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DIARY OF A BANDWIDTH BULL

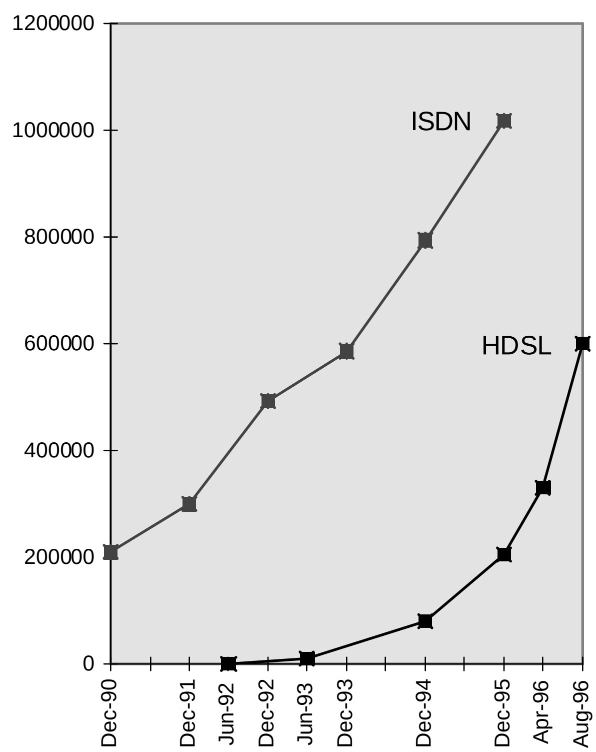
"You want to bet?" barked Leslie Vadasz, **Intel** founding father, buffetting me, a bandwidth prophet in full flight at high altitude, with unexpected turbulence. I tried to shrug him off with an Olympian smile. We were in Aspen, after all, in the summer, relaxed and lite in "Bel Air North." Let's cool it and take lunch at the Mezzaluna was my view. But Vadasz was serious; he wanted Popperian falsifiability, which means possible public humiliation, with real money changing hands from the information poor to the silicon rich. The issue? Bandwidth abundance.

What was he doing at this event anyway? I wanted to know. We weren't interested in the details around here; we were illuminati, authors of the Magna Carta of the Information Age and other high falutin documents of prophetic hue from Newt Gingrich's Progress&Freedom Foundation. But there he was, pesky Intel Senior Vice President, and second string Hungarian, warning the crowd with a doleful view of 28.8 modems and ISDN lines at 128 kilobits a second on into the millennium, with charts to prove it. If I persisted in my illusions to the contrary, Vadasz wanted to get me on the line with an explicit public bet.

As a strategic fact, defining the conditions of the business and the opportunities of the era, broadband is now.

You got it, Les. I say that by the turn of the century, a little over three years from now, virtually anyone in America who wants a broadband Internet connection will be able to get one. I define broadband as T-1 speeds (1.544 megabits per second) or higher, which offers, with compression, what is termed "VCR quality". Full motion video downstream at 2 to 6 megabits per second for MPEG 2 (like the **DirecTV** satellite images that give the best available pictures in homes today) will be accessible

ISDN, Too Little Too Late



The window of opportunity for ISDN to become the transitional technology between 28.8Kbps modems and broadband technologies is closing. The evidence is broad and persuasive.

***Chart 1** shows that although the number of Basic Rate ISDN Interfaces equipped has steadily increased, growth of installed 1.544Mbps HDSL systems is accelerating even faster-- fueled by burgeoning demand for high speed connections to the Internet. The success of HDSL is proving that xDSL technologies are refined and ready for prime time. The potential price performance advantage (measured in bps per dollar) of emerging IDSL systems over ISDN is incentive enough to bypass ISDN (Chart 10). Furthermore xDSL is not the only technology with connection speeds faster than ISDN. DirecPC is available today, offering up to 400Kbps links through a satellite to your PC (Chart 7). Additional satellite systems such as Teledesic are planning to offer even faster connections (Chart 2). And, cable companies are upgrading their systems, finishing trials and beginning to offer high speed cable modem connections (Charts 11 and 12).*

The spearhead of technological advance moves from the microcosm to the telecosm, from electronics to spectronics.

almost everywhere from satellites, fiber, and cable. These downstream pipes will complement upstream modems over telephone and coaxial lines or new microwave networks.

I focus on availability, not penetration. The key issue to me is when the top 20 percent of households–comprising some 50 million people with most of the intact marriages, online children, PCs, productivity, income and wealth–begin buying broadband internet links in volume. Everyone else can get them a few years later at one seventh the price.

This opening to the top cohort of homes will happen within the product cycle for which Intel had better be preparing today. As a strategic fact, defining the conditions of the business and the opportunities of the era, broadband is now. This is a fundamental paradigm shift–an inflection point like those described in Andy Grove's riveting new book, *Only the Paranoid Survive.*

In the new paradigm, the Moore's Law advance of MIPS and bits gives way to the Metcalfe's Law explosion of bandwidth (see, GTR, July 19). The spearhead of technological advance moves from the microcosm to the telecosm, from electronics to spectronics. Electronics concerns itself with switches, buffers, and processors–all the costly equipment deployed by telephone, television and computer companies to compensate for the narrowband infrastructure of 4 kilohertz copper wires. Spectronics focuses on the infinite span of waves–in the electromagnetic spectrum–moving through solid state devices, wires, and air.

These two paradigms lead to different information architectures and economics. The electronics view pervades telephony, consumer television and the conventional Wintel computing structure. The spectronics view favors the rise of network computers, teleputers, and other systems that overthrow the existing architectures. Spectronics means the death of telephony and television and the restructuring of the computer, networking, and software industries.

