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The Death of Telephony

The Internet is becoming the central nervous system of a new global economy of information. The Web is a cornucopian mall. So I have been telling the world for seven years. But, as for the beef, it seems chiefly to come from subscribers grousing every month or so about the snail mail delivery of our still paperbound reports.

Hey, guys, with **Cybercash** (CYCH) still burning losses without an ascent of users, with **Digital's** (DEC) millicents not making any, with **First Virtual** (FVHI) still shrouded in vapors, with **Clickshare** closing down, with **Open Market** (OMKT) digesting Folio Inc., with even **IBM** hiding in its mostly empty Cryptolopes while it dumps its World Avenue, and with **MCI** (MCIC) dissolving its Mall, the web commerce bonanza—for transactions in our league—seems to be an empty piñata.

Internet commerce is indeed booming—business to business. Such Internet transactions will rise 1,000 percent over last year, leaping up to a total of some \$8 billion dollars of everything from **Cisco** (CSCO) routers and **Boeing** (BA) airplane parts to natural gas and crude oil. Also soaring is financial trade, with some \$7 billion of online mortgage originations in 1997, and with **Charles Schwab & Co.** (SCH)—which holds a 35% share of online trades—reporting 908,000 net accounts with assets of \$66.6 billion. Led by **Microsoft's** (MSFT) Expedia and an array of software suppliers, online travel and software sales are climbing briskly up the web.

Absent is a similar ascent of information transactions. Even the *Wall Street Journal's* imperial web pages attract only 70 thousand hits

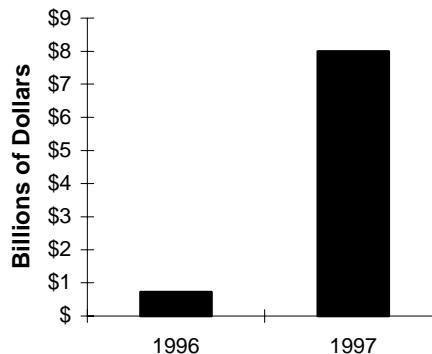
a day from their millions of readers. The World Wide Web makes every Internet user a possible Internet publisher and distributor, at radically reduced costs, but fails to guarantee revenues flowing back from the information customers. While corporate credit accounts, investor stock accounts, and consumer credit cards have enabled large scale Net commerce, no standard has released a boom in information transactions. Could it be that the net is insufficiently dumb?

Smart and dumb are the two key network paradigms. The smart

model entails lots of switches and services incorporated in the fabric of the net. The Public Switched Telephone Network (PSTN), both local and long distance, is the leading example. Salient companies are **AT&T** (T) and **Bell Atlantic** (BEL). Every service supplied by the network is embodied in hardware and software

Over the next decade, all telecommunications will become Internet communications. And the killer app will be commerce.

Chart 1
Internet Business-to-Business Trade



Source: Forrester Research

The key goal of the new paradigm companies is to make the Internet as fast as it is dumb.

within the fabric of network switches, signaling systems, codecs, access standards, protocols, security functions, and central offices. The other kind of network is dumb. As physicist George Keyworth put it nearly a decade ago, "the network should be as dumb as a stone," with nothing between the ears but air or dumb bandwidth, empty spectrum or dark fiber.

The trouble with smart networks is that they cannot readily accommodate change on the edges. Only dumb nets can readily deal with a world where computer power doubles every 18 months, Internet traffic doubles every 4 to 6 months, and new applications proliferate from scores of thousands of software and microchip companies.

Now the smart paradigm seems to be crashing at AT&T itself, with troubled officers, boards, earnings, margins, growth rates, and corporate courting of **Southwestern Bell (SBC)**, while key executives bolt to the new paradigm of dumb and dark. First, in 1996, Alex Mandl, long considered a likely heir apparent to CEO Robert Allen, defected to a vendor of dumb wireless bandwidth, **Associated Communications**, now **Teligent**, which commands a national swath of bandwidth in the 18 gigahertz microwave band. In February, another top AT&T executive, Joe Nacchio departed to **Qwest Communications (QWST)**, which has built a far reaching

fabric of dark fiber optic lines along the railway rights of way of **Southern Pacific Railway**—a feat reminiscent of Wiltel's fiber deployment in the abandoned natural gas pipelines of its parent, **Williams (WMB) Oil and Gas**. Then, in late July, with blessings and funds from AT&T, Tom Evslin, formerly in charge of AT&T's WorldNet Internet access service, left to form **ITXC Corporation** (Internet Telephony Exchange Carrier Corporation). ITXC will collaborate with **VocalTec (VOCLF)** of New Jersey and Israel, to provide IP (Internet Protocol) telephone service. Evslin declared that in the future a single IP network would replace the existing PSTN, presumably including the circuit switched fabric of AT&T. Finally, one of AT&T's leading technologists, David Isenberg put it all into writing in a stirring call for a "stupid network" to replace the smart network that his bosses currently command.

The current telecom infrastructure is optimized for person-to-person communications, dominated by voice. The new telecom infrastructure must serve computer-to-

computer communications, dominated by data. Voice needs a narrow band link for a long time, typically a 64 kilobit per second circuit maintained for the duration of a call. By contrast, data requires a broadband link for a short time. Humans can comprehend information at a rate of about 55 bits per second. Computers can store scores of megabits a second.

