

Speed of Light, Span of Life

By Russell Redenbaugh

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Once again we are indebted to George Gilder for poetically showing us a new world. In this case it is the world of the telecosm that is most exemplified in that mysterious uncontrolled organism known as the Internet. Many have tried to dismiss the Internet as a CB radio plus typing, or as a toy run by two 15 year old boys from their basement. But the Internet, or more accurately, the technologies that make it possible, have already changed and will continue to change the global economy.

The Internet is already transforming the global economy. It is eroding hierarchical grids and power structures. It is collapsing proprietary, that means closed, systems and replacing them with open, inexpensive, available-to-all, anybody-to-anybody communications. Dow Jones News Service, CompuServe and AOL are closed and proprietary services and are losing market share to the open, worldwide web. Consumers on the Net can find, at almost no cost, the cheapest airline tickets, the best prices on CDs or books, the florist that will send the best custom arrangements and restaurants and lodging in foreign cities. Retailers can no longer charge higher prices in some markets than others. The web arbitrages these price differences. The largest book store in the world exists only on the web - a million titles, not in downtown real estate, but in a warehouse.

Throughout this article we provide excerpts from George Gilder's "Feasting on the Giant Peach," which ran in Forbes ASAP (8/26/1996). The entire article can be located by getting Forbes ASAP or visiting Gilder.com.

George Gilder writes...

"Will the Internet Collapse? No Way!

What is all this commotion in Massachusetts? The very source of the ARPAnet at Bolt, Beranek & Newman--the cradle of the Internet-- Massachusetts is falling to the forces of Auntie Spiker and Aunt Sponge.

These are the mingy ladies in the Roald Dahl story who rejoiced in James's Giant Peach as long as it didn't take flight. Now Massachusetts- -the state that

once barred Apple shares as a likely West Coast levitation scam--looks askance at the Giant Peach of the Internet, aloft in Silicon Valley and around the globe, with James Clark, James Gosling, Netscape and a series of thin-air IPOs.

Howard Anderson of Boston's Yankee Group, long an Internet tout, thinks those wired yahoos on Wall Street and Sand Hill Road are blind to the inevitable sine waves of advance: What goes up must come down, he sternly avers, trying to bring some simple physics to the scene, as if the Internet has to obey the law of gravity.

And now Bob Metcalfe--Metcalfe himself!--inventor of Ethernet, pioneer of ARPAnet and the founding father of the networking era. Here he is, prophesying lugubriously into every megaphone he can grasp, from the New York Times Magazine and PBS to U.S. News & World Report and InfoWorld, that the Internet will collapse in 1996. Metcalfe now predicts a general retreat to Intranets, shielded from the public system and unavailable to it. Et Tu, Bob

Metcalfe was striking a blow against the very solar plexus of my prophecies. I had founded my confidence in the Internet on the continuing power of the law of the telecosm, an edict adapted from Metcalfe's very own law of networks. Metcalfe's Law ordains that the value of a network rises by the square of the number of terminals attached to it.

In its most basic form, this law merely captures the exponential rise in the value of any network device, such as a telephone, with the rise in the number of other such devices reachable by it. Metcalfe, however, shrewdly added in the declining cost of Ethernet adapters and other network gear as the Net expanded. In the law of the telecosm, I summed up these and other learning-curve factors by incorporating into Metcalfe's Law the law of the microcosm.

Based on the power-delay product in semiconductors, the law of the microcosm ordains that the cost-effectiveness of the terminals will rise by the square of the number of additional transistors integrated on a single chip. Amplified by the law of the microcosm, the law of the telecosm signifies the rise in the cost-effectiveness of a network in proportion to the resources deployed on it and the number of potential nodes and routers available to it.

As the network expands, each new computer both uses it as a resource and contributes resources to it. This is the secret of the stability of the Internet. The very process of growth that releases avalanches of new traffic onto the Net precipitates a cascade of new capacity at Internet service providers (ISPs). They supply new servers and routers, open new routes and pathways for data across the Web, and buy new terminals and edge switches to upgrade their connections to the Network Access Points (NAPs), the Internet supernodes that in turn exert pressure on the backbone vendors to expand their own bandwidth.

Because all these routes and resources are interlinked, they are available to absorb excess traffic caused by outages, crashes or congestion elsewhere on the Net. Because all these resources are growing in cost-effectiveness at the exponential pace of the law of the microcosm, and total available bandwidth on

the Net is rising at the still-faster pace of the law of the telecosm, the Internet has been able to double in size annually since 1970 and increase its traffic two times faster still, without suffering any crippling crashes beyond the Morris worm of 1988.