The key breakthrough in semiconductors was the recognition in the late 1960s that as transistors became smaller they did not become hotter, slower, more fragile and more costly, as previously thought, but cooler, faster, cheaper, and better. The key breakthrough in spectronics is the recent discovery that as information systems move up spectrum they do not necessarily become more expensive, power hungry, and immobile, as previously thought. Rather higher frequencies with shorter wavelengths can use smaller, cheaper antennas, at lower power, and offer more bandwidth. Bandwidth, as Claude Shannon showed, can serve as a replacement for power and for switches.

Whether in computer backplane buses, copper wires, fiber optic lines, or the air, the ascent up-spectrum–to higher frequencies–is a fundamental part of the new paradigm of bandwidth abundance. Over the last decade, spectrum climbing has ruled nearly all technologies. Microprocessors ascended from 30 to 500 megahertz, deep in the microwave zone, PC buses rose from 33 megahertz to 66 megahertz while quadrupling their width, displays rose from 13.5 to 74.25 megahertz and higher, workstation buses rose from 40 to 83 megahertz, Local Area Networks moved from 10 megahertz to 100 megahertz, cellular phones running at 900 megahertz evolved into digital PCS phones at 2 gigahertz, Metropolitan Area Networks moved from 4 kilohertz wires to 38 gigahertz **Winstar** wireless, Cable television soared from 350 megahertz coax to 12 and 14 gigahertz DirecTV digital satellite systems or 28 gighertz terrestrial **Cellular Vision** two way links, and all long distance trunks moved from 2 or 28 gigahertz microwave to the multi-terahertz light frequencies of fiber optics.

The industry catalogs these technologies as wired and wireless, RF, microwave and optical, buses and processors, LANs and input-output (I-O) channels, phones and computers, TV broadcasting and fiber trunks. But in fact all these systems are converging in the new spectronic paradigm. The up-spectrum trajectory mandates development of ever higher frequency chip technology using exotic materials such as gallium arsenide, indium phosphide, and the **IBM-Hughes**' revolutionary new silicon germanium-- all manufactured and tested by ever higher frequency photolithography and simulation gear which itself must use the microwave chips. Companies such as **Qualcomm** contemplate the use of cheap cryogenic gear from **SCT** to lower noise temperatures.

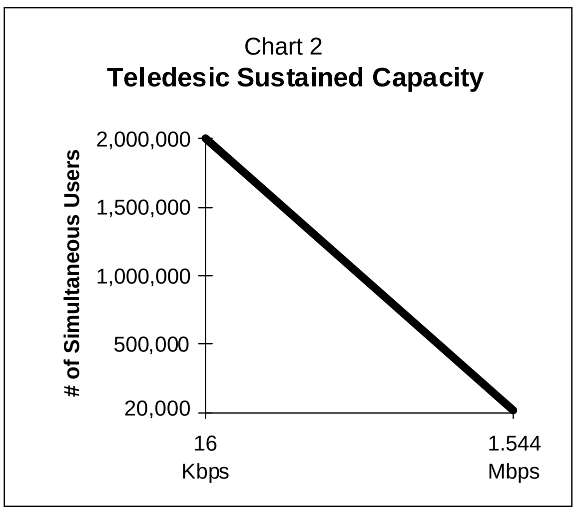
Today, beginning at 300 megahertz, the lower boundary of microwave frequencies, most information technology functions near the microwave region. Even **Texas Instruments**, the silicon DSP titan, projects that gallium arsenide wireless sales will grow by a factor of five over the next four years in a wireless chip market that will grow about 60 percent. In the midst of a silicon slump, **Vitesse** and **Anadigics** have reported boom quarters.

Epitomizing the power of the spectronics paradigm was Alex Mandl's departure from **AT&T**, which had recently paid some $20 billion for rights to spectrum at 900 megahertz and 2 gigahertz, to a startup called **Associated Communications** supported by **TCI** and the **Associated Group** of Pittsburgh. The only significant asset of Associated Communications is its rights in 31 cities to 400 megahertz spans of frequencies at 18 gigahertz, which it acquired for nothing. In the spectronic view, the high frequencies that went for nothing may well prove even more valuable than the low frequencies that went for $20 billion. Winstar commands a similar bonanza at 38 gigahertz.

The move up spectrum is not confined to the air, however. You can also climb spectrum in wires. At the Ritz in Aspen, I walk out into the hall behind the conference room. There I am to meet two friends of John Gage, chief scientist at **Sun Microsystems**. You want bandwidth, Gage told me, John Seamons and Alex Huppenthal of **Aspen Internet Research** (AIR) will have bandwidth to burn.

As a bandwidth bull, I normally talk of the vast intrinsic capacity of the world's 40 million miles of fiber optic lines, each potentially capable of carrying all the globe's phone calls and sixty percent of it "dark" (unused for communications). I cite the immense developing power of digital satellite technology, beginning with DBS (direct broadcast satellite) from the Clarke belt 23 thousand miles away, proliferating as AT&T, **MCI**, **Fox** and others enter the fray. Each satellite could transmit downstream all the traffic flowing through Internet National Access Points (NAPs) in the US (270 terabytes a month). I speak of the immense potential of two-way low earth orbit technology such as **Teledesic** and **Globalstar.** I point to the huge capacity of the cable television plant–each line capable of between one and eight gigabits per second–installed in 64 percent of US households and passing 95 percent. And I write of the smart radio revolution in wireless.