Entirely different, these functions have engendered radically different network paradigms. The voice network, however, must die. Outgoing FCC Chairman Reed Hundt puts it as well as anyone: "We need a data network that can easily carry voice, instead of what we have today, a voice network struggling to carry data." A broadband network optimized for data could carry voice as a virtually imperceptible trickle of bits amid the floods of data traffic. Forrester Research, for example, estimates that a continuation of the growth of Internet data traffic over the next seven years

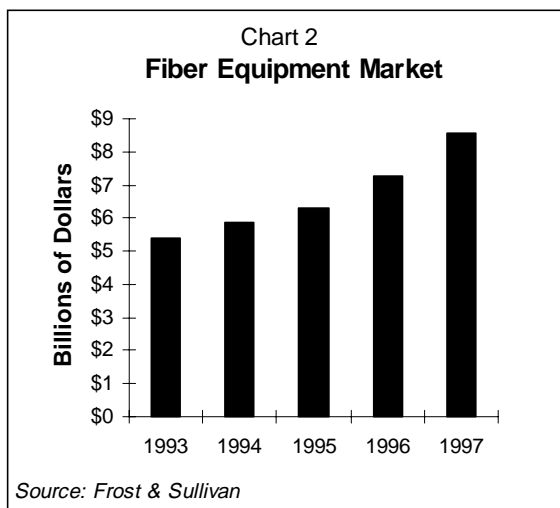
will reduce voice to less than one percent of the worldwide total.

While most estimates of Internet growth focus on the increase in the number of computer hosts, which has been doubling every year since the early 1970s, the real index of Internet expansion is the increase of traffic. Traffic has increased some 100 fold since the privatization of the net in April 1995, from

an estimated 31 terabytes (trillion bytes) per month to a GTG projection of some 3 petabytes (3 times 10 to the 15th) in August 1997. This number extrapolates from estimates by MCI, **Sprint (FON)** and others that less than a third of Internet traffic now passes through the National Access Points (NAPs) and only a half of that is measured in the NAP gigaswitches.

The excess of the traffic growth over the growth in the number of hosts illustrates the power of Metcalfe's Law of the Telecom: the performance and value of a network grows by the square of the power of the computers attached to it. The growth of traffic also reflects the eclipse of Moore's Law by Metcalfe's Law as the spearhead of technological advance. Moore's Law ordains a doubling in computer power every 18 months; Metcalfe's Law implies more than a tripling every year, as **Novell (NOVL)** CEO Eric Schmidt now projects.

In the near term, bandwidth could well rise at a still faster pace. As an index of the explosive possibilities, contemplate the fact that as recently as three years ago the entire world telecommunications network—all the wires and



switches of the global PSTN—collectively operated at an average rate of about one terabit per second. Early this year, **NEC** (NEC) announced that it had used Wavelength Division Multiplexing (WDM), combining separate light beams of many colors in a single fiber, to send three terabits per second for 55 miles. **Lucent** (LU), **Fujitsu**, **Hitachi** (HIT), and **British Telecom** (BTY) had previously reported one terabit per second transmissions. This technology is not merely a laboratory curiosity. Lucent, **Ciena** (CIEN), **Pirelli**, and **Alcatel** (ALA), among others, are now racing to put 100 gigabits per second on operational facilities, including the new cross-Pacific fiber link.

This capability has yet to reach the Internet, but it soon will. Shearing away all consumer products, **Corning** (GLW) Glass is now investing some \$300 million in a new research facility to bring this fiber capacity closer to the nations homes and businesses. Lucent, Ciena, and **Tellabs** (TLAB), using chips from **Uniphase** (UNPH), **SDL** (SDLI), and others, are moving ahead with plans for passive optical add drop multiplexers, splitters, and other components for a full communications network as opposed to merely point to point connections.

Meanwhile, scores of wireless companies are working to deliver Internet access at T-1 rates (1.544 megabits per second) and higher directly to households and offices. Some will use **Qualcomm** (QCOM) broadband CDMA cellular systems; some such as **Teledesic** will employ low earth orbit satellites with fiber like delay times; others will move up to bands at 18GHz—Teligent; 28 GHz—**CellularVision** (CVUS); and even 38 GHz—**Winstar** (WCII). Although these high frequencies are afflicted with problems (chiefly the likelihood that Congress will choose once again to auction them off in a typically litigious and pettifogging way), the technologies were all on view in Boulder in August at the IEEE Wireless Communications Conference.

The most important facet of this Internet bandwidth is that it is dumb. That is also the forte of computers; they are dumb but fast. The key goal of the new paradigm companies is to make the Internet as fast as it is dumb. Celebrated in the August GTR was **@Home** (ATHM)—the newly public collaboration of **Kleiner Perkins** venture capital with cable companies led by **TCI** (TCOMA). @Home accelerates net access by coupling the cable

infrastructure with a national fiber backbone and local Web caches. Meanwhile, a new paradigm access infrastructure is emerging from a seething welter of some 4 thousand Internet service providers (ISPs), up some 80 percent during this year of acclaimed “consolidation,” while revenues rose by a factor of three and traffic by a factor of ten.