Impelling the growth of the largest interconnected network, the law of the telecosm means that the most open computer networks will prevail. Proprietary networks lose to a worldwide web.... “

Two of my friends provide an interesting contrast. One, a professional investor, announced that he is not going to use the web until it gets as easy to use as the telephone. Another, a very seasoned and successful executive who has run large companies and large software development projects, complains that Windows NT, Microsoft's new operating system, is wasteful because it requires 32 megabytes of memory. His claim is that if it were written carefully enough and with the right software design, NT could run in only one megabyte of memory. He is offended by the wasting of the 31 megabytes of silicon.

Both are being the wrong observer. The investor should not be looking for ease of use, but rate of return. The technical purist should not be striving to squander human effort and spare abundant silicon, but exactly the reverse. That is: waste that which is abundant and preserve that which is precious.

It is no accident that the richest man in the world, Bill Gates, is the person who is most successful at wasting silicon. Gilder shows this phenomenon brilliantly:

“New Scarcity, New Abundance

....Marking every industrial and economic transformation are new forms of scarcity and new forms of abundance.

Economics has been termed the dismal science of scarcity. Indeed, scarcity is at the heart of most economic models; many of my critics still live in the grip of the dismal scarcities and zero sums of pre-Netic economics. But what is the controlling scarcity of an information age? In the Industrial Age, natural resources and real estate were scarce. But Julian Simon of the University of Maryland has shown that, as manifested by falling real prices, all natural resources, such as foodstuffs, minerals, clean air and available water and energy, have been increasing in abundance over the last century.

If conventional resources are becoming more abundant, what is the ruling scarcity of the information era? Is it information? Hardly. The information glut has become a ruling cliché. As all resources--from energy to information--become more abundant, the pressure of economic scarcity falls ever more heavily

on one key residual, and that single shortage looms ever more stringent and controlling. The governing scarcity of the information economy is time: the shards of a second, the hours in a day, the years in a life, the latency of memory, the delay in aluminum wires, the time to market, the time to metastasis, the time to retirement.

The ruling scarcities in the economy of time, however, can be distilled to two commanding limits: the speed of light and the span of life. They form the boundaries of all enterprise.

The speed of light is the most basic constraint in information technology. As a key limit, the speed of light shapes the future architectures and topologies of computers and communications. For example, the light-speed limit dictates that the fastest computers will tend to be the smallest computers. Electrons move nine inches a nanosecond (a billionth of a second). As computers move toward gigahertz clock rates--a billion cycles a second--the longest data path must be decisively smaller than nine inches. Pulses of electromagnetic energy--photons--take some 20 milliseconds to cross the country and one-quarter second to reach a satellite in geostationary orbit (as you notice in a satellite phone call). At a gigabit per second, this means that as many as 250 megabits of data--many thousands of IP packets, for example--can be latent (or lost) in transit at any time, thus playing havoc with most prevalent network protocols, such as TCP.

Thus light speed is a centrifuge. It abhors concentration in one place, ordains that these small supercomputers will be distributed across the globe and will always be near to a network node. Although the networks will be global in reach, they will depend on the principle of locality: the tendency of memory or network accesses to focus on clusters of contiguous addresses at any one time. Light speed imposes limits on the pace of any one processor or conduit, and pushes both computer and communications technologies into increasingly parallel and redundant architectures.

As a governing scarcity in the new economy, no less important than the speed of light is the span of life. Just as light speed represents the essential limits of information technology, lifespan defines the essential shortage of human time. Although medical and other health-related advances have increased the span of life in the United States some 5 years in the last 25--while the media focused on aids and cancer, and zero-sum pundits declared that our descendants, the scions of our science, will live less well than we do--the ultimate lifespan remains limited. Indeed, the modal economic activity of the information economy is exploitation of the technologies of the speed of light to increase the effective span of life by increasing efficiency in the use of time.

GDP and other economic numbers from the National Income and Product Accounts (NIPA) totally miss the minting of new time through innovation: the opening of parallel universes of choice in ideas, courses, arts, letters, entertainments, therapies and communities. Finding stagnation and poverty and agonizing over new wealth, Morgan Stanley gapologist Stephen Roach plumbs

the shallows of NIPA for all the world like the CIA economists who found the Soviets exceeding the United States in growth for 17 years. Video teleconferencing, telecommuting, teleputing, digital wireless telephony, Internet mail, cybercommerce, telemedicine and teleducation all are in the process of compressing the span of life toward the increasingly thronged channels of the speed of light.

If time is scarce, what is the growing and defining source of abundance among all the material abundances in the information economy? Signifying the definitive abundance in any economic era is the plummeting price of a key factor of production. In order to grow fast, every new-era company must exploit the drop in the cost of the newly abundant resource. Companies that use the resource that is plummeting in cost will gain market share against all other companies and will come increasingly to dominate the economy.... “

Technology only becomes successful when it modifies our social practices. Technologies that don't are quaint devices that can be seen in museums. As technology brings forth new social practices it creates new wealth and destroys old wealth. The ages of steam and steel transformed the economy and produce entirely new ways to produce wealth.