All these sources together comprise a technically practical and economically plausible total of bandwidth of petabytes per second, literally millions of times greater than all the current telephone traffic in the world (a total which averages about a terabit a second). In the face of this technology, I am almost embarrassed to bring up another source offering merely 150 terabits per second of total capacity–capable only of carrying the entire internet monthly traffic every 15 seconds. It is a humble resource, but it possesses the three key components of broadband value: location, location, and location.



I speak of the bandwidth lying largely dormant in the 65 million tons of copper commanded by the local phone companies of America. The telcos will tell you that this installed base is cheaply accessible only in the form of ISDN, which runs at 144 kilobits a second and is not really available anyway in most places. To get the 150 terabits total capacity of the copper plant, you have to buy T-1 lines and they cost $500 to $600 per month plus equipment outlays at your place of business of $1000 for a CSU-DSU (essentially a T-1 modem, termed a channel service unit-digital service unit). These charges reflect what Roger McNamee calls Moron's Law–the regulatory labyrinth that turns fiber and copper from an information superhighway into a regulatory briarpatch.

Deregulation, competition, and entrepreneurship should blow this bottleneck away during the next two years, opening up vistas of bandwidth that might be termed "dark copper." For very short distances (hundreds of feet) twisted pairs can accomodate frequencies comparable to current fiber and with fiber-like bit error rates. Indeed, **PairGain Technologies** of Tustin, California, calls its HDSL (High Speed Digital Subscriber Line) system "copper optics." It was this bandwidth and this opportunity that Seamons and Huppenthal wanted to tell me about in Aspen.

From the spectronic point of view, copper wire, fiber, air, and orbits offer technically similar paths for bits. All these paths, wired or wireless, suffer *attenuation* by an inverse square law (in wire and space) or fourth law (in terrestrial air), dependent on the conditions in the channel. That is, the strength of the signal weakens by some exponential power of the distance it travels. All the paths affect different frequencies differently. Thus bits of different frequencies tend to run together after awhile causing *inter symbol interference* (ISI). All paths can overflow into each other causing *crosstalk*. And all paths both endure and emit *interfering radiation* (though fiber is immune to radio interference). If outgoing rays are too powerful, for example, they violate the part 15 emission rules of the FCC.

T-1 lines solve all these problems in the most expensive way. To combat attenuation, crosstalk, and intersymbol interference, T-1 lines demand $1,600 repeaters per port on "pedestals" every mile or so and require that incoming and outgoing T-1 paths be separated several inches in space. All these remedies entailed high expense, which was duly incorporated into the tariff structure of pricing. When **Bellcore** proposed far cheaper high speed digital subscriber loop (HDSL) technology that worked over twisted pairs for up to three miles without amplication, the tariffs remained in place.

Companies led by PairGain, with chip suppliers **Brooktree** and **Level One**, have soared high on Wall Street by supplying the telcos cheap HDSL solutions at prices set for costly T-1s. (Now PairGain makes its own chips). HDSL effectively moves up spectrum, circumventing many of the problems of T-1 by sending 768 kilobits per second two ways on each pair without repeaters. It uses digital signal processors to equalize and condition the chan-

Spectronics means the death of telephony and television and the restructuring of the computer, networking, and software industries.

COMPETITION RULES, NETSCAPE HOLDS

Chart 3
Competition and the Internet

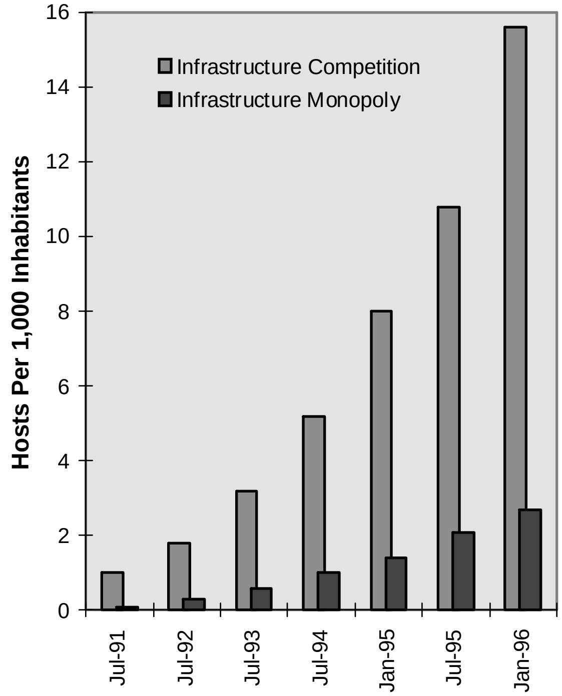
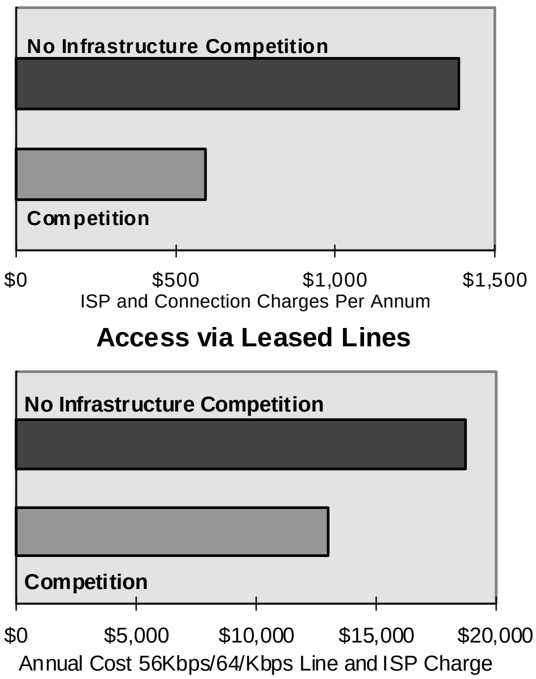