Among the creators of the new net are **PSINet** (PSIX), joining its worldwide network of some 350 points of presence with **IXC Communications**’ (IIXC) fiber network of some 10 thousand miles. **Digex** of Maryland is linking its some 200 points of presence with **Intermedia**’s (ICIX) fast growing local loop and long distance business. Other ISPs, led by **TIAC**, a profitable \$20 million force in Massachusetts, are exploring links with utility companies to supply cheap broadband access. TIAC’s partner is **RCN**, a subsidiary of **C-TEC** that is collaborating with **Boston Edison** (BSE) in a \$300 million fiber buildout and with **Pepco** (POM) in the DC area.

The leader of the pack of new paradigm telecom suppliers is **WorldCom** (WCOM), which combines one of the world’s largest long distance fiber networks inherited from Wiltel, with one of the world’s largest local access fiber deployments, from MFS, and with UUNet, the nation’s largest Internet Service Provider (with \$250 million in revenues in 1996). WorldCom will

soon add one of the largest independent networks in Europe. Bringing all these strengths to a commercial pitch will be the launch of international Internet fax business later this year. With some 50 percent of all international phone traffic already devoted to faxes, WorldCom plans to offer the service on ordinary fax machines at some 50 percent below the usual circuit switched rates. The company estimates the global fax market at some \$92 billion. With the usual elasticities of telecom, that amount will grow as the Internet lowers the price. Based on software from **Open Port** and adapted dial up concentrators from **Ascend** (ASND), the system enables a company to combine its desktop, email, and standalone fax traffic in one common Internet fax connection. With fax leading the way, WorldCom is also well situated to capture an increasing share of other data traffic on its Internet service, while preparing to move voice as well to the new Internet paradigm. That is the power of a dumb network.

With even less between the ears is the Qwest network of dark fiber; the fiber is not lit in any

Qwest Communications has built a far reaching fabric of dark fiber optic lines along railway rights of way.

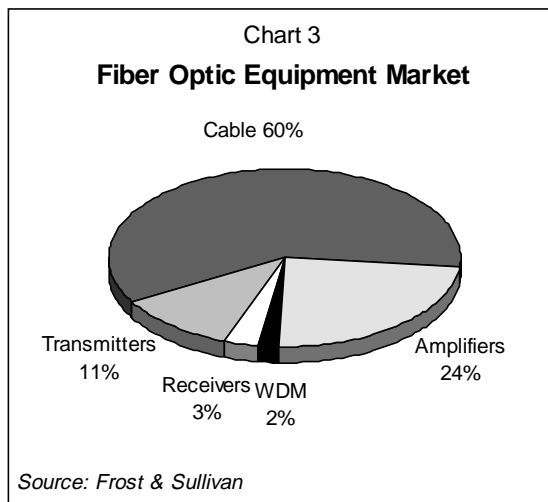
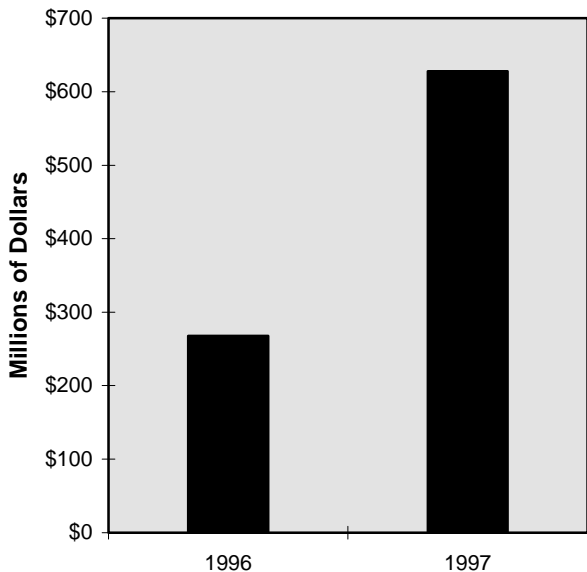


Chart 4

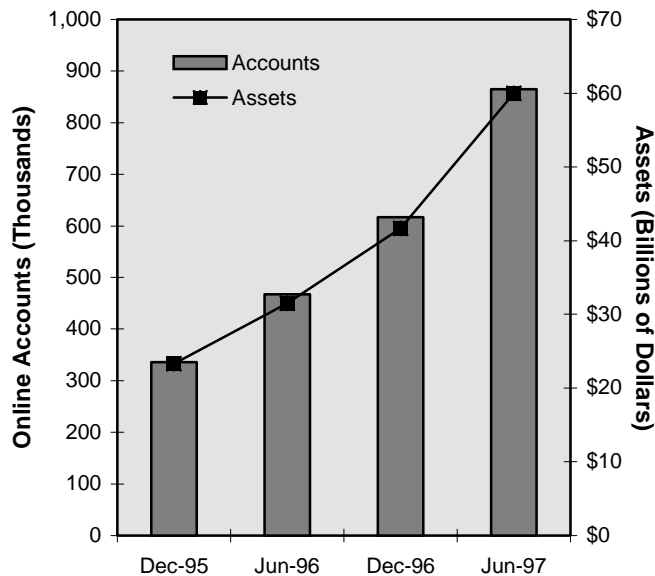
Online Trading Commissions



Source: Piper Jaffray Inc.

Chart 5

Schwab Online Accounts



Source: Charles Schwab & Co.

