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TELECOSM 2K

Companies pioneering "disruptive" technologies in new markets achieve a success rate 6 times higher and revenues 20 times greater than companies trying to enter established markets.

"Don't solve problems, pursue opportunities," has long been my Druckerian mantra. Many of you are bored with it, right?

I add to it here the observation of the great James Burnham, a Drucker of yore, who wrote *Managerial Revolution* in the 1940s and in *Suicide of the West* helped shape Ronald Reagan's defense policy.

Burnham's corollary is: "If there is no solution, there is no problem."

I was thinking about both these apothegms last month as I underwent the cognitive shock of passing from the Gilder/Forbes Telecosm Conference, Bandwidth Blowout, at Squaw Creek to the Discovery Institute Year 2K conference in Washington, DC. From the sublime reaches of the Telecosm to the ridiculous pits of the millennial glitch is the definition of bathos. But there is nothing ridiculous about the threat to our prosperity implied by the year 2K imbroglio and nothing trivial about the technical and managerial challenges of the issue. The real year 2K crisis is a crisis of the old order in software as it faces what Clayton Christensen calls "disruptive" technology.

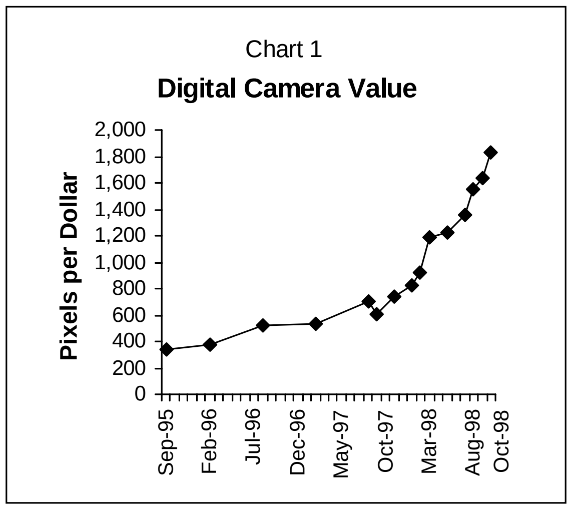
Christensen opened the program at Telecosm with a teleconferenced keynote based on his masterpiece, *The Innovator's Dilemma.* The most profound and useful business book ever written about innovation, it catapults its softspoken author abruptly into the class of Burnham and Drucker. It also makes Christensen the paradigmatic marketing visionary of the Gilder Technology Report. Along with Michael Jensen, Christensen is a rare creature: a Harvard Business School professor who produces original research of powerful relevance to businessmen and investors, of all people.

With trenchant and detailed exploration of a variety of industries, from disk drives and steel minimills to excavators and motorcycles, from retailing and computers to printers and medical equipment, Christensen shows that brilliant management cannot defend an established business against what he calls a "disruptive" technology. By contrast, established firms are nearly impregnable in delivering "sustaining technologies." These are technologies, however novel and challenging, that improve performance in existing markets with existing customers or move the firm up market to yet more demanding higher margin customers. Look at **Intel** (INTC) and **Microsoft** (MSFT) for many current examples. Yet

Next year, Qualcomm's pdQ will incorporate a digital modem that operates wirelessly at rates up to 2 Mbits a second. Sprint PCS is preparing to launch it throughout their regions.

disruptive technologies are the source of most of the growth and change in any economy. They are cheaper and worse technologies, like the personal computer or steel minimill were, or digital cameras and Java are today, that cannot compete in mainstream markets but gain a niche among less demanding customers. Because they are cheaper, they ultimately command larger markets. Thus they accumulate unit volumes faster and ride a steeper learning curve. In the end, the disrupter surges into the mainstream and sweeps away its established rival.

Christensen shows that companies pioneering "disruptive" technologies in new markets achieve a success rate six times higher and revenues 20 times greater than companies trying to enter established markets, even with superb new technologies. Boldness and creativity, out of the box and off the wall, trump market research nearly every time. If the market already exists to research, you are too late. The usual surveys and focus groups are worthless. You have got to listen to the technology. This is one of the reasons why you read GTR.



Christensen is so humbly superb that we kept him in the program at Telecosm even after he announced late in the game that he would have to stay home to teach his classes in Cambridge. He vindicated this decision, despite the limits of narrowband links across the country, by setting the theme for the rest of the conference, including Bill Joy's gripping presentation of the disruptive new Java paradigm called Jini.

Christensen's insight is that if all your dreams as a CEO come true, you are doomed. If you are a brilliant manager with big margins, dominant market share, exclusive channels, large factories, loyal customers, and proprietary technologies, growing like crazy, you may well be about to hit the wall. Particularly if you are a virtuoso of the 80-20 rule–focusing on the top 20 percent of the market and products that bring 80 percent of the revenues–you are a sitting duck in a "failure framework." Especially if you listen to your customers and investors, summoning you toward big margins. Your customers and investors are Scylla and Charybdis, sirens luring you onto the rocks. Big margins will marginalize you.

The good news is that most of the time there is no way you can know it. All the indices of your success will improve right until the very moment that you crash. **Bethlehem Steel** (BS), for example, saw its market capitalization rise from $175 million to $2.4 billion between 1986 and 1989 by retreating from all low margin steel markets into its apparently impregnable bastion of high quality high margin sheet steel. In 1989, **Nucor** (NUE) launched the first continuous thin slab casting facility for sheet steel that would ultimately make obsolete most of the Bethlehem plant and equipment. Reporting record margins and revenues, Digital Equipment was acclaimed as one of the world's most excellent companies by Waterman and Peters (without notable dissent from anyone else) at the very moment its minicomputer stronghold was about to fall to PCs and workstations. There are scores of examples in the book.