Chart 4
Dial-up Access Prices



Charts 3 and 4 *derive from an OECD study and compare Internet infrastructure and access pricing in the 19 OECD member countries in which much of the telecommunication infrastructure remains under monopoly control and those 8 which allow competition.*

On an ongoing basis, Netcraft attempts to find every server attached to the public Internet and once a month they poll them all and find out, among other things, what type of server software they are running. ***Chart 5*** *shows the number of servers found and the brands of web server software they are running.*

Chart 6 *summarizes browser data from Engineering Workstations WWW server (EWS) at the University of Illinois at Urbana-Champaign which was accessed 540,685 times by 65,144 hosts in 94 countries during the week ending 8-25-96. Between 1-21-96 and 8-25-96, total Netscape market share has decreased from 84.1% to 78.3%. Microsoft's share has increased from 6.4% to 15.1%.* ***This has not resulted from a shift of users from Netscape to Microsoft, but from the dynamics of the expanding browser market****. Netscape's Windows-- based browser has maintained a level 62% to 63% share of the market. Microsoft's gain has resulted partly from the erosion of third party browsers whose share dropped from 9.5% to 6.6%, but more fundamentally from an increasing market share for the Windows platform-- where Microsoft has a foothold-- at the expense of the Macintosh and Unix platforms-- where Netscape has a near monopoly.*

As Web appliances, Teleputers, smart phones and Network Computers come to market, opening the Internet to non-PC users, the dynamic effect of platform market share on browser market share will be seen in new ways. On August 26, Netscape announced the formation of a new company to enter these emerging markets.