Business-to-business commerce on the Internet will rise 1,000% from 1996 totals to \$8 billion this year according to Forrester Research (Chart 1, page 1). Durable goods manufacturers, such as Cisco and Boeing, will account for at least \$3 billion (Cisco alone now calculates a \$3 billion run rate from Internet sales). Spot trading of natural gas and crude oil will raise the utilities sector to \$2 billion (Chart 15, page 7). While businesses shift trade to the Internet to reduce costs and increase sales, investors are also benefiting from discounted financial services being offered online. Piper Jaffray reports that even though online trading commission rates have fallen some 50% from 1996 to 1997, total commissions will rise 129% to \$628 million dollars, representing almost 30% of the discount brokerage market (Chart 4). Ahead of rapidly growing E*Trade and Fidelity Investments, Charles Schwab & Co. leads the online trading industry with 35% of all trades. In July 1997, Schwab counted 908,000 active online accounts with assets of \$66.6 billion (Chart 5). Schwab customers now place over 40,000 online trades a day—36% of all the company's transactions.

Home PC sales will accelerate as component prices decline, fueling the continuing rise of the Internet and e-commerce. While a June Wall Street Journal /NBC News poll found PC penetration has climbed to 51%, there is still room to grow according to a recent CEMA survey of non-PC owners. Of non-owners, 22% reported they were very or somewhat likely to buy a PC, potentially raising penetration to 62% (Chart 6). Asked why they didn't yet own a PC, 6% replied that they intend to buy one. Another 18% who cited PCs as too expensive and 7% who can use a PC outside the home, may be induced to buy as prices decline. As workers become more dependent on email, as e-commerce proliferates, as cheap Internet telephony and the wonders of the Web beckon, many of the 65% of non-PC owners who claim they have no need for a PC will change their opinions (Chart 7). We see no near-term limit to PC penetration and the home PC market is by no means limited to first time purchasers. Only 36% of home PC purchases in the first half of this year were first time buyers, with replacement and additional purchases each accounting for just under 1/3 of sales (Chart 8). Price drops will obviously encourage sales of additional PCs, PC upgrades and replacements. PC Meter reports that only 41% of home PCs are current-generation Pentium-class systems, 47.5% run Windows 95 (Chart 9).

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Chart 6

Non-PC Owner Likelihood of Buying PC

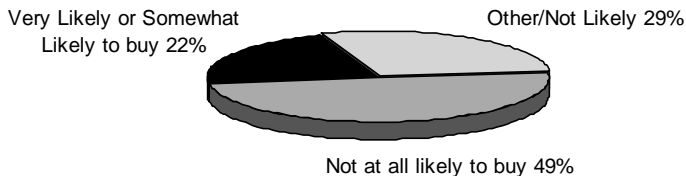


Chart 8

Home PC Purchases

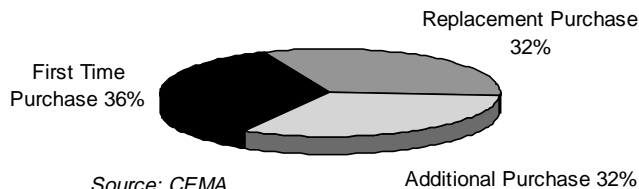
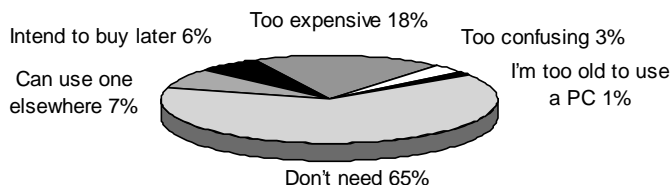


Chart 7

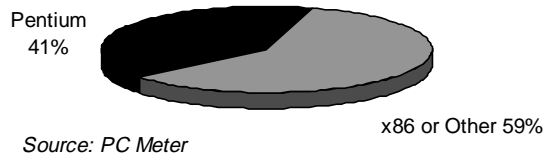
Why Don't You Own a PC?



Source: CEMA

Chart 9

Home PC Upgrade Potential



Source: PC Meter

Chart 10
100% Pure Java Applications

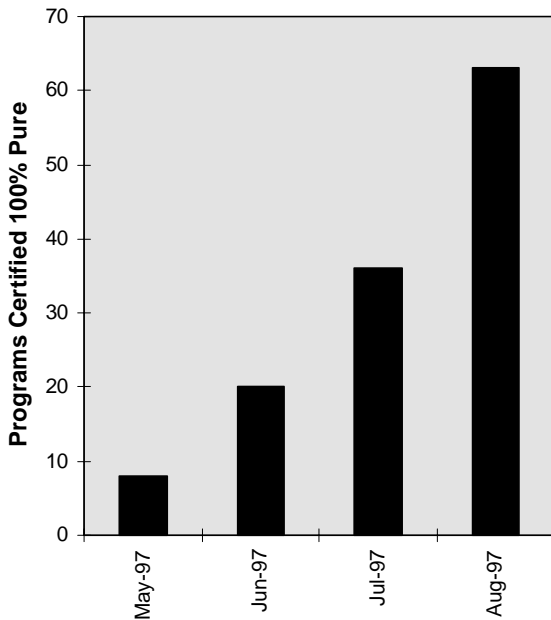
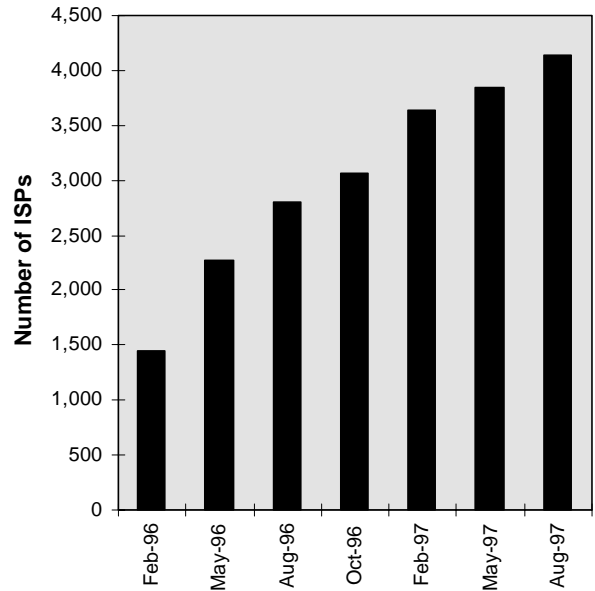