Historically we only found an end to starvation about 150 years ago as we moved away from production based on muscle power, human and animal, and toward production based on water, then steam, then oil, then electricity.

Living standards were both low and static for the 6000 years of human history until we moved away from muscle power. Since then, the prices of everything have been in a persistent decline when measured in terms of the number of hours of work needed to produce them.

Hours of work is, of course, the best standard for measuring the cost of anything. It is a measure not subject to inflation or deflation and tells us the price we need to pay in terms of that which is most precious for any of the things we wish to acquire.

Gilder:

“From Watts to MIPS and BITS

Over the last hundred years, there have been three such economic eras. The industrial era fed on the plummeting price of physical force or energy, best measured in watts. Some 30 years ago, with the regulatory sclerosis of the nuclear and natural gas industries, the price of watts began to plateau, dropping

less than 0.7% per year for the last 35 years. The last 30 years brought the reign of the microcosm, which fed on the plummeting price of transistors, manifested in the exponential drop in the cost of computer MIPS (millions of instructions per second) and memory bits. For the last 30 years, the price of a bit of semiconductor memory has dropped 68% per year. With this year's decline in DRAM prices, the trend line is being resumed after a four-year hiatus. The likely result is a sharp upside surprise in PC sales--and thus in chips--through 1997.

As fast as the price of MIPS and bits continues to drop, however, this Moore's Law trend line will no longer dominate the economy. Like a great river headed for a falls, a new factor of production is racing toward a historic cliff of costs. Over the next 30 years, the spearhead of wealth creation will be the telecosm, marked by the plummeting cost of bandwidth--communications power--measured in gigabits per second.

This result means that the growth of bandwidth will outpace the growth of processor power....”

Wealth flows the enterprise that is most successful in using more of the resource that is falling in price and less of the resource that is precious. This is no place more obvious than looking at the Forbes Four Hundred for 1996. (See excerpt below) Increasingly, this list is made up not of heavy industry and products of the earth, but rather products of the mind. Clearly each wave of technology changes how wealth is made.

This is only obvious after you see it. There are knowledgeable people still trying to save silicon rather than squander it. There are still people who don't see that the Internet is not like your electric bill. With your electric bill, the more you use it, the less money you have. The same is true of gasoline and the telephone.. But looking from the perspective that time is money, time is life, the more you use the Internet, the richer you get: the Internet brings time and opportunity.

As Gilder eloquently shows, time is the only non-renewable resource, the only thing that any one of us can not get more of, the ultimate precious commodity.

“The Internet as Life Extender

The Internet is a human contrivance requiring finance and physical renewal. In practice, this means capital from phone companies and other large institutions. In the real world, self-organizing systems rely on market incentives rather than bio-analogies. Metcalfe is right that these incentives must be protected and extended in order for the law of the telecosm to conquer the laws of entropy.

The key remaining obstacle to the fulfillment of the promise of the Internet is government regulation. This obstacle is being overcome at last by the brute force of bandwidth abundance, stemming from breakthroughs in fiber optics, smart radios, satellites and cable modems.

In every industrial transformation, businesses prosper by using the defining abundance of their era to alleviate the defining scarcity. Today this challenge implies a commanding moral imperative: to use Internet bandwidth in order to stop wasting the customer's time. Stop the callous cost of queues, the insolence of cold calls, the wanton eyeball pokes and splashes of billboards and unwanted ads, the constant drag of lowest-common-denominator entertainments, the lethal tedium of unneeded travel, the plangent buffeting of TV news and political prattle, the endless temporal dissipation in classrooms, waiting rooms, anterooms, traffic jams, toll booths and assembly lines, through the impertinent tyranny of unneeded and afterwards ignored submission of forms, audits, polls, waivers, warnings, legal pettifoggery.

All these affronts once were tolerable in an age when the customer's time seemed abundant--an available economic externality in an economy of material scarcity. All are intolerable in an age of compounding abundance, pressing down on the span of life as the irreducible scarcity.

For all this abusive waste of the most precious resource, the remedy is the Net. Businesses must use its defining abundance--MIPS, bits and gigahertz--to redress the residual scarcity of time. A key way to save time is to economize on space--geography. In practical terms, there is only one way to collapse time and space together.

That is to relegate more and more of the routine functions of life to microchips, where room expands as space contracts, and where operations cycle in nanoseconds, and then to interconnect the chips through the technologies of the speed of light. This is the promise of the Internet and it will keep the Giant Peach aloft and ascendant in the new global economy of bandwidth abundance."

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