Chart 5
Web Server Software

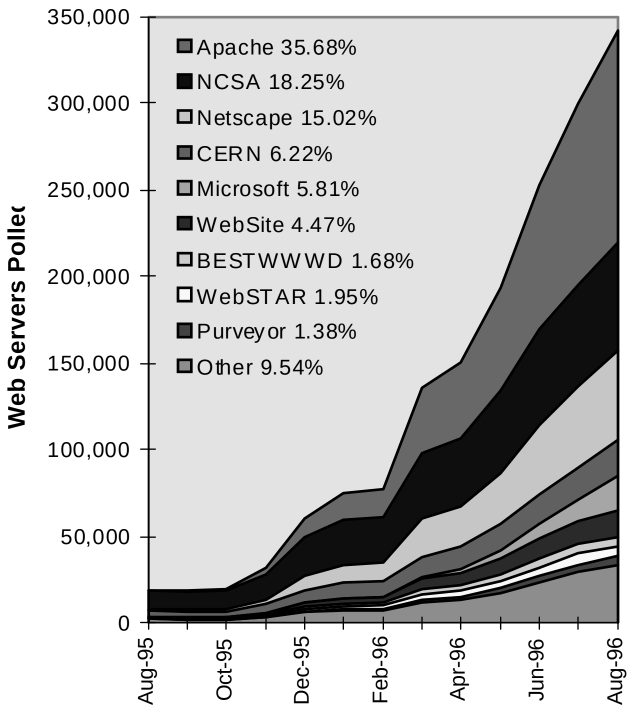


Chart 6
Browser Marketshare

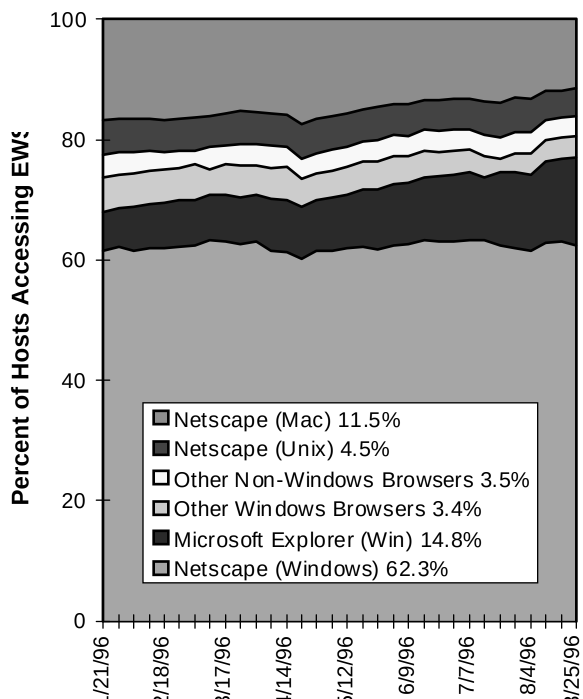
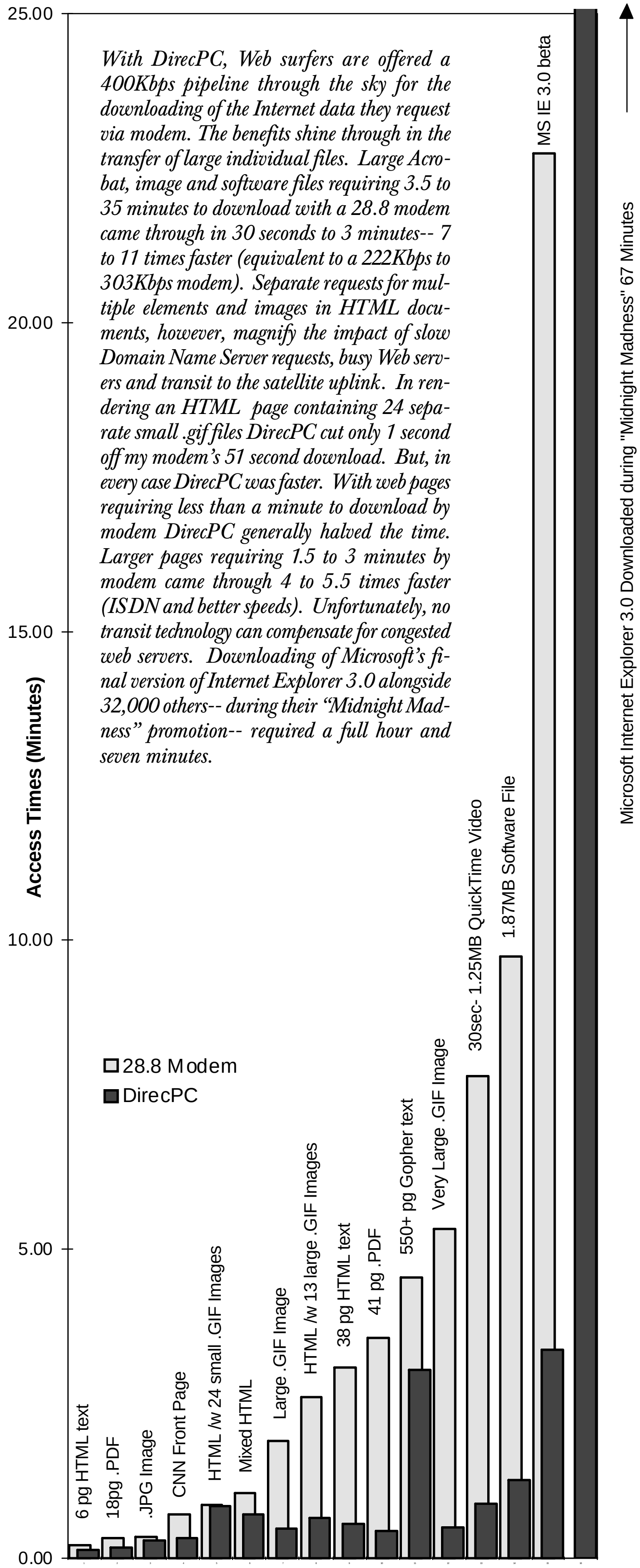
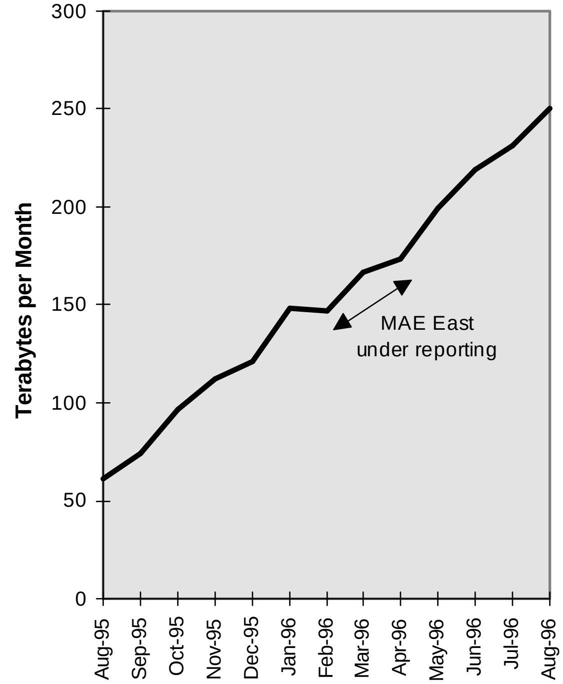


Chart 7
28.8 Modem v. DirecPC



With DirecPC, Web surfers are offered a 400Kbps pipeline through the sky for the downloading of the Internet data they request via modem. The benefits shine through in the transfer of large individual files. Large Acrobat, image and software files requiring 3.5 to 35 minutes to download with a 28.8 modem came through in 30 seconds to 3 minutes-- 7 to 11 times faster (equivalent to a 222Kbps to 303Kbps modem). Separate requests for multiple elements and images in HTML documents, however, magnify the impact of slow Domain Name Server requests, busy Web servers and transit to the satellite uplink. In rendering an HTML page containing 24 separate small .gif files DirecPC cut only 1 second off my modem's 51 second download. But, in every case DirecPC was faster. With web pages requiring less than a minute to download by modem DirecPC generally halved the time. Larger pages requiring 1.5 to 3 minutes by modem came through 4 to 5.5 times faster (ISDN and better speeds). Unfortunately, no transit technology can compensate for congested web servers. Downloading of Microsoft's final version of Internet Explorer 3.0 alongside 32,000 others-- during their "Midnight Madness" promotion-- required a full hour and seven minutes.

