



## Hey, Buddy! Wanna Buy Some Storage?

### A Storage Revolution is imminent in the consumer sector

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By Drew Lanza, Partner, [Morganthaler Ventures](#) , August 23, 2007, 12:21 PM

You all remember floppy disks, right? They were the backbone of the first computer network -- the *sneakernet*. You could take your data with you. After floppies came hard drives, CDs, DVDs, and USB keys. When we put these in motion, we got Netflix and digital cameras. And when we connected them to the network, we got TiVo and iPods.

Pretty soon, in a year or so, you'll be able to turn your iPod into an audio "TiVo" for HD radio that will give you access to publicly available songs whenever you want them. A little later, you'll buy new products that capture and store ubiquitous wireless and Internet-based audio and video.

With each innovation you adopt, you and much of the world will, almost unawares, find yourself accelerating faster and faster down a very steep Storage Slope -- much steeper than the Bandwidth Slope, much steeper than the Processing Slope (also known as Moore's Law), and ultimately much more powerful than either of them.

Where will it all end? I think it will end in a dark alley. That's right, a dark, albeit figurative, alley. There, someone is going to creep out of the shadows and say, "Psst. Do you want to buy all the jazz music ever recorded? One hundred bucks and it's yours." And you'll hand over the cash (or its electronic equivalent) and take back 10 terabytes worth of music -- enough for four hours of listening with no repetition *every day for the rest of your life*.

With that single act, no more than a few years in the future, copyright law will disintegrate -- and with it the last impediment to unlimited, virtually free storage. All of Sinatra in a thumbnail-sized box for \$10? Why not? Even the most ethical of us will succumb. Hollywood's business model will crumble. Another communications monolith will be left wondering what hit it.

I'm not advocating it. I'm just making a simple observation about basic human nature. (For a different take, see [my partner Greg Blonder's column](#).)

Many of us have had trouble seeing the Storage Revolution coming. Twenty years ago, when I was at Raynet selling fiber-to-the-home gear to phone companies, the killer application that the big telcos were going to dominate was Video on Demand. Blockbuster killed that. Then the theme became broader selection (re: "The Long Tail") that was, once again, going to stimulate Video on Demand. Netflix killed that. Then it was going to be time-shifted Situation Comedies on Demand. TiVo killed that. None of these innovations embodied any great leap in technology. Instead they represented simple, cheap alternatives from entrepreneurs who used inexpensive storage to undercut the collective bandwidth and processing assumptions of some of the world's largest corporations and most experienced VCs.

Storage advances march to a staccato beat. And that steady thud -- e.g., improvements in flash or rotating memory -- keeps finding one more way to outstrip its competitors.

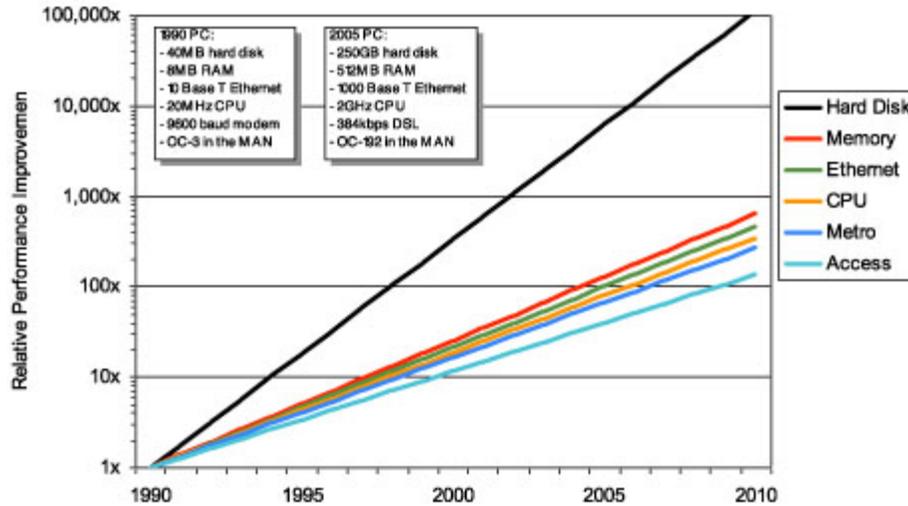
Additional bandwidth? It can never arrive faster than we can put up new cell towers, dig up the petunias, or install new boxes on the garage wall. And that's not very fast. It takes time to dig a trench, erect a tower, or send a guy out to screw some electronics to a wall (not to mention the labor costs involved in all of these).

Additional processing power? It can never arrive faster than it takes to develop the software (think Microsoft Vista) to make it usable. Besides, ten years ago we could already make MP3 chips powerful enough to play audio, so who cares about more processing power?