Chart 11
Internet Service Providers



Source: Boardwatch Magazine

Sun's version of platform-independent 100% pure Java has been gaining momentum. *As of August, 1997, 65 Java applications from some 55 different companies have been certified "100% pure Java" (Chart 10), even though Microsoft created JDirect, which ties Java directly to Windows-specific APIs (application programming interfaces) and drew a line in the sand, threatening not to ship Sun's JFC (Java Foundation Class) libraries. With the Microsoft-Apple investment and agreement to collaborate on Java virtual machines to ensure compatibility, Microsoft seems to have committed to making its implementation of Java platform-neutral—for at least those two operating systems. Meanwhile, beyond the PC desktop, Java is making its biggest strides in small processors embedded in smart cards. Nearly all the smart card vendors have licensed Java, and Sun recently acquired Integrity Arts for its smart card expertise. The biggest advance comes with Visa's 21,000 member banks' approval of a move to Java-based smart cards. Visa expects to have 2 to 3 million Java-based smart cards in use in the US by the end of next year and to have Java cards replace 200 million of the 600 million Visa cards in use worldwide by 2001.*

The number of Internet service providers (ISPs) continues to climb despite claims that the industry is consolidating. *This summer, the number of ISPs self-registered at "the List" plunged from over 5,000 to just 3,000. The drop occurred when the List renovated their site, removed all ISPs from the database and asked them to re-register. Within days, over 3,000 had done so and the new total continues to rise. Meanwhile, the database of ISPs maintained by Boardwatch magazine which is continually being revised—both with additions and occasional removals—has consistently grown (Chart 11).*

The Internet continues to grow at an astounding pace. *The number of domains registered with InterNIC, counted in domain name system (DNS) databases by Network Wizards, and actually individually polled by Netcraft have increased 9% to 10% a month (Chart 12). The number of "hosts", or domain names with an IP address in the DNS—typically a permanently connected computer such as a Web, mail, or FTP (file transfer protocol) server—increased 51% in a year to 19.5 million. While Dataquest estimates the total number of named (hosts) and anonymous computers connected to the Internet has climbed 71% in a year to 82 million. Our data on Internet traffic passing through the major national NAPs (network access points) and MAEs (metropolitan area exchanges) shows traffic increasing by an average of just over 7% per month, which corresponds to MCI reports of traffic on their network growing by 6% per month (Chart 13).*

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Chart 12
Internet Domains

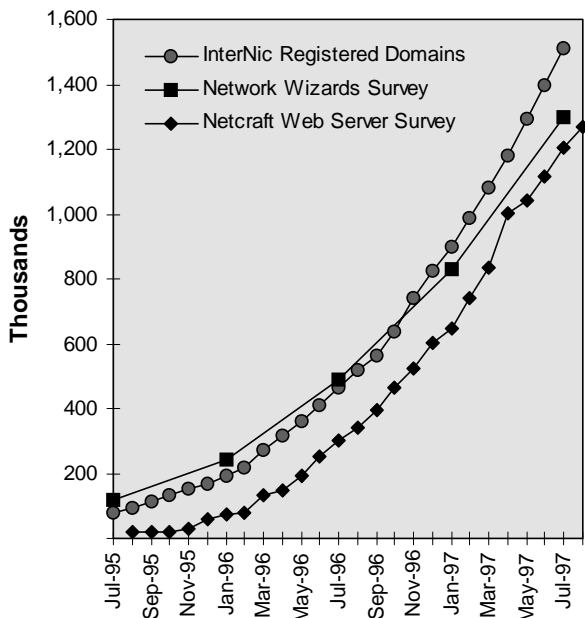
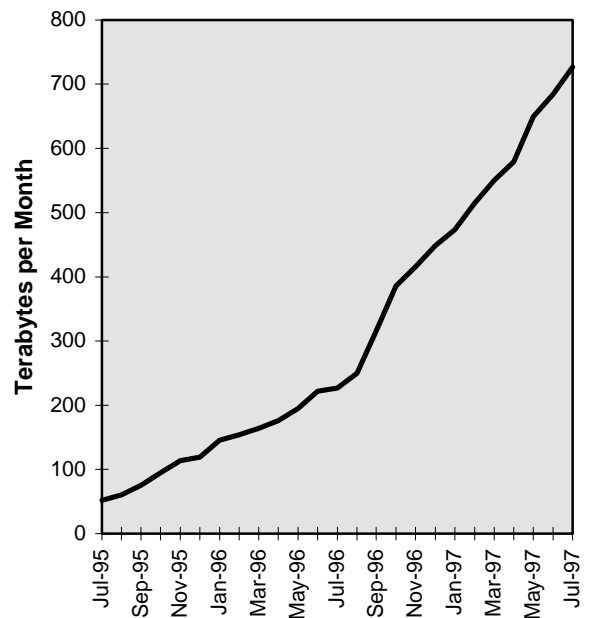


