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Guest Opinion: Thinking big, fast and broad is what's needed to bust those technology dams

by Martin E. Hellman, Spectrum - Wednesday, July 16, 2008

In 1965, Gordon Moore of Intel postulated what is now known as Moore's Law: that the computing power of ICs doubles approximately every 18 months at no increase in cost.

I prefer an equivalent version of Moore's law that says computing costs decrease by a factor of 10 every five years.

Applying this law to the last 50 years — 10 periods of five years — we find that a computation that costs $1 today would have cost approximately $10 billion 50 years ago.

From a computational point of view, we are all billionaires.

This unprecedented, steady, rapid reduction in cost has produced major changes in the computing landscape. In the early stages of the computer revolution IBM automated accounting and other, previously manual systems, saving customers huge sums while making a fortune for its shareholders.

But IBM faced disaster when minicomputers replaced mainframes at cost savings comparable to what IBM had achieved over manual systems.

Only by reinventing itself as a services company did Big Blue manage to stay alive and prosper.

An analog of Moore's Law applies to communications. Fifty years ago the cost of a transcontinental phone call was on the order of $1 per minute, with approximately half the cost due to switching and half due to long-haul communications. Since switching can be accomplished by computational means (packet switching), the 50 cents worth of switching cost can be accomplished today at an infinitesimal cost, approximately a billionth of a cent per minute.

The cost of long-haul communications has also fallen by at least a factor of a thousand, and probably a million or more. As just one example, a current trans-Pacific fiber project has a capital cost of approximately $30 per voice circuit.

The net result is that all wired phone calls today should be a free add-on to broadband service. Instead of being pleased with the seeming bargain rate of 5 cents per minute that many now pay, that rate should be seen as highway robbery compared to pricing in a truly competitive environment.

Even using the conservative factor of a thousand for the reduction in communications cost, the free-market pricing should be on the order of .05 cents (not dollars) per minute. That's 20 minutes for a penny.

To contrast the computer and communications revolution, think of the steady, exponential decrease in the cost of computation as a mountain spring that feeds a river. Those of us living in the valley fed by this river have derived great wealth and other benefits from its strong, steady flow over the last 50 years.

The communications analog of Moore's Law is like another mountain spring, feeding another river emanating from the mountains on the other side of our valley. But numerous dams have stunted what should have been a strong, steady flow into an unsteady trickle, with occasional surges when a dam is breached. For a long time, the dams were the Federal Communications Commission and its foreign counterparts. In their bureaucratic thinking, any cost reductions in an inflationary era were mistakenly seen as excellent performance. The idea that costs could fall by 99 percent or more was probably never even considered.

But by 1995 the Internet had poked a hole in the bureaucratic dams and allowed a sudden surge in the "communications river." With the advent of the Internet, I could send large amounts of data anywhere in the world at no additional cost over my monthly charges from my Internet service provider (ISP).

Yet in spite of great advances by the Internet, the potential of the Communications Revolution has been largely unrealized.

Today, my cable-modem service is only several times as fast (and sometimes agonizingly slow) and approximately the same cost as when I started using it about 10 years ago. If Moore's Law were operative, it would be 100 times faster at no increase in cost.

The FCC's dam has been replaced by one constructed by my cable company, which cannot offer me low-cost, higher-speed service without cutting into its lucrative high-speed business market. While some of this blockage is due to short-sightedness some is also due to the fundamental nature of communications.

And some is due to the fundamental fact that the big guys on top at any given time would like to see Moore's Law repealed, at least as it applies to them.

When DEC introduced its VAX minicomputers in the 1970s, they packed the power of IBM mainframes at a fraction of the cost. Although IBM would have loved to stop customers from migrating to DEC to save money, it was powerless to do so.

Similarly, when SUN workstations arrived on the scene 10 years later with technology that was a generation ahead of the VAX, there was nothing DEC could do to prevent its customers from jumping ship, and DEC became a shadow of its former self.

The flow of the computational river could not be staunched by entrenched vendors wanting to protect their high-end business.

But when a faster cable modem comes out I can only use it if my cable company sets up a similar modem at its end. The same is true for faster DSL modems controlled by the phone companies. Competition between cable and phone companies does bring some pressure to bear, but this duopoly has not brought true competition.The result is that communications practice significantly lags what is possible from a technological point of view.

Unlike the steady, strong flow of the computational river, the communications stream will experience long droughts, while a store of water develops behind the dams of a few entrenched vendors. Then, when the potential cost reductions become so great they cannot be ignored, capital will flow into large ventures that breach the existing dams. But the sources of that dam-busting capital then erect new ones to protect their own revenue streams.

We may see innovation stifled for years, followed (as with the Internet Revolution) by a sudden reduction in costs by several orders of magnitude. Riding on this intermittent river plagued with flash floods will be much less fun, and more dangerous.

While I prefer free markets, in some cases government action is necessary to benefit the public good. Eliminating the "last-mile problem" fits that mold, for example by government-mandated, universal high-speed

communications, operating in a utility model (meaning net-neutral). Given the current situation in Washington, such action is more likely to occur at the state or local level.

I applaud Palo Alto's fiber-to-the-premises project as a good example of the far-sighted thinking needed at this time.

In planning for the last mile, it is important to look 10 to 20 years into the future. The greatest cost in changing communications over the last mile is usually digging the trenches. Since this happens only once every 20 years or so, and the communications analog of Moore's Law should produce speed increases on the order of 1,000 over such a time frame, the communications medium placed in the trench should ideally have a bandwidth that exceeds current needs by a similar factor.

Yet some cable-to-the-home systems are planning for approximately 20 megabits per second (Mbps). While very high by today's home-broadband standards, this will support only three high-definition-television channels, leaving no room for future technologies.

But if the fiber that is laid can support on the order of 20 Gbps (gigabits per second) without retrenching, then new hardware can be added as technology develops.

I know it is hard for the human mind to plan for changes by several orders of magnitude, but that's what it will take to realize the full potential of the communications revolution.

Martin E. Hellman is a professor emeritus of electrical engineering at Stanford University. He is co-inventor of public-key cryptography, the technology used to secure the Internet. He can be e-mailed at hellman@stanford.edu.

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