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Message from Korea

The Korean example shows that when the new broadband connections are deployed, the Internet will undergo a new non-linear surge comparable to the hundredfold U.S. rocket of 1995 and 1996.

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Try to start a business from a home in the Berkshires of western Massachusetts, as Charlie Burger is trying to do, and you'll soon tumble into the gap between bandwidth and connectivity. If you are a phone company, putting terabits per second through a fiber is practical, and measured by the bit is cheap. Connecting to the fiber is the rub. Charlie's home is just six miles from the Massachusetts Turnpike, along which run several fiber optic cables streaming terabits per second of potential bandwidth, but he must dribble his bits through a dialup modem. I live even closer to bandwidth Nivana, a fiber cable running down the valley along a Tennessee natural gas pipeline a quarter mile below my house. But the bits may as well be on the moon. In fact, I get my Internet service from 23,600 miles away, through an artificial satellite moon launched by **Hughes** (GMH) Directway. Most residential users in the U.S. are not so lucky and still connect to the Internet via a dial-up service such as **AOL** (AOL) or **Earthlink** (ELNK).

In the past—and still today in benighted circles in Washington's communications bureaucracies—this narrowband plight of Americans is taken for granted. The then Chairman of the President's Council of Economic Advisers pointed out to me a few months ago that cable modems and telco digital subscriber lines (DSL) are available to ninety percent of the population. But only 20 percent take it. The problem is demand. Most people are satisfied with their TVs. They take their broadband service downstream only, as God intended, mixed with a pulsating potpurri of edifying advertisements.

In the face of news from abroad this American complacency and ignorance cannot last. The inventor, incubator, popularizer, and financier of Internet technology the U.S. may be. But the U.S. is no longer anywhere near the lead in applying it. In the last three years Asia has swept massively ahead of the U.S. in broadband deployment and use.

As Charlie has regularly pointed out, the Internet and its traffic are non-linear. Business and investment life are non-linear. It takes little time to turn the world of technology upside down. It happened here. Including a near hundred fold burst of new email and browser traffic in 1995 and 1996, Internet use rocketed 9,000-fold in seven years by 2002. Carrier traffic changed from docile 64 kilobit streams of voice to bursty riots of data requiring at least six to one headroom to handle. From under one percent of total traffic in 1994, IP (Internet protocol) data soared to near 60 percent in 2002. Some 5000 new Internet Service Providers (ISPs) popped up and sought ways to peer with the backbone kings such as **AT&T** (T), **Sprint** (FON), and Worldcom, who in turn were contested by upstarts **Qwest** (Q), Global Crossing, **IXC**, and **Level 3** (LVLT)—all once imperial companies now either gone or gimpy.

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Amid this eruption, optical equipment suppliers had to meet demand for capacity to handle hundreds of billions of emails, hundreds of millions of web pages, then billions of them, increasingly laden with pdfs, pics, gifs and jpegs, QuickTime and Real, Macromedia Flash and **Microsoft** (MSFT) media, then a surreptitious galore of peer-to-peer MP3 music files and MPEG2 films. The few experts who knew what was going on, such as Ethernet inventor Bob Metcalfe, believed that the Net would crash under the pressure. But despite many slow crashes and fast financial debacles, the industry rose to the challenge, providing for under half a trillion dollars an infrastructure that would have cost $39 trillion to build with the technology—all those **Lucent** (LU) 5ESS switches and **Nortel** (NT) Add/Drop Multiplexers (muxes)—on sale in 1995.

Some called this amazing achievement a bubble, citing as precursors tulip mania and South Seas panic. But it was more like 1929, a policy debacle in which protectionism, taxes, and deflation aborted a decade of overwhelming accomplishment. The Roaring Twenties propelled radios, automobiles, and telephone, oil and steel into mass markets, and laid the foundations for an ascendant America that could win World War II. The accomplishments of the 1990s were comparable.

Overseas revolution

After meeting the hundredfold Internet surge of '95 and '96, American communications technology managed to handle an ongoing ramp of traffic at a pace of near doubling every year through 2003. As traffic rose by a factor of 3,000 between 1996 and 2001, telecom revenues rose 50 percent. But bureaucrats in several Federal agencies and 50 states imposed a million word regulatory stranglehold on telecom and taxed the local loop as if they wanted to stop it in its tracks like tobacco. MIT economist Jerry Hausman estimates the average tax on wireless services at 18 percent. Because of the high elasticity of demand for cellphone use, so he calculates, these taxes costs the industry $3 in revenues for every $1 collected by the government. Added to these direct taxes were the punishing indirect taxes of an incredibly destructive spectrum auction process both in the U.S. and in Europe. Meanwhile, during the very period that the global telecom infrastructure was rebuilt for the Internet, monetary authorities imposed a deflationary chokehold on the dollar.