Chart 13
Internet Traffic



The leader of the pack of the new paradigm telecom suppliers is WorldCom.

particular way. If you want to send data, you can laser it yourself in any pattern that fits the increasingly capacious fiber bandwidth. You can send any kind of bits you want, from orotund speeches to encrypted credit cards to CAE netlists to first-step baby videos to callipygian ladies of the night. The net will not care. As Isenberg, AT&T's house iconoclast puts it, in a smart network the network tells the data what to do and where to go; in a dumb network, the data tells the network what to do and where to go. The key to the Internet is that it operates at a layer above all the physical and transmit systems. It is not smart enough to mess with your communications.

Isenberg became a convert to dumb networks when he served on an AT&T "True Voice" technical team. "AT&T True Voice was a valiant attempt to improve circuit switched voice quality as much as possible in the context of current network architecture. If we had not been constrained by network architecture, the easiest way would have been to increase the sampling rate or change the coding algorithm." For example, a psycho-acoustics expert recommended boosting the base frequencies. "But to actually do this, we would have had to change every piece of the telephone network except the wires." Modems, fax machines, echo cancellers, voice mail systems all depended on "intelligent" assumptions about the acoustics of the signal.

Over the last three years, Internet Service Providers have been building a dumb infrastructure to displace the Advanced Intelligent Networks of the phone companies. Yet is it really likely that such dumb companies as **Netcom** (NETC), **BBN** (GTE), **WorldCom**, **Verio**, **Earthlink** (ELNK), **Mindspring** (MSPG), **ANS**, **Digex**, **@Home**, **ATMNet**, **Net Access**, **TIAC**, and your own **neighborerd.net** will really replace the giant Regional Bell Operating Companies (RBOCs)? That Internet telephony will displace the circuit switched systems of the past? Are not the ISPs already struggling for survival.

The answer is that the dumb networks are now worth some \$30 billion and are growing some twenty times faster than the old smart networks of the RBOCs. Not only did the number of ISPs climb by 48 percent over the last 12 months but their total revenues approximately tripled. The dumb network suppliers—such as Cisco and **3Com** (COMS)—are rolling over the old telecom equipment vendors and have become the fastest growing industry in the world economy. Lucent,

AT&T, and Micom, a **Nortel** (NT) subsidiary, are all rushing into the market for IP telephony gateways, which link IP voice to the public switched network. Some 20 percent of all corporate Intranet traffic is now voice.

But voice is merely a symbol of the threat to the existing telephone nets. The real menace to established telecom companies is the rampant spread of Internet data, at a time when data bits outnumber voice bits even among the regnant local exchange carriers. Over the next decade, all telecommunications will become Internet communications. And the killer app will be commerce.

Why then does commerce languish, as CD-ROM titles proliferate and expire, educational software limps, and the heralded movement of newspapers onto the net finds few interested customers? Following John Perry Barlow's pioneering *Wired* essay on intellectual property, "New Wine in Old Bottles," Esther Dyson

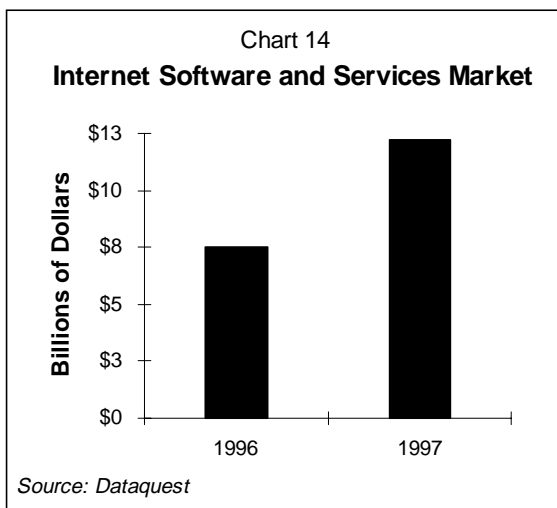
proclaims—as a glum portent for the coming age of information—a general devaluation of information goods. To make money, she says, us information touts will have to hoof it out again onto the Chautauqua circuit. (OK, so I'm holding a conference in September with all the chat & talk ya could want). Yes, the net offers Virtual Vineyards and Flowers galore. But is the net still languishing

through days of wine and roses? A typical company may spend a quarter of a million dollars on its web site during the course of a year, garner millions of hits, and no RBIs (revenues batted in).

To win on the net, you must have the right paradigm. The key to Internet commerce is the correct allocation of complexity and simplicity, power and control, conduit and content.

Let us try a list of ten rules of Internet commerce for a paradigm company.