But additional storage? Virtually nothing stands in its way. With the introduction of 1-Tbyte perpendicular storage this spring by both Hitachi and Seagate, the path has opened to 1-Pbyte disks in just a few years.

And while demands go up, up, up, costs come down, down, down. The combination of low- and high-tech storage innovation and the volume production stimulated by the avalanche of new storage applications -- like the TiVo and the iPod -- have produced the steepest downward cost curve in all of electronics.

## Storage, Computing and Communications Horse Race



Nor will the cost-cutting stop. Radically new storage technologies on the horizon, to point out just one future vector, promise to supersede current flash memory capabilities by orders of magnitude.

It's clearly time to alter our collective view of the future. Many of us still focus too much on bigger pipes and faster computers. Yet [it's been clear for a few years](#) that we've reached a more-or-less permanent ceiling in transmission speed. And it's becoming clear that the conventional vision of a central server farm in the sky with a million channels to surf just isn't going to fly. And "slower and proven" in computer processing chips looks certain to supersede "faster, but more difficult-to make."

But what will replace outmoded visions of the future? A few educated guesses:

- Storage will outstrip our senses in the next decade; i.e., we'll be able to carry around more to view and listen to than we can humanly absorb in a lifetime.
- The old "pull" model of communication -- selecting a channel, reaching into a stack of magazines, etc. -- will diminish, while the "push" model expands. How can you pull from a storage device that contains millions of songs? "Push" means that we'll just subscribe to two or three "channels," which will customize content to our tastes. Others will recommend a sequence of songs or videos that we might like to watch from the millions on our portable storage. Can you say *playlist*? Me, I'm going for the 1960s jazz channel coupled with a side helping of Monty Python meets the Marx Brothers. Or do you want to focus on Christian prayer and professional football?
- Storage will be increasingly machine to machine, even though you will probably be able to program it to accept recommendations from a select group of friends who know, say, that you like a certain type of music.
- The communications network (think DSL or cable modem) won't be very fast, but it won't need to be, since it will be chugging along 24 hours a day dripping stuff into your storage "tub." Even at the slowest DSL and cable modem speeds, today's TiVo could add a high-definition DVD movie, a couple of hours of TV, and many hours of music in a 24-hour period. Day in and day out. Just how much can you watch or listen to after you get home from a hard day at work?
- As individuals, we'll save more and more of our pasts. I already use my computer more for storage than for processing; all my emails for the last 20 years are indexed and searchable. Say, who was that guy I ran into at the reunion four years ago who emailed me saying to look him up the next time I was in Romania? It won't be long before our computers save not just the last 100 Internet Websites we've visited, but all of them. They will even offer an index function to jog our memories. If I read something interesting about Zimbabwe on a Website four years ago, I'll know where to look. And what about helmet cams that we might use to record everything from an important meeting to our every step 24 hours a day? You could store everything you've done for 15 years in a hard drive the size of a paperback book. As YouTube has demonstrated, the human capacity for infinite narcissism can never be underestimated.
- As a civilization, we'll become increasingly tribal. Even less than they do now, Southern gun enthusiasts won't see or read anything in common with lesbian liberals or immigrant farm workers. Where will we find common ground for compromise decisions that democracy requires?
- Entertainment business model? There's always been this see-saw tension between the artists and the promoters/programming directors. What happens when everyone becomes an artist (see YouTube) and we're searching for the programming director who

likes sixties jazz and Monty Python like I do? If Hollywood is to protect the legitimate rights of its artists long-term, it will have to totally rethink its business model.

- Net neutrality will govern the future Internet infrastructure. I don't care about the quality of service. And I don't need a faster pipe. Just hook some slow, clunky, corroded pipe up to my TiVo. I don't care if it gives me less than a megabit per second when the network is busy and a few megabits per second at four in the morning. My faithful TiVo can just chug away in the background storing it all for me to watch or listen to later. So, based solely on technology trends, at least, it looks like the net neutrality advocates stand to beat out the big carriers in that political battle.
- Trade relations with China and others will be affected. We've come to expect that developing countries will break copyright and patent laws early in their growth phase, but to eventually give into pressure, once they get more established and follow the example set by their more developed customers. Maybe, however, the Storage Revolution reverses that pattern for copyright, whether for music or software, and the rest of the world could start to follow the Chinese example instead. I wonder what Chairman Mao would have to say about all of this?

My take on it all? The future is not dictated by what the lawyers or the visionaries want. It's dictated by what the engineers produce.

And they have set their sights on a future of nearly infinite, cheap, portable storage. They'll hit that goal by 2020.

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