Although Christensen does offer some consoling advice to established firms–set up entirely independent businesses with entirely different managers to test "disruptive" ideas–his message for the Brobdingnags is essentially bleak. Your success is an almost insuperable barrier to entry into the most fateful new markets–a barrier to your entry. And you don't really care. To executives in established markets, the low end products of disruptive technology offer paltry margins, flakey customers, and daffy marketing channels and deal in technologies that are drastically inferior to your own. Digital's customers, for example, had no interest in personal computers, which could not execute any Digital software and were inferior in every way except price.

Similarly, each new disk drive generation with a smaller form factor was inferior to the last in speed, capacity, and cost effectiveness. The only benefit of the smaller and worse drives was in providing storage first for desktop, then for portable, then for laptop, then for notebook, and finally for palmtop computers, all nearly non-existent markets at the time of introduction. Now the issue is flash memory modules for cellphones and smart cards. But don't sweat it. Although the downfalls of Digital Equipment and several disk drive producers were abrupt, the Bethlehem Steel folk enjoyed ten years of high margins before the new process began to cut deeply into their high end markets.

A likely current portent of future disruption is cheap low resolution low-profit CMOS (complementary metal-oxide semiconductor) cameras sold for **Nintendo** Game Boys and **Mattel** (MAT) Barbie Dolls. Based on a CMOS retina chip suggestive of Carver Mead's invention, the **Mitsubishi** device used in the Game Boy camera has a resolution of only 128 by 128 pixels with four gray scales. A further use is in parking lots–to tell attendants when a space opens up. Far worse than the charge-coupled devices (CCDs) used in high end digital cameras (a sustaining technology) and infinitely worse than high resolution analog cameras, this CMOS toy operates far beyond the ken of a **Kodak** (EK) or **Canon**

(CANNY). Nothing in their history or repertory of competence gives them any idea of how to respond. Moreover, they may well not have to. The vast majority of these inferior technologies fail. One of them will kill you, but you don't know which one.

If you try to defend against all likely disruptions, you will lose focus and jeopardize your forte and core competence as a company and still probably miss the disrupter that can bring you down. Your marketing channels, your technical resources, your manufacturing systems, your intellectual capital, your pattern of internal communications, your links to suppliers, your experience on the learning curve, and above all, your best customers and investors all define your very DNA as a corporation. You can no more beget disruptive technologies than an elephant can beget a batch of puppies. You can launch a kennel, but arguably, that is no longer your company. It is a new startup, a new investment, and you had better not hire elephants to run it.

Some large firms may gain an aptitude for harboring innovative new markets. **3M** (MMM) and **Thermo Electron** (TMO) are famous for successes as venture capitalists. That has become their core competence. **IBM** had a brief disruptive ride with its entirely autonomous Boca Raton PC project which introduced the IBM PC in 1981. **Hewlett Packard** (HWP) set up an entirely separate ink-jet printer company in Vancouver, Washington, to compete with the rest of the company, including its spearhead laser printer operation in Boise, Idaho. In the mid 1980s, **Quantum** (QNTM) won one battle in the disk drive wars by allowing a group of disgruntled executives to begin a new company, 80 percent Quantum owned, to pursue the then disruptive 3.5 inch disk market. Quantum's board closed down the original company when the new "Quantum" succeeded. Such exceptions prove the rule.

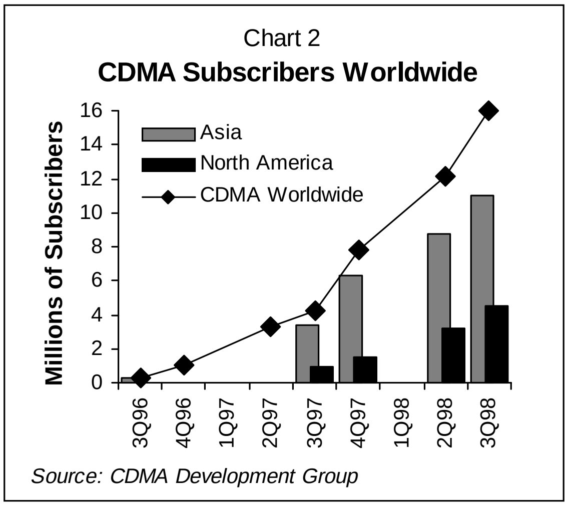


Chart 2

CDMA Subscribers Worldwide

Source: CDMA Development Group

In general, established corporations cannot grow by fostering small disruptive innovations. As a startup, **Apple** (AAPL) could win a stunning success by selling 45,000 Apple IIs in the first two years, generating almost all its revenues and growth. As a behemoth, Apple incurred a crushing setback by selling 150,000 Newton personal digital assistants in the first two years–three times the initial Apple II total–representing one percent of its revenues. Newton was disruptive, but launched within the old company, it chiefly disrupted Apple.

Similarly in retailing, Woolworth and Woolco floundered together, while **K-Mart** (KM) flourished when it was spun out entirely from Kresge. Kept within the corporate structure, Woolco's low margins, fast turnover, and alien culture chiefly disrupted Woolworth and brought both divisions down.

Offering a series of charts, Christensen graphs companies moving up and to the right–to the "Northeast Quadrant"–with the highest margins and the "best" most loyal and demanding customers. Companies are heliotropes, moving always toward the sunlight of the largest profits in New York and Boston. But as the largest margins come from an ever diminishing number of customers, in the end the light in the Northeast Quadrant is an aurora borealis leading firms into arctic wastes–with withered volumes and stunted learning curves–where companies go to die. See **Silicon Graphics** (SGI) clutch at Cray and the supercomputer market.