- 1) *Separate content from conduit.* If you own a broadband conduit, you will want everyone's content to run on it. If you own content, you will want it to run on everyone's conduit. Violation of this rule has torn **Time-Warner** (TWX), among other companies, apart. It doomed the Orlando project, devoted to streaming movies over state of the art **Silicon Graphics** (SGI) terminals to homes. It has rendered TCI, for all John Malone's brilliance, a schizoid mess. And Time Warner is still at it, announcing a new cable service to hotels in New York, combining a set of complex delivery technologies with a set of TW content, and **USWest** (USW) is still embroiled with Time



Warner content. In the new infrastructure, ISPs and bypass providers such as **Teleport** (TCGI) and WorldCom leave content production to their customers.

2) *Wield Occam's razor*; shear off all unnecessary complexity; the simplest solution will prevail. For example, if you are creating a system for Internet cash, it should not entail the creation of complex digital wallets, signatures, passwords, and other paraphernalia that stuffs the pockets of the mind to overflow. This has been the mistake of most of the cyber, digi, net, and milli cash projects.

3) *Remember Einstein's caveat* to Occam: the solution should be as simple as possible, *but no simpler*. Encompassing necessary levels of security, efficiency, collections, and delivery, electronic commerce is inherently complex. Excessively simple solutions are likely to violate the Einstein's caveat.

4) *Be insecure*. Life is insecure. So will be the Internet. Live with it. The effort to banish all possible threats to the security of web transactions will doom them to stifling complexity. The Web is already exempt from many perils of the real world, including burglary, shoplifting, mugging, arson, water damage, and flat tires. It may be more vulnerable to computer hackers. As time passes, people will learn to circumvent them.

5) *Forget TV sets*. They are not an interactive medium and never will be. Within the next five years, TV content will be a subset of the net, delivered through web sites; sets will be a mere display option—a special purpose monitor. Using the TV as a mere monitor, however, may work for Joe Parkinson, the former **Micron** (MU) CEO, who is now spearheading a new public company called **8x8** (EGHT), which sells full video teleconferencing systems, from chips to box and camera, for \$329. Today it works only with the TV and he is summoning an impressive business, including a \$5.25 million license from US Robotics. Incorporating a Planet Web browser, it also can surf the net; a WebTV plus video telephone. Give one to Grandma. By next year, I predict, it will be adapted to PCs.

6) *Be platform neutral*. You should not care whether the information product you are selling comes from a hard drive, a DVD drive, a CD, or a tape drive, and you don't care whether it is delivered from a satellite, a local ISP, or a FedEx truck. TIAC recently decided to replace its Silicon Graphics web servers with Digital Alphas that function faster and more reliably.

7) *Bet on bandwidth*. Whatever is possible today, will be available tenfold next year. Do not commit to a delivery system that will be obsolete within three years. Commit to a terminal system that is scaleable and upgradeable—i.e. a PC or network computer.

8) *Put the PC maker into the action*. The computer companies that create the terminals for Internet commerce will demand to participate in the recurring profits. This is the strength of **Wave Systems** (WAVX), which manufactures an encryption and metering system allowing hardware suppliers to participate in the transactions flow through their machines—rather than forgetting the customer as soon as the machine is booted up. (My presence on the Wave Board of Directors, suggesting a superior interest but not necessarily any superior knowledge, has yet to work any magic).

9) *Keep out the conduit supplier*, except by compensating for conduit services. In an era when

global commerce migrates to the net, the communications business will thrive. But communications companies should not be in the movie business or the book business.

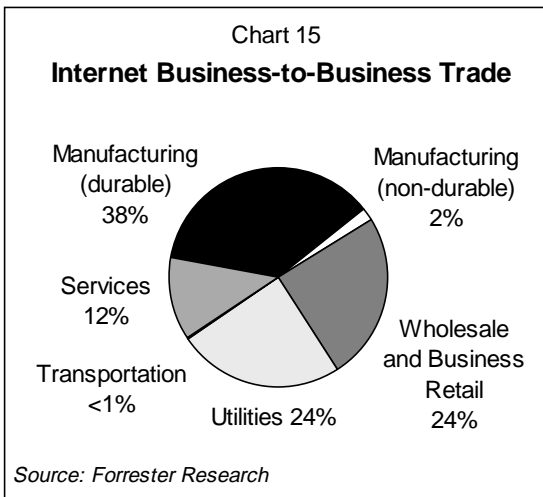
10) *Don't solve problems*. You'll subsidize your weaknesses and starve your strengths. Instead, pursue opportunities. For nearly every business, Internet commerce is today the world's largest new opportunity.

A key function of entrepreneurs is to define and create defensible forms of property. Until the invention of barbed wire, open land seemed as indefensible as information on the Web today. From corporate equity to bond strips, the history of the financial industry is chiefly a saga of invention of new forms of salable and defensible property. In this process, property is never defined with perfection or defended hermetically. The Web scarcely excels the Xerox machine and the disk drive as a threat to the property rights of authors and programmers. Yet book, magazine, and software industries have become central economic activities.

It is not dishonest people who threaten the property rights of the software industry. From retail stores to microchip trucking docks, dishonest people steal whenever they get the chance. Moderate levels of security—and aggressive police work—can control this problem. The problem of software and intellectual property rights is thievery by honest people. This is chiefly a problem of moderate security combined with reasonable pricing.

For example, leading Computer Aided Design

The key to Internet commerce is the correct allocation of complexity and simplicity, power and control, conduit and content.