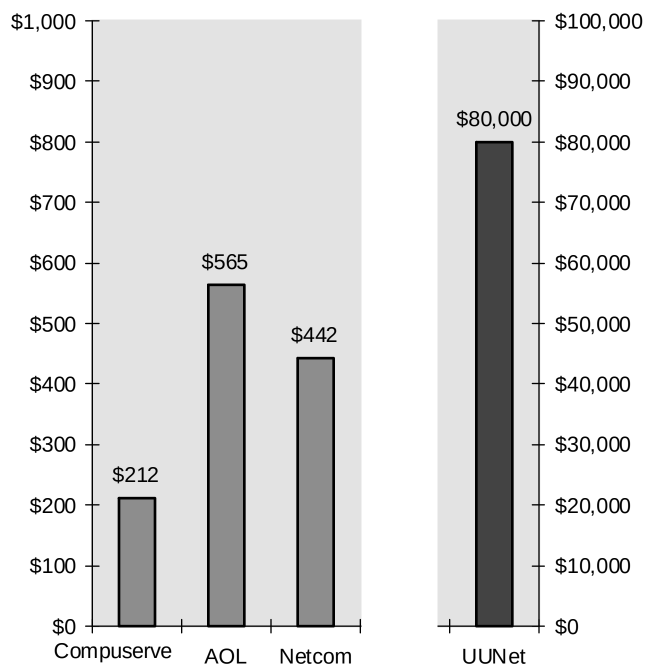
Chart 8
Internet Traffic



Internet traffic *transiting through the five largest NAPs and MAEs continued to climb through the end of July and August (**Chart 8**) despite the bad publicity of AOL and Netcom service outages and increasing efforts to peer at private exchange points and new exchanges. In fact, calculating the daily numbers we are seeing a jump in traffic as August comes to an end, suggesting the possibility of a post summertime boom, as students return to class. More next month…*

Chart 9 *shows the market capitalization per subscriber for online providers Compuserve and AOL and Internet service providers Netcom and UUNet. The UUNet figure, registering value of business customers, is based on the $2 billion purchase of UUNet by MFS. MFS is now in the process of being purchased by Worldcom for $14B (8/26).*

Chart 9
Market Capitalization Per Subscriber



The AIR strategy is to overthrow the parasite farm and create an entirely new market-based pricing structure for communi-cations.

nel. For these feats, PairGain commands a market capitalization of nearly $2 billion on the basis of estimated 1996 revenues of around $200 million and operating margins of 24 percent and rising.

PairGain, though, sells its products exclusively to businesses and mostly through the telephone companies. Taking advantage of the absurd T-1 tariffs, it is thus, in a way, part of the problem. Seamons and Hoppenthal want to use a yet cheaper adaptation of HDSL technology to bypass the telcos and use the Internet. They call their product IDSL (Internet Digital Subscriber Line).

A former protege of Sun founder Andreas Bechtolsheim, of Steve Jobs at **Pixar**, and of George Lucas at **Lucas Films**, Seamons has been around. He was a key figure in Sun's **Aspen Smallworks**, Bill Joy's incubator of the Java project and still works out of Sun's Aspen office on East Hopkins Avenue. A bearded young man in denim, Seamons showed me a small computer card, perhaps 3 inches by four inches in size, that he had contrived in a basement in Basalt. It contained a Brooktree HDSL chipset, which can create T-1 lines on twisted pair copper wires, a **Silicon Systems** (now bought by TI) 10 base T ethernet adapter chip, that links to your computer, and a **Microchip** microcontroller that does the ethernet bridging between boxes over the DSL link. Costing in total under $100, the card can link you to the Internet over a single "bare telephone copper" pair at 1.1 megabits per second (half the European E-1 rate).

HDSL manifestly works; there are some 600 thousand HDSL lines in operation today, mostly installed by the phone companies using PairGain systems. Seamons and Huppenthal, however, are not offering T-1 service with its 24 channels at 64 kilobits per second switched through the telco central office and requiring some $2,000 worth of equipment from PairGain and some $600 per month to the phone company. Instead, AIR's IDSL supplies an ethernet link to an Internet Service Provider (ISP) using a USOC (Universal Service Ordering Code) that allows point to point copper connections for alarm, telemetry, radio stations and other uses.

These connections run through the phone company Central Office (CO) to an ISP point-of-presence without using the switch. The FCC's August rulings (FCC 96-325) interpreting the Telecommunications Act of 1996 specified that the local phone companies could not charge for access beyond the cost of the copper unless the customer uses the CO switch. By bypassing the switch and allowing the copper lines merely to be clipped together in the CO, AIR qualifies for a USOC tariff not of $600 per month but of between $16 and $31 per month in Colorado and 31 other states. For this amount, plus the cost of the card (under $100), an ISP with the AIR board can offer 1.1 megabit per second service over 12,000 feet or 768 kilobit per second service over three miles, which, incidentally, is the ISDN distance limit.

So much for ISDN, I observed cheerfully.

This is what is ultimately at stake. The world of communications technology divides into two parts. On one side is a parasite farm, feeding on the archaic tariff structure of the telcos with its $1000 per month T-1 lines and narrowband ISDN (144 kilobits per second) hyped as new technology. The other side grasps the spectronic future of broadband. Any companies accomodating the telcos absurd ISDN plans to link businesses to the Internet at 144 kilobits per second and call it progress are part of the problem. This includes many of Wall Streets favorite "Internet" stocks, such as **Ascend**, **Shiva**, and **US Robotics**, and IPO prospects such as **Livingston Enterprises**. The AIR strategy is to overthrow the parasite farm and create an entirely new market-based pricing structure for communications.

To test their plan, Seamons and Huppenthal will use the ISP they created, **Aspen Internet Exchange**, which serves some 2000 households in the town over a T-1 line at Aspen Smallworks. At the ISP, the twisted pair links to a Sun Unix workstation that can handle 160 copper lines over 25 ports. At the residence or small business a single AIR Box can manage 16 ethernet ports. Milo Medin of **@Home**, the TCI-**Kleiner-Perkins** cable modem venture, sees this technology as an effective way to reach the some 85 percent of American homes that currently lack two-way cable connections linked to fiber.