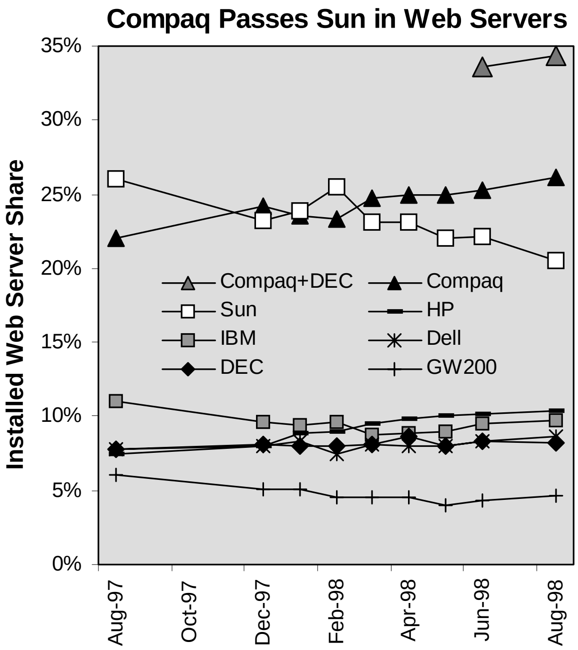
Like the deadly incurable diseases at large in the world, disruptive technologies may ultimately get you. But if you obsess about them, you will die instead of *mental* illness. Since there is no solution for you, there is no problem. You can console yourself that in illuminating your predicament, Christensen has at the same time pointed to a crucial reason why capitalism succeeds. Unlike socialism, it does not evolve into a petrified forest of oligopolies, unless government intervenes to enforce them.

In an offhand comment at the end of his speech at Telecosm, Christensen mentioned that in software, a classic disruptive technology for Microsoft is Java. It is slow, has little market share, most of your customers don't want it. It is buggy and unstable. Its chief function is as a web page cosmetic, as Microsoft's Charles Simonyi puts it, and there are many other web page cosmetics on the market that are easier to use. Java is gaining ground in such areas as smart cards and web application servers and CAE (computer aided engineering systems) and set top boxes and among anti-Microsoft bigots at companies such as IBM, **Sun** (SUNW), and **Oracle** (ORCL). Joined with Jini, it is gaining in white goods companies, appliances, security systems, and cell phones. This is no small thing. Readers of this newsletter know that the most common PC of the next era will be a digital cellular phone.

The two disruptive technologies are converging. Next year they will detonate. Mark Jacobs of **Qualcomm** (QCOM) showed me a new Qualcomm pdQ phone that includes a complete Palm [Pilot] organizer, with Eudora email and an onboard analog modem that operates up to 33 kilobits a second. Next year's pdQ will incorporate a digital modem that operates wirelessly anywhere at rates up to 2 megabits a second. **Sprint PCS** is preparing to launch it throughout their regions. In its first take, I am

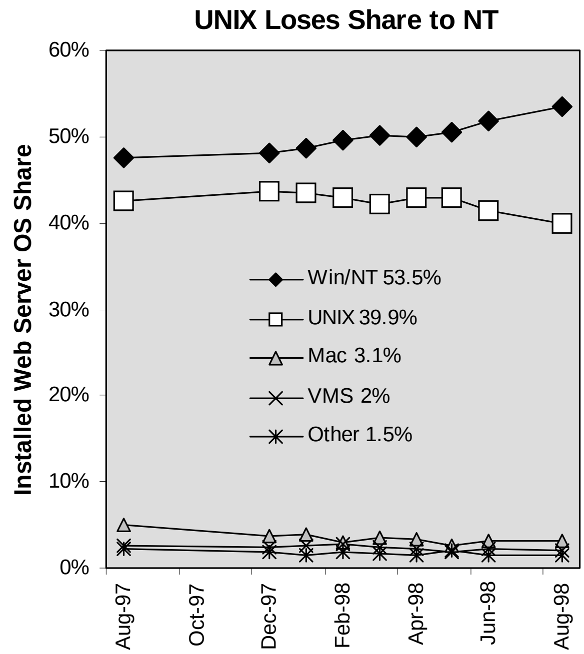
Big bandwidth is a classic disrupter. By most usual telecom metrics, it is inferior. Big bandwidth doesn't guarantee anything because it doesn't know what it contains.

