes 6M bytes. With compression, however, the size can be reduced to about 1M with no visible loss in quality. So today's 4G disk drive will hold about 4,000 photographs. Averaging

10 pictures a day, it would take about a year to fill the disk. The 100G disk that we'll all have in 2005, however, will hold 100,000 photographs—far more than anyone but the most avid photographer will take, or even collect, in a lifetime.

Photo libraries on disk are thus already practical for many people and will fill almost everyone's needs within a few years. So let's move on to audio. A music CD holds 550M. With compression, music can be encoded with comparable or higher quality in less than 2M/minute—under 100M for a typical CD. At this rate, today's 4G drive holds 40 CDs; a 100G drive will hold 1,000 CDs; and a 1-terabyte drive will hold 10,000. So it will be only a few years after large photo collections fit on one disk that even very large music libraries will also fit.

But of course there is always video. Uncompressed NTSC video consumes about 25M/second, but good compressed video can be encoded in 1M/second. This rate works out to 3.6G/hour, filling up today's 4G disk with a single movie—and a short one at that. HDTV will cut this down to a short subject.

Move up to a 100G drive, however, and you can now store 28 hours of video, or about 15 movies. With a terabyte, you will be able to store 280 hours—plenty to cover all the videos of several kids, dozens of vacations, and a hundred movies. Serious movie collectors will want tens of terabytes of storage, but they'll be in the distinct minority!

Of course, each disk drive must be shared among many uses. That 1-terabyte disk drive might need a few gigabytes for Windows 09 and another ten gigabytes or so for Office, but this won't make much of a dent. And few people will have large photo, music, and video collections.

Having all this storage won't matter much if it isn't a lot more convenient than it is today to get pictures, music, video, and so forth into the computer—and to find them again when you want them. Everyday consumers aren't going to use PCs to do this; specialized information appliances for photos, music, and video are much more likely to achieve widespread success. The disk drive is likely to be separate from the user-interface devices; it may live in a small storage server—another kind of information appliance. Although it will be possible to depend on Internet-based storage, most homes will have their own disk in one device or another. Offering fast access to billions, eventually trillions, of bytes for less than \$100, hard disks offer tremendous value, making it compelling to include them wherever they are useful. ■

See www.MDRonline.com/slater/terabyte for more on this subject. I welcome your feedback at m Slater@mdr.zd.com.