TELECOSM TECHNOLOGIES

ASCENDANT TECHNOLOGY	REPORT(S) Volume: No.	COMPANY (SYMBOL)	Reference Price	Price as of 8/29/97
Cable Modem Service	I: 2, 3 II: 7, 8, 9	@Home (ATHM)	19 1/2	19 1/8
Erbium Doped Fiber Amplifiers, Telecommunications Infrastructure, Wave Division Multiplexing (WDM)	II: 2, 3, 4, 7, 9	Alcatel (ALA)	16 3/4	24 5/8
Analog to Digital Converters (ADC), Digital Signal Processors (DSP), Silicon Germanium	II: 3, 7	Analog Devices (ADI)	22 3/8	33 1/8
Java Thin Client Office Suite, Rapid Application Development (RAD)	II: 6, 7	Applix (APLX)	4 1/2	11 1/16
Digital Video Codecs	II: 5	C-Cube (CUBE)	23	30
Erbium Doped Fiber Amplifiers, Wave Division Multiplexing (WDM)	II: 2, 7, 9	Ciena (CIEN)	23 *	47 3/4
Low Earth Orbit Satellites (LEOS)	I: 2 II: 1, 3, 4	Globalstar (GSTRF)	21 3/4	38 13/16
Single Chip ASIC Systems, CDMA Chip Sets	II: 8	LSI Logic (LSI)	31 1/2	32 3/16
Telecommunications Equipment, Wave Division Multiplexing (WDM)	II: 1, 2, 7, 9	Lucent Technologies (LU)	47 1/8	77 7/8
Single Chip Systems	II: 8	National Semiconductor (NSM)	31 1/2	34 7/16
Internet Software	I: 1, 3, 4 II: 1, 4, 6, 7, 8	Netscape Communications (NSCP)	53	39 13/16
Code Division Multiple Access (CDMA)	I: 1, 2 II: 1,3,4,7,8,9	Qualcomm (QCOM)	38 3/4	46 1/4
Nationwide Fiber Network	II: 9	Qwest Communications (QWST)+	40 3/4	40 3/4
Java Programming Language, Internet Servers	I: 1, 2, 3, 4 II: 1, 5, 6, 7, 8	Sun Microsystems (SUNW)	27 1/2	48
Servnet System Area Networks (SAN)	I: 1, 7	Tandem Computers (TDM) **	9 1/2	34 1/4
Optical Equipment, Smart Radios, Telecommunications Infrastructures	I: 1 II: 1, 2, 3, 9	Tellabs (TLAB)	29 1/8	59 11/16
Digital Signal Processors (DSP), DRAM	I: 2, 3, 4 II: 5, 8	Texas Instruments (TXN)	47 1/2	114
Wave Division Multiplexing (WDM) Modulators	II: 7, 9	Uniphase (UNPH)	58 3/4	68 1/4
Code Division Multiple Access (CDMA) Testing Gear	II: 1, 2, 7	Wireless Telecom Group (WTT)	10 3/8	11 15/16
Telecommunications, Fiber, Internet Access	II: 9	WorldCom (WCOM)+	29 15/16	29 15/16
Field Programmable Logic Chip	I: 3	Xilinx (XLNX)	32 7/8	47 1/2

+New Addition

** To be acquired by Compaq

* Initial Public Offering

Note: This table lists technologies in the Gilder Paradigm, and representative companies that possess the ascendant technologies. But by no means are the technologies exclusive to these companies. In keeping with our objective of providing a technology strategy report, companies appear on this list only for these core competencies, without any judgement of market price or timing.

and Engineering companies such as **Cadence** (CDN) and **Mentor** (MENT) employ "dongles" to protect high end software from theft. A dongle is a small extension to the parallel port of a computer that validates a particular piece of software; your program will not run without the right dongle. You can move the dongle to another computer. But with just one dongle programmed to run a particular package, you cannot duplicate software.

This device suffices to protect complex and costly programs used by honest people. But a hardware attachment is clearly unsatisfactory for net commerce in software and fails to alleviate the misalignment of prices.

A technical leader among the raft of companies pioneering in the creation of new forms of defensible property, correctly priced, Wave in July announced a software licensing agreement with **Aladdin Knowledge Systems** (ALDNF) of Israel, a leading dongle manufacturer, which has also purchased part of Wave. This license will allow Wave to create a software dongle that could be used to sell software on the net.

Also July 17, Wave announced a joint venture with **Internet Technology Group**, a fast growing Internet provider in Great Britain, to launch a high-

speed electronic content distribution service based on Wave's metering, security and transaction processing system in Europe, Africa, and the Middle East. With one million dollars paid by ITG on signing, Wave recognized its first significant revenues. Nothing comes easily, however. Although close to breaking through with hardware and software producers, Wave now faces the threat of delisting from NASDAQ as a result of falling below the \$4 million capital requirement. Hey, the R in GTR can stand for risk as well as return!

The rise of the dumb network is inexorable. Reed Hundt, the outgoing FCC Chairman got it almost right: "Today's system is a \$300 billion sunk cost, circuit switched telco network whale with a tiny market of ISPs circling around like pilot fish." But ISPs are far beyond the pilot stage. Let's call them piranha. Hundt demanded cheaper T-1 lines and other measures. But what is truly needed is aggressive bypass onto the ever widening highways of Internet commerce.

George Gilder, September 1, 1997

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