Chart 3



Source: ZD Market Intelligence

Chart 4



Source: ZD Market Intelligence

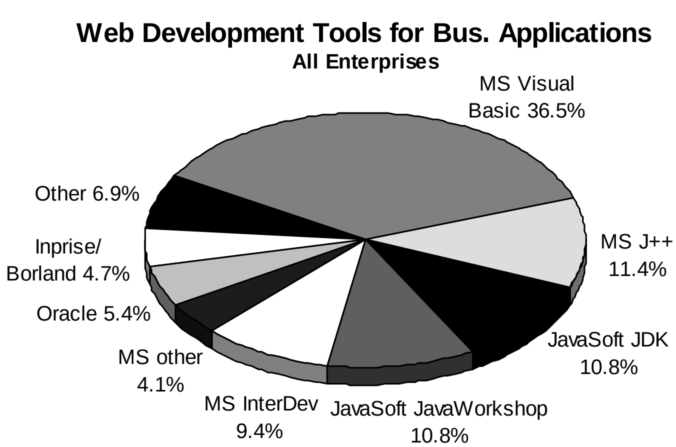
Sun Microsystem's record web server performance, *announced September 22, 1998, in which Sun demonstrated benchmark measures some 12% to 38% faster than competing systems, may be key in slowing Sun's declining web server market share. While Sun led among all hardware vendors in market share of installed web servers during 1997 and at the beginning of this year, Compaq assumed the top spot in the Spring. And following Compaq's merger with DEC (Digital Equipment Corporation) in June 1998, the Compaq-DEC combined share increased to nearly 35% (***Chart 3***). Sun's hardware share mirrors the declining share of web servers using the Unix operating system versus Windows NT based systems (***Chart 4***). The 130% growth in web servers from September 1997 to September 1998, prevents the automatic conversion of declining market share into declining sales figures. Dataquest reports Sun's worldwide server revenues grew 37% from 2Q97 to $1,157 million in 2Q98, even as the total market contracted 11%. But despite such success, Sun must be cautious. While Sun has staked its claim to making high performance servers, the NT threat crosses product lines. Dataquest also reported Sun's $930 million in workstation revenue for 2Q98 was down 20% from 2Q97, as the total workstation market shrunk 3.2%. Worldwide, Unix held a 66.5% share of workstation revenue, but NT led with 54.4% of unit shipments, reflecting NT's cheaper system prices.*

JAVA'S DISRUPTIVE ADVANCE

Microsoft's share of the web development tool market *decreased slightly from April 1998 (67%) to August 1998 (64.3%), as did Sun's JavaSoft division (25%-23.3%). While Borland (now Inprise) and IBM remained stable, Allaire jumped from 1.1% to 4.5%. Among US workplace sites conducting internal web development, HTML, including dynamic HTML, remains the most widely used development environment, with a penetration of 83%. Java's 39% penetration is 2.7 times third place CGI and nearly 6 times that of ActiveX. The market for web development tools used to create mission-critical business applications is led by Microsoft's Visual Basic with a 36.5% share among enterprises of all sizes. Microsoft's Java development tool, J++, is the second most popular tool with an 11.4% share, just ahead of JavaSoft's JDK and JavaSoft's JavaWorkshop with 10.8% share each (***Chart 5***). Among enterprises with 100-999 employees and 1,000+ employees, Microsoft's dominance increases and Java's share is diminished. But among enterprises with less than 100 employees, Java's dominance is near total, with the top three Java tools, led by JavaSoft, holding 89.5% market share (***Chart 6***). This striking "grass-roots" adoption of Java lends credence to Clayton Christensen's characterization of Java as a disruptive technology, and suggests the possible veracity of Sun's claims of 1 million Java developers worldwide.*

