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Back To The Days Of (Relative) Storage Scarcity!

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It's easy to take disk space for granted. These days commodity storage is capacious and inexpensive, and it gets more-so every day -- its rate of growth even outpaces the vaunted Moore's Law! Given disk drives' dramatically accelerating rate of price/performance improvement, it's no surprise that they have generated an entirely new class of product that is dramatically changing our established, decades-old television entertainment model. And as such, this is an interesting example of how extremely rapid technological improvements will continue to change all the rules!

Who Needs More Disk Space?

If you remember 5 MEGabyte commercial disk drives (which were magic in the early 80s!), you surely marvel at today's common 160,000 MEGabyte (160 GIGabyte) commodity drives, not to mention the high-end 250 gigabyte models. But even these massive drives can now seem pretty small, considering that 400 gigabyte drives have been on the market since March.

For example, according to [Hatachi](#), their currently-available "Deskstar 7K400" packs almost half a terabyte of capacity with respectable performance for about \$400.

But now even THAT'S small!

Just weeks later, [LaCie](#) announced a 1-TERabyte (1,000 GIGabytes) external disk drive for \$1,199!

Incredible. Yet aside from large businesses or governments, who *needs* such storage behemoths?

The Days Of (Relative) Storage Scarcity.

During the '80s and early '90s it was the computer industry that drove storage developments. The all-too-often-true "joke" was that each time Microsoft came out with a new operating system or version of Office, it was necessary to upgrade the disk storage to accommodate it. For the past several years though, that's become a non-issue as disk drives' ever-greater capacities have finally outstripped the size of new applications.

Now though, it increasingly appears that it will be the consumer electronics industry that drives our ever-larger storage need.

This shouldn't surprise us, since over the past 30 years or so we've been living the first "Convergence" -- the coming together of Computing, Communications, Content, and Consumer Electronics which, in many ways, is now subsuming the computing industry.

As an example of this "convergence," consider how one single development -- the advent of Personal Video Recorders (PVRs) and *not* PCs, will return us to The Days Of (Relative) Storage Scarcity.

Taking Personal Control.

Exemplified by [TiVo](#), these hard-disk based entertainment-revolutionizing devices allow us to pause live TV and to easily time-shift shows to our schedule. But -- they never seem to have enough storage. The latest TiVo Series2 PVR will record 40 hours of standard TV programming (at the highest quality setting). Yet, for those who have come to rely on their PVR to put them firmly in control of their TV watching, 40 hours isn't nearly enough. This had led to the availability of "[mods](#)," both in do-it-yourself and in kit forms, that allow users to add ever-larger disk drives to boost their PVR capacity.

Surely, then, if we could add a terabyte disk drive to our PVR so that we could record around 800 hours of highest-quality standard TV, that would surely satisfy even the hungriest PVR user. Right? (Note though that current PVR software can't make use of such huge disk drives -- yet.)

Wrong!

The rub is that technology marches on, in this case in the guise of HDTV, where even a one-terabyte monster disk drive will store only 120 hours of HDTV's 6.6-times more data-intensive programming. (Capacities are extrapolated from the specs for the 250-gigabyte DirecTV "HR10-250" HDTV PVR - http://www.weaknees.com/hd_tivo.php)

Since contemporary history teaches us that that many users won't consider this nearly enough PVR storage, terabyte HDTV PVRs may feel like "entry level" devices when they hit the mainstream. And that guarantees a continuously-growing demand for ever more-serious consumer storage, for this one application alone.

We've Only Just Begun...

Indeed, I suggest that this is a pattern that will continue, over and over (and not just for storage!) Technology will get to a point where we "just don't need any more" (does CPU performance come to mind?) Then someone, somewhere, will develop another watershed application that, like HDTV and PVRs, makes everything before it obsolete.

I don't have a PVR yet (I'm waiting for one that will do HDTV, through two tuners, from my digital cable system--I can't see low-enough to the horizon, in the right direction, for the DirecTV HDTV service). But I'm going to go out on a limb here and project that in ten years, PVR recording will become as standard, and as built-in, as stereo sound. And because HDTV is SO good (it really is, if you haven't tried it), the demand for ever-larger storage for this application isn't going to abate.

Storage demands will also be accelerated as other developments make it feasible, and eventually desirable, for us to make 24x7 recordings of everything that transpires around us, complementing the records that are already kept by the myriad surveillance cameras that increasingly litter our environment. (Over time, the gear to accomplish this will get rather smaller and more stylish than a prototype shown at Ananova).

Won't *that* alter the social and legal fabric of our societies! And even if the idea of recording every glance, meeting, and interaction is repugnant to you, once your competitors/customers/neighbors/etc. begin doing this, you may feel you have no choice but to do so in "information self-defense."

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Returning to the PVR issue, let's see - a seemingly reasonable 480 hours of HDTV recording would demand a four-terabyte disk drive. Yet such capacities aren't sci fi at all -- [Seagate](#) believes that its Heat Assisted Magnetic Recording (HAMR) technique may increase storage density to 1 terabyte per 3.5-inch platter by 2010. And since four platters within a disk drive are already commonplace...

Will something eventually stop the ever-higher density and increasing access and data transfer speeds of storage?

For many years scientists believed that there was a minimum *size* to the magnetic "domains" on a disk drive that could hold and read back a one or zero -- it's called the "paramagnetic limit." Yet every time that our disk drives approached that "limit," innovative scientists came out with successive ways to push that "limit" smaller, and the process is still continuing today through techniques such as HAMR that we discussed above.

But "limits" move both ways. Now looking at the *speed* at which magnetic domains can be switched from a one to a zero, scientists at the [Stanford Linear Accelerator Center](#) have just *lowered* their expectation of a "speed limit" on how fast data can be written to magnetic media -- they now feel that it's about 1,000 times slower (less than 2-picoseconds, or 2 one-trillionths (10- 12) of a second), compared to the one-femtosecond, or one-quadrillionth (10- 15) of a second that had previously been anticipated.

So does this new "limit" (still *far* in our disk drives' future) really cap storage performance? As has been proven time and time again, I suspect that creative innovation may well find ways through or around this new "limit" as we approach it -- assuming that we haven't completely replaced our cumbersome and fragile disk drives with incredibly dense arrays of nano-memory cells, or similar technologies that are being researched and prototyped today.

Massive Technological Improvements Are Disruptive -- Always!

The sea-change here is that it's not the traditional "computing" industry that will now drive our storage needs, but it will be our TVs and other entertainment applications -- the Consumer Electronics industry -- that will eventually make our computers, and all the parts and subsystems that go into them, "disappear" into the common devices around us!

Which is a good lesson, and good food for thought, as we move further into the 21st century.

Is your business and industry ready for similar changes?

Don't Blink!

This essay is original and was specifically prepared for publication at Future Brief. A brief biography of Jeff Harrow can be found at our main [Commentary](#) page. Other essays written by Jeff Harrow can be found at his [web site](#). Jeff receives e-mail at jeff@theharrowgroup.com.