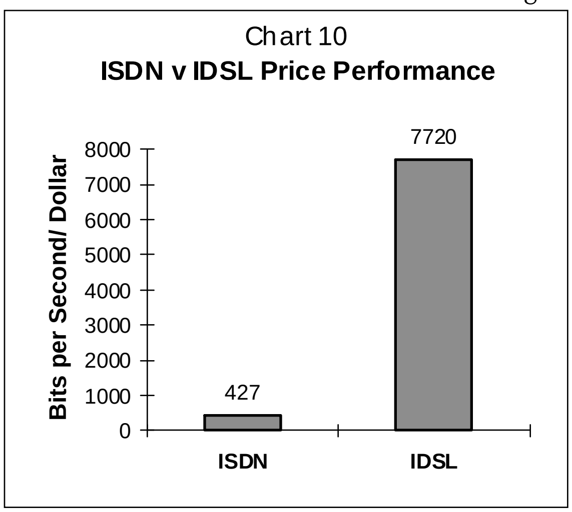
One further point, Seamons said. To get the business launched and the revolution under way, they need 350 thousand dollars. They are tired of waiting for John Doerr of Kleiner-Perkins to read their business plan.

Returning to my hotel room, I discovered what might be part of their problem–the threat of competition. George Middlemas of **Apex Venture Capital** in Chicago, one of the original backers of **America OnLine**, **Steinbrecher** and several other important firms, called to say he had a hot new company for me, called **Tut Systems** of Pleasant Hill, California. It offered a new way to achieve cheap broadband Internet connections. I took note. Then the next week I had dinner with Andrew Kessler and Fred Kittler of **Velocity Capital** in San Francisco. They, too, said they had a great broadband Internet story. It, too, was Tut, which had just raised $11 million in a private placement.

Kessler explained that former Berkeley Computer Science Chairman Marty Graham and his student Matt Taylor had patented an analog technology that allowed the use of cheap 8 bit Analog to Digital converters and low end Texas Instrument DSPs to access the Internet at T-1 speeds. The next day, I was off to Pleasant Hill, near Walnut Creek, to meet with Sal D'Auria, the physicist CEO originally from HP and Matt Taylor, Chairman, founder, and technical guru with Graham. Graham and Taylor have parlayed their expertise on the physics of copper wire into a stream of patented devices that allow transmission of ethernet packets anywhere from the phone wiring in your house to the twisted pairs running to the telco CO.

In 1986 and 1987, Taylor had worked at **SynOptics** (now **Bay Networks**) next to Rick Anderson, the effective inventor of 10BaseT ethernet. Both Taylor and Anderson were addressing the problem of putting ethernet on twisted pair wires for the relatively short distances required in buildings. Anderson, though, aimed at high end twisted pair. Taylor wanted to run ethernet over raw telephone company plant–unshielded and often poorly twisted pairs.

When Anderson succeeded with 10 Base T, SynOptics abandoned Taylor's more ambitious plan. Taylor left SynOptics, just before it rode 10 Base T to stardom, and joined an ill fated startup. Then in 1991, he helped Graham launch Tut Systems.



Graham had recently electrified the crowds at Berkeley by bursting into the corridor at Corey Hall yelling "Eureka" or something similar because he had figured out how to increase the common mode rejection of twisted pair lines by a factor of 100. Since real signals were different on the two wires, common mode signals–electrical activity that was the same on both–constituted noise, an interfering source from outside. By reducing noise, you could improve some combination of the bandwidth, the distance, and the bit error rate. Until then, the technologies for passing differential signals and rejecting common signals as noise were cumbersome and relatively ineffective. For the hundred-fold improvement, Graham added a pair of shunt capacitors to a small inductor circuit that is routinely used to reject common mode noise. Channeling the noise to ground, the net result is more usable bandwidth out of old telephone wires.

Graham patented his invention, a new kind of "balun" (balance to unbalance) and formed Tut to translate it into products. After an ethernet repeater that could link networks some 1,500 feet apart on twisted pair, they set out to solve the Internet access problem.

Unlike AIR, Tut decided to target the telephone companies first. The telcos specified a product that could send 2 megabits per second two ways down at least 12,000 feet of twisted pair wire and could combine a POTS (plain old telephone service) line with a T-1. To achieve this goal, Graham and Taylor made two further inventions. One was a preequalizer that could recover a signal integrated on a wire by transmitting its derivative. The other was a new asynchronous coding scheme called time modulation with adaptive duplexing, a form of pulse *duration* modulation. Sending four bits per symbol, it took advantage of the low cost and high reliability of time sensors compared to accurate amplitude detectors.

Tut today has a series of Internet access products in the pipeline for release over the next few months. Among the most intriguing now goes by the codename "Bob's House." It permits the creation of residential ethernets without any change in household wiring. This system will enable Internet connections throughout the house on telephone wires at rock bottom cost. Like AIR, Tut calls its Internet access technology, IDSL. Together with PairGain, they hold the keys to two-way broadband Internet connections within the telco cage. To break out of the cage, they will have to extend the distance of IDSL to reach the close to 45 percent of potential subscribers who live beyond the 3 mile limit. Here is where Tut's analog expertise could prove decisive.

In future letters, we will contemplate more fully the bandwidth coming from satellites, cable modems, and fiber. All the communications companies soaring on Wall Street under the sheltering wings of telco tariffs must face a world of competition where the current telco price structure collapses. One way of explaining it is to take Andrew Grove seriously in his most prophetic statement: "During the last decade, the microprocessor flattened the structure of the computer industry. During this decade, it will flatten the structure of the communications industry." He made this point in 1991. We are now six years into the decade, still yammering about ISDN.