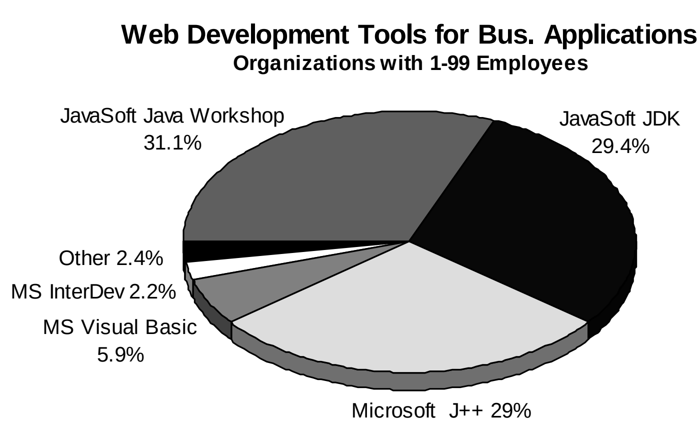
-KE

Chart 5



Source: ZD Market Intelligence

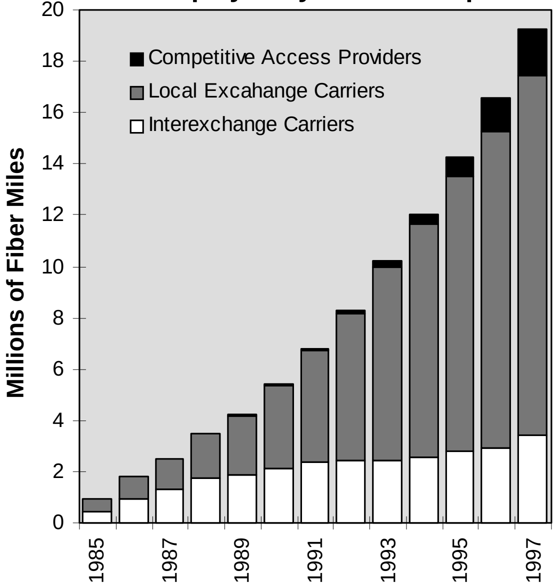
Chart 6



Source: ZD Market Intelligence

Chart 7

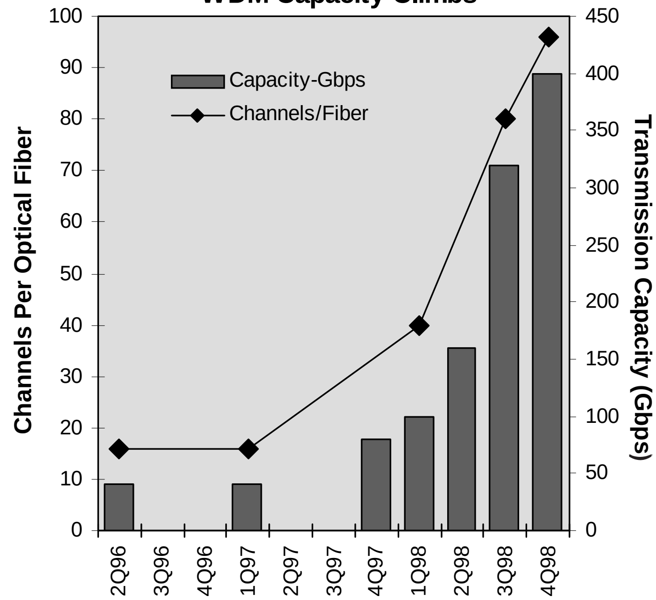
Fiber Deployed by Phone Companies



Source: FCC

Chart 8

WDM Capacity Climbs



Fiber Deployed by US Phone Companies, *as measured in fiber miles, increased 16% in 1997 (***Chart 7***) following 1996's 16.46% increase. Competitive access providers (CAPS) laid 513 thousand fiber miles, increasing their installed fiber by 39%. Deploying 477 thousand fiber miles in 1997 (vs. just 166 thousand in 1996), interexchange carriers increased their installed fiber 16.2%. Local exchange carriers with the largest base of fiber (over 14 million fiber miles), rose 13.56% while installing 1.674 million fiber miles, up slightly from 1.628 million in 1996.*

Wavelength Division Multiplexing *(WDM) capacity continues its rapid climb in 1998 (***Chart 8***). Lucent is reportedly now shipping its WaveStar WDM system. Surpassing Nortel's system of 32 OC-192 (10 Gbps) channels, WaveStar combines 40 OC-192 channels for a capacity of 400 Gigabits per second, but WaveStar can also carry up to 80 channels at slower rates. Ciena leads in number ofchannels , having demonstrated a 96 channel system in September. Ciena's introduction of an OC-192 interface will potentially increase their systems' capacity to 480 Gbps in early 1999, and nearly 1 Terabit per second by 2000.*

US Telco Fiber Capacity *is increasing faster than the 16% annual rise in fiber miles deployed due to WDM's vast improvement fiber transmission rates. Multiplying the length of a fiber (miles) by the inverse of the speed of light (seconds/mile) gives the approximate time it would take to transmit down the length of a fiber. Further multiplying by the transmission's data rate (bits/second) tells us how many bits can be stuffed down a length of fiber before spilling out the other end, the fiber's capacity.* **Chart 9** *combines the US phone companies' previous-year-end fiber mile total (from Chart 8) with the next year's fiber transmission rate (from Chart 9) to represent the total potential US telco fiber capacity.*

Global Undersea Fiber Capacity *mirrors the explosion seen in US telco terrestrial fiber (***Chart 10***), despite the differences between terrestrial and submarine fiber, such as fewer fibers per cable and the difficulty or impossibility of refitting undersea fiber with the latest WDM transmission equipment. The explosion of undersea capacity is due to the proliferation of major new cables using the latest WDM systems, such as Global Crossing's new networks. Systems planned and currently under construction will increase undersea fiber miles over 370% between 1997 and 2001. Over the same period, transmission speeds are increasing from 5 Gbps to 160 Gbps, resulting in a 8,134% rise in undersea fiber capacity, without retrofitting any existing systems.*

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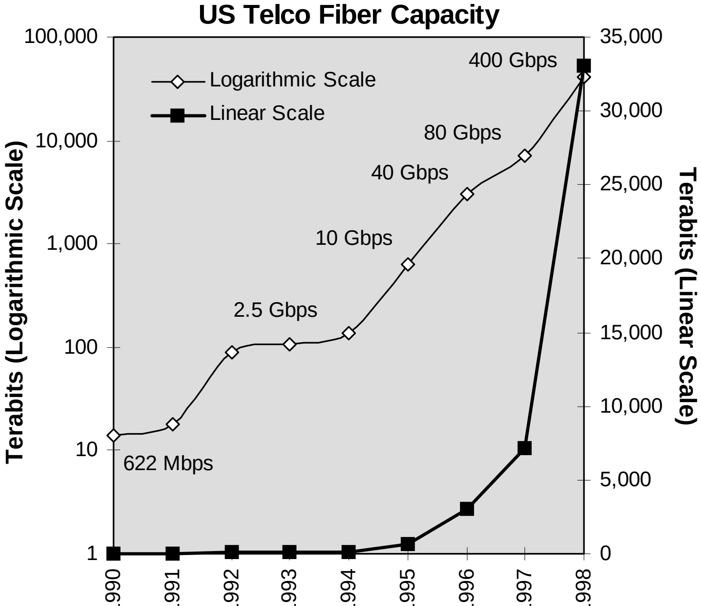
Chart 9

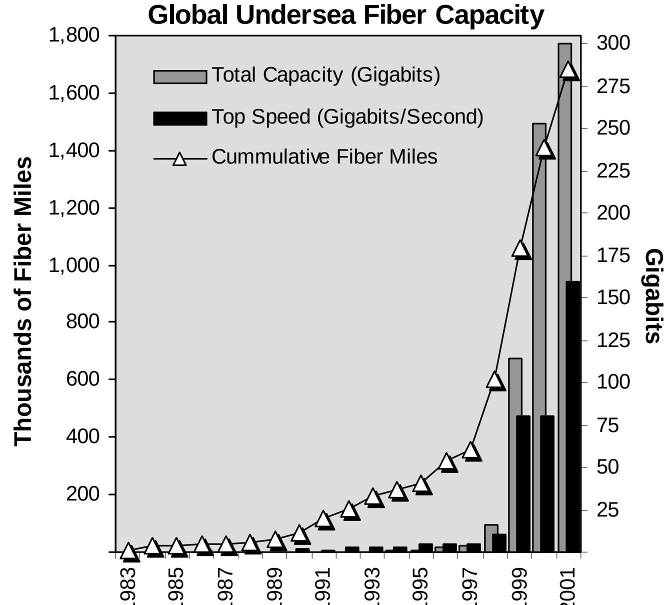
US Telco Fiber Capacity



Sources: FCC, GTG

Chart 10

Global Undersea Fiber Capacity



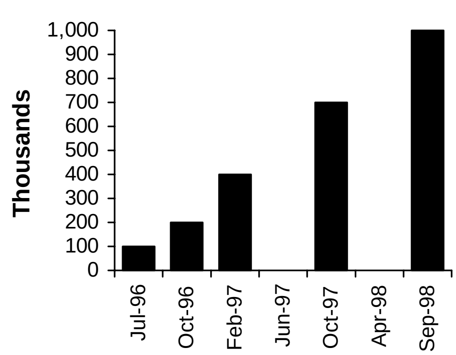
Source: GTG

Contrary to the apparent stock market appraisal, Tellabs needs Ciena far more than Ciena needs Tellabs. Unless Tellabs can figure out a transition to WDM, it is probably on the way out.

embarrassed to note, the pdQ does not include Java, but it will incorporate a Java runtime engine as soon as the Java folk get their act together to fit this form factor.

In other words, your digital cellphone will soon have a more powerful modem, more flexible email, and a better organizer and calendar than your desktop computer linked to the public switched telephone network. It will be a feasible vessel for video teleconferencing. Soon it will command speech recognition and link to a variety of new display technologies. It will become the modal PC. Its victims will reach beyond the established PC industries. For example, so called ADSL lite, the telcos' 600 kilobit per second answer to cable modems, is already obsolete. The new wireless modems in CDMA (code division multiple access) cell phones will enable full-motion, full-screen video to your notebook portable and fuel T-1 speed web browsing. Breaking the bandwidth bottleneck for Windows notebooks, it will be good for Microsoft. But it moves the value added in the industry away from the Wintel axis to single-chip systems for mobile devices. By every usual measure, these systems are inferior to Pentium IIs. But they economize on power and silicon area, the modal scarcities of the new paradigm.

Chart 11
Java Developers Worldwide



Sources: GTG, IBM, Sun Microsystems

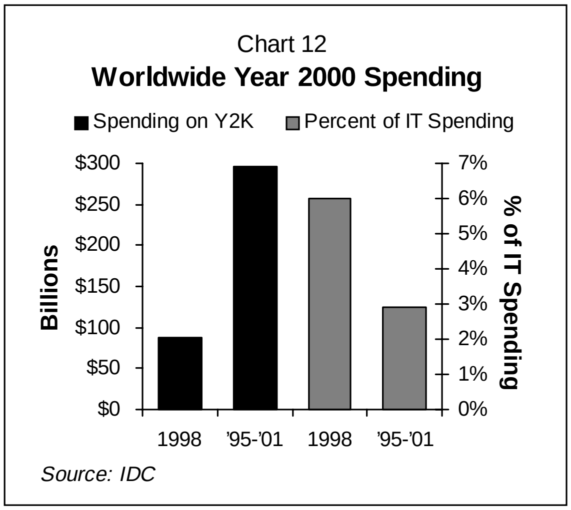
At a moment of dire transition in the industry, Java becomes a central disruptive force driven by as many as a million developers who are mostly producing inferior slow small programs that Microsoft's customers don't want. With bandwidth on the Net rapidly becoming comparable to bandwidth on computer backplane buses, however, the disaggregation of computer components and software, what Eric Schmidt called the "hollowing out" of the computer, becomes possible. Software fights free of its incarceration in bloated Office suites and breaks into manageable components that live on the Net. This allows Jini, Bill Joy's method of empowering a variety of appliances, from printers to cell phones, to announce themselves to other devices, such as automobile speakers or palmtop computers, as Java objects (rather than requiring an array of special purpose device drivers in your computer).

Christensen's model implies a shift to disruptive technology throughout the PC industry as Intel with superfast high powered processors and Microsoft with huge Office suites overshoot the needs of the market. The rise of the digital cellular phone as the key PC form factor heralds a shift in the basis of competition from megahertz and megacode. The industry is moving to low silicon area and low power in processors and convenience, reliability, and compactness in software, saving the customer's time and the programmers time rather than the microprocessors time. Java is quicker to write not only because of its considerable platform independence but also because of its garbage collection and other automatic memory management and its elimination of pointers. It is easier to use over the Net because of its security sandbox and it is better in application servers on the Net because of platform independence and it is better for smart cards and portables because of its compactness and security. None of these characteristics is of significant interest to the customers of Intel and Microsoft. Therefore these systems–single-chip, low-powered microprocessors and applets of component net-based software–are disruptive technologies.

From the model of disruptive technologies, the fact that Java cannot now be used in mainstream applications is to be expected (prematurely targeting the mainstream software market with Java was **Corel**'s [COSFF] mistake). But the attributes that make it unattractive in the mainstream market–limits of scalability, lack of powerful pointers, lack of panoply of device drivers–make it more appealing for the Internet market, for mobile cell phones, and for Jini based appliances. The fact that Java is ill suited for current distribution channels–PC makers and software retailers–is also to be expected. Java will move software distribution to the Net, redefining the distribution channel in a typically disruptive way. Java does not fit Sun's mainstream markets. Therefore Sun is correct in spinning off its Java division as an independent organization that can grow its own markets.