Two representative disasters in the making are Ascend Communications and Livingston Enterprises. Both are so-called "Internet companies" valued for the huge promise of the ascent of the net. Yet if the assumptions of their business plans and product lines are correct, there won't be much of an Internet in a couple years. Both of these firms have been seduced by the telcos into

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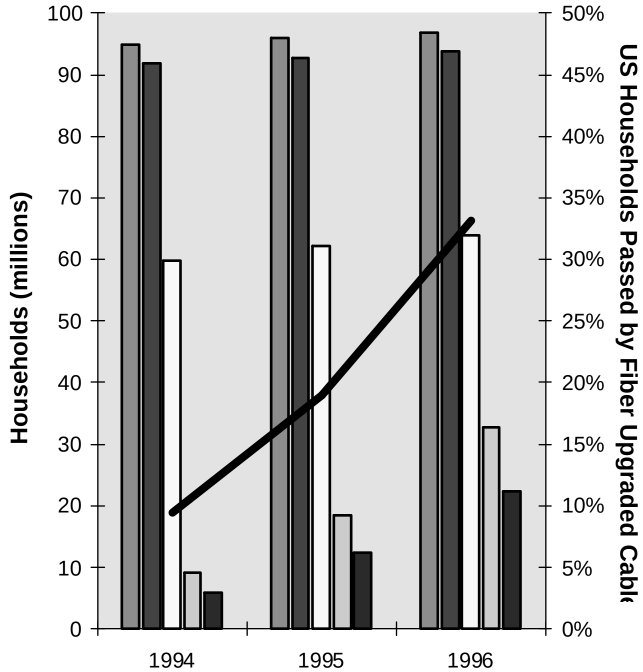
CABLE MODEMS READY FOR PRIME TIME

Chart 11

Cable Fiber Upgrades



Source: Paul Kagan Assoc., Inc.

Chart 12

Cable Modem Availability

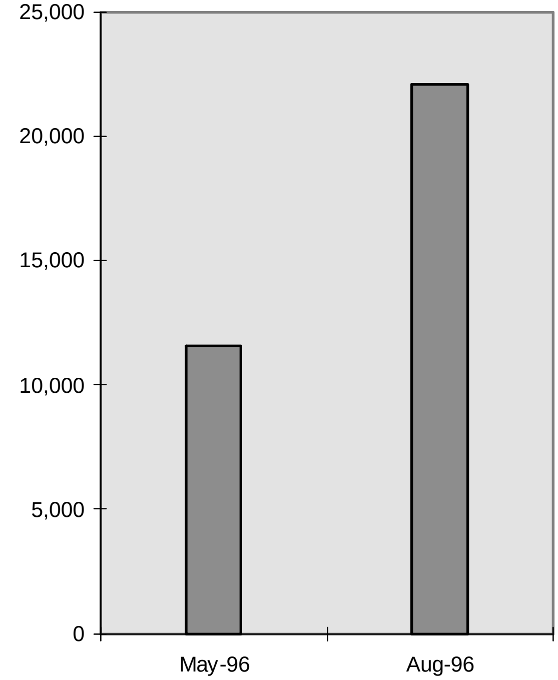


***Chart 11** (left) shows the rapid penetration of fiber upgrades in the cable industry, with 550-750Mhz systems increasing to 35% in 1996. This allows increased channel selections and new services such as the roll-out of online access through cable modems-which is now moving from trial to commercial stages.*

***Chart 12** (above) shows conservative estimates of the availability of cable modem service based on published figures for trial sites and participants, subscribers to commercial services and homes currently being offered service. CableLabs estimates some 75 thousand cable modems have shipped, based on a survey of its members earlier this year and additions of subsequent purchase orders and shipments. While most of those modems are presumably being used in trials, some are being stockpiled for use in commercial services now being introduced. Time Warner Cable has announced a September 10 scheduled start date of cable modem based online service in Ohio. Barring any last minute delays, this is expected to expand availability to 300,000 additional cable subscribers. Purchasing agreements, letters of intent and so on are approaching 3 million units.*

betting big on ISDN. Similarly, **Cisco** just spent $200 million acquiring **Telebit** for its ISDN capability.

Consider Ascend. Some 85 percent of its revenues come from its MAX 400X product that allows ISPs and Intranets to accomodate some 96 ISDN lines and "bond" groups of them, with compression, into 512 kilobit a second channels. An expanded product is coming soon called TNT. Competition has just arrived from Cisco which is launching a rival machine called the 5200 that duplicates most of the MAX features.

Almost all this equipment is based on complementing the telco monopolies, linking analog modems or complex and expensive narrowband ISDN to even more costly telco T-1s. It is oriented to a lobbied and regulated world of no competition. But competition is breaking out all over and regulation is being radically changed. Who will want 128 kilobits per second when cheaper links at 1.1 to 2 megabits per second will be available from Tut and others? Yet Ascend's market cap is nearly $6 billion or close to 12 times *sales* that reached a $500 million run rate in the last quarter.

Like TV, telephony is technologically dead. Last year, databits outnumbered voice bits on the telco networks. Data and voice are radically different in their needs. Voice needs a little bandwidth (4 kilohertz) for a long time. Data needs broadband for a short time over shared channels. ISDN has enough momentum to carry it for another year or so, but it will then hit a wall. What is needed today is not more fat and happy vendors of gear fitting into the present pricing structures and telco architectures, but more aggressive entrepreneurs such as Tut and AIR, **Echostar** and @Home, Teledesic and Globalstar, Winstar and Associated Communications that can upend this government guarded parasite farm.

The news for Les Vadasz is that these companies are on the way. The spectronic paradigm is ascendant and will triumph in three years. I'll bet on it and Intel had better bet on it too.

George Gilder – August 29, 1996

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