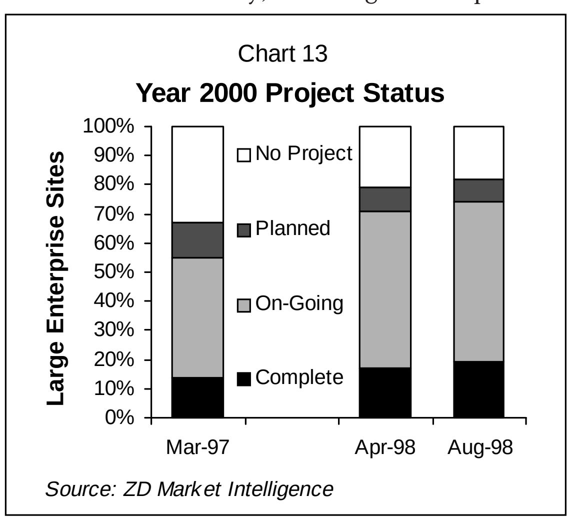
Java will become steadily more attractive as the bandwidth tidal wave sweeps component software sold on the Net into the mainstream. Thus Java converges with the other great disruptive technology: big dumb bandwidth.

Telcos and networking companies are meeting the innovator's dilemma in acute form as technologists make them choose between seductive proprietary forms of network intelligence and big dumb pipes linked with mostly passive devices. At the Telecosm Conference, David Passmore conducted the debate with himself–moving dramatically from one side of the stage to the other–as a choice between "big bandwidth versus managed bandwidth." Today, led by Microsoft, Intel, and the established telcos and telco suppliers (**Lucent** [LU], **Nortel** [NT]) and aspiring suppliers (**Cisco** [CSCO], **3Com** [COMS]), industry leaders are attempting to respond to bandwidth bottlenecks and network defects with software. They are offering guaranteed "quality of service"–low latency, low jitter, and assured rates of committed bandwidth–through "policy based networking," prioritization, time division muxing, rate shaping, flow control, Asynchronous Transfer Mode, flow based queuing, weighted fair queuing, reservation protocol (RSVP), and other fashionable buzzes. These algorithms enable you to provide guaranteed channels for full-motion video, CD-quality voice, super- bursty data, real-time transactions, secure financial flows, and palpable three dimensional holographic kisses over the Net, and charge differently for each one.



It won't happen. Let's begin by acknowledging that there are as many arguments for managed bandwidth as there are specialized services over the Net. Everyone wants to charge different customers differentially for different services. Everyone wants guarantees. Everyone wants to escape flat rate pricing. Forget it. In his brilliant evenhandedness, Passmore suggested that both big bandwidth and managed bandwidth would widely succeed. Thus he failed to reveal the full futility of the managed bandwidth argument.

Passmore could just have well named his debate, "Big Bandwidth versus Big Software." Needless to say, bandwidth and software are not perfect substitutes. But big bandwidth is a classic disrupter. By most usual telecom metrics, it is inferior, offering no particular quality of service, network control, or committed rates and latencies. Big bandwidth cannot connect you to 100 thousand 64 kilobit telephone circuits in a city. Big bandwidth doesn't guarantee anything because it doesn't know what it contains. But it is advancing its cost effectiveness at least 40 times faster than big software. In some ways (Y2K, for example), big software is going backward. With a factor of 40 or more, you can make up for a lot of latency and jitter, misalignments and misfits and missed dates.



Bandwidth is a substitute for much software complexity. Compare a wavelength division multiplexing (WDM) system which splits off a lambda with a simple bandpass filter with a digital add drop multiplexer that has to process the entire time division multiplexing (TDM) bitstream or a central office circuit switch with as many as 26 million lines of software code.

Passmore's dichotomy concealed the fact that the *only* way to guarantee quality of service is through big bandwidth. Quality of service software is mostly an optical illusion contrived by marketeers. It adds complexity and actually consumes the bandwidth it allegedly saves and increases delay while promising to reduce latency. While extending new guarantees and assurances of quality and reliability, it actually multiplies the number of potential points of breakdown and failure. It brings you into a maw of big software, proprietary systems, and smart networks.

Big bandwidth is the ultimate disruptive technology. With largely passive arrays of splitters, couplers, filters, and amplifiers, WDM menaces all the towers of switching, multiplexing, cross connecting, add-drop processing that dominate existing phone systems. That is why, contrary to the apparent stock market appraisal, **Tellabs** (TLAB) needs **Ciena** (CIEN) far more than Ciena needs Tellabs. Unless Tellabs can figure out a transition to WDM, it is probably on the way out. With rich resources of WDM technology, Ciena will be fine. Losing out at present to Nortel and Lucent's "sustaining technologies"–hybrid SONET/ WDM systems (often with the WDM left out for installation later)–Ciena will become a powerful contestant in the disruptive metropolitan and local area optical markets.

The year 2K crisis is only a particularly acute symptom of the flaws in the old order of mostly monolithic software. Millions of lines of intermeshed code, with complexity measured by the square of the number, with arbitrary goto leaps and loops across the mesh, with poor documentation and unintelligible logic, with costs dominated by debugging and testing, crowding what is scarce (shelf space, silicon area, marketing channels, programmer time and customer time), and ignoring the nearly infinite availability of storage on the Net and bandwidth emerging across it.

In many cases, as year 2K catastrophists will

In many cases, as year 2K catastrophists will explain, this tangle cannot be unravelled. There is no solution. Therefore, there is no problem, merely a condition. Much of the system has to be thrown out and replaced.

TELECOSM TECHNOLOGIES

ASCENDANT TECHNOLOGY	COMPANY (SYMBOL)	Reference Date	Reference Price	Price as of 10/9/98
Cable Modem Service	*@Home* (ATHM)	7/31/97	19 1/2	37 1/8
Silicon Germanium (SiGe)	*Applied Micro Circuits* (AMCC)	11/11/96	22 11/16	17 5/8
Analog to Digital Converters (ADC), Digital Signal Processors (DSP)	*Analog Devices* (ADI)	7/31/97	22 3/8	14 5/16
Dynamically Programmable Logic, SiGe, Single Chip Systems	*Atmel* (ATML)	4/3/98	17 11/16	7 15/16
Single-Chip Broadband Data Transmission	*Broadcom Corporation* (BRCM)	4/17/98	24 *	62 1/8
Digital Video Codecs	*C-Cube* (CUBE)	4/25/97	23	15 1/4
Erbium Doped Fiber Amplifiers, Wave Division Multiplexing (WDM)	*Ciena* (CIEN) +	10/9/98	8 9/16	8 9/16
Fiber Optic Cable, Components, Wave Division Multiplexing (WDM)	*Corning* (GLW)	5/1/98	40 15/16	28 7/16
Low Earth Orbit Satellites (LEOS)	*Globalstar* (GSTRF)	8/29/96	11 7/8	9 13/16
Business Management Software	*Intentia* (Stockholm Exchange)	4/3/98	29	17 1/4
Wave Division Multiplexing (WDM), Fiber Optic Equipment	*JDS Fitel* (Toronto Exchange)	5/1/98	19 1/4	11 3/8
Broadband Fiber Network	*Level 3* (LVLT)	4/3/98	31 1/4	26 7/8
Single Chip ASIC Systems, CDMA Chip Sets	*LSI Logic* (LSI)	7/31/97	31 1/2	11 9/16
Telecommunications Equipment, WDM, CDMA, SiGe	*Lucent Technologies* (LU)	11/7/96	23 9/16	62 13/16
Single-Chip Systems, Silicon Germanium (SiGe)	*National Semiconductor* (NSM)	7/31/97	31 1/2	8 1/8
Telecommunications Equipment, WDM, CDMA, SiGe	*Nortel Networks* (NT)	11/3/97	46	29 11/16
Point to Multipoint (7-50 Ghz), Spread Spectrum Broadband Radios	*P-COM* (PCMS)	11/3/97	22 3/8	2 7/8
Code Division Multiple Access (CDMA)	*Qualcomm* (QCOM)	9/24/96	38 3/4	40 15/16
Broadband Fiber Network	*Qwest Communications* (QWST)	8/29/97	20 3/8	30
Linear Power Amplifiers	*Spectrian* (SPCT)	7/31/98	14	8 3/4
Nationwide CDMA (Code Division Multiple Access) Wireless Network	*Sprint PCS* (Private) +	Anticipated IPO		
Java Programming Language, Internet Servers	*Sun Microsystems* (SUNW)	8/13/96	27 1/2	43 1/2
Broadband Wireless Services	*Teligent* (TGNT)	11/21/97	21 1/2 *	24 1/8
Digital Signal Processors (DSPs)	*Texas Instruments* (TXN)	11/7/96	23 3/4	51 1/16
High-Speed Copper Networking	*Tut Systems* (Private) +	Anticipated IPO		
Wave Division Multiplexing (WDM) Modulators	*Uniphase (UNPH)*	6/27/97	29 3/8	40 1/4
Telecommunications, Fiber, Internet Access	*WorldCom* (WCOM)	8/29/97	29 15/16	44 7/8
Field Programmable Gate Arrays (FPGAs)	*Xilinx* (XLNX)	10/25/96	32 7/8	35 13/16

\+ New Addition * Initial Public Offering

Added to the Table: Ciena, Sprint PCS, Tut Systems. Removed from the Table: Tellabs.

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.

explain, this tangle cannot be unravelled. There is no solution. Therefore, there is no problem, merely a condition. Much of the system has to be thrown out and replaced. That is good news for the software industry. It is also good news for the participants in my Bandwidth Blowout conference. Bandwidth can serve as a replacement for much of software complexity in computer networking and telecom. The year 2K issue will give huge impetus to a campaign to replace many of the obsolescent systems that pervade the information economy as it faces the onslaught of disruptive technologies.

I do not believe that the private sector needs any additional incentive to confront this crisis. Companies that fail will go bankrupt; executives who fail will lose their jobs. The reason Y2K is threatening is the array of public systems run by bureaucrats and politicians whose instinct is to shun the issue (i.e. Al Gore) and who have no market constraint to face.

The largest threat is the possible failure of power grid and military systems. Since nearly all the power equipment is manually operable, this will not be an extended outage. But it will exacerbate other problems. Full of embedded chips and software, the power grid is a largely public responsibility run by the public utilities commissions of fifty states and by bureaucrats in the Department of Energy. Because of the suppression of nuclear power, the system is dependent on railroad and transport infrastructure, ports and pipelines, railroads and tollways, also heavily regulated and bureaucratized and full of embedded chips. The key to getting these government systems working is political leadership. A good start would be for Washington to halt the impeachment circus.

George Gilder, October 9, 1998

After much consideration, we have decided to allow ForbesASAP exclusive rights to publish an occasional adapted text from the reports some six to eight weeks following receipt by GTR subscribers. In practice this will mean there is a possibility of a second wave of impact after initial publication.

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