In a five-year deflation beginning in 1996, the dollar rose between 25 and 40 percent in value against other currencies, gold, and commodities. During the same five years, the U.S. telecom industry plunged hugely into debt to transform the global network. The chief effect of deflation is to punish debtors, who have to pay back their creditors in more valuable dollars. With a total of around 800 billion dollars of debt, increasing in value to over a trillion 1996 dollars by 2001, the communications industry sank under the load.

Hearkening to the regulators and litigators and ascribing the mostly non-existent bubble to *in*flation and *easy* money—as *Barron's* did just last week—the purblind media and politicians got almost everything wrong. A thousand bankruptcies in telecom? That was a product of accounting fraud and entrepreneurial crime. A paralysis in the local loop? That stemmed from the obstinate refusal of the Bell Operating companies to share their wires with rivals. The disappearance of thousands of dot.coms launched in the expectation of a broadband world? That reflected a lack of demand for broadband. A rapidly surging stock market? That resulted from inflationary monetary policy by Alan Greenspan, trying to assure the election of Republicans. Now, after the deflation is long over, Greenspan has begun warning about a deflationary spiral that already happened and the press fumes that the FCC is too deregulatory.

The real case was summed up by [Walter] Wriston's law, "Capital goes where it is welcomed and stays where it is well treated." While Washington raged at CEOs, concocted farfetched indictments, pummeled telecom with new rules and taxes, and supplied cover for trial lawyers, the industry's advance did not stop. Internet deployment and use accelerated sharply. The politicians, regulators and trial lawyers simply drove the capital and technology of the Internet revolution overseas, from Silicon Valley to Korea and China.

Sandy Fleischmann of the Telecosm board (www.gildertech.com) reports that the tweedledee dums at the FCC are still proud of their broadband policies, which are said to have sated Americans with bandwidth. "Fastest deployment of any consumer product," they crow. Yet Korea, a country of 48 million, with half of America's per capita wealth, commands at least twenty times more per capita bandwidth, both wired and wireless, than the U.S. does. American service providers charge around $40 a month for well under one megabit per second. The Koreans charge $25 for between five and eight megabits per second (with widespread reports of special deals for as low as $12 per month). For around $30 per month, they have also already linked more than a million households with VDSL (very-high-data-rate DSL) connections at 13 to 20 megabits per second and plan deployment of some two million links of 50 megabits per second in the next twelve months. Rapidly deploying **Qualcomm's** (QCOM) CDMA2000 (code division multiple access) and launching the 2.4-megabit-capacity EvDO (offering an average speed of 500 kilobits per second), Koreans have even supplied *wireless* bandwidth per capita comparable to U.S. wired connections. My answer to the skeptics at the FCC: If U.S. customers similarly enjoyed bandwidth at a price per bit some 20 times lower, there would be a broadband boom in the U.S. as well.

The trillion-dollar challenge that can truly unleash the Telecosm is access, last mile connections to homes and offices.

Starting in the local loop, the difference in bandwidth ramifies back through the network. U.S. telcos supply on average one broadband DSLAM (DSL access multiplexer) slot for every 35 customers and call it broadband. Korea has provisioned its local loops with one channel for every four customers. Most U.S. telcos supply backhaul from the local loop on T-3 lines of 45 megabits per second. Koreans provide optical carriers (OC-3) at 155 megabits per second, with many links at OC-12 (622 megabits per second).

Korean broadband explosion

While the U.S. has supplied a meager form of broadband to 20 million households (20 percent of the total), Korea has connected some 11 million households (73 percent of the Korean total) with real multi-megabit pipes. While the U.S. pretends that the Internet boom was a scam and a delusion, the Koreans now run a third of their economic transactions through the Net. They execute 70 percent of their stock trades on the Net, half of all banking transactions, and constant retail orders around the clock for everything from groceries to furniture. While the U.S. depicts Internet commerce as mostly a mirage, Korea is living the reality.

The Koreans accomplished all this in just three years. With the adjustments needed in a poorer society, the Chinese have made similar gains and now lead the world in total cellphone use and are third in use of the Internet. While the U.S. communications industry remains mired in depression, the Korean and Chinese industries are thriving. *Barron's* warns against the overvaluation of Samsung, the Korean colossus that is selling at 13 times earnings and 7.3 times cash flow. The *Journal* dwells portentously on an Internet bubble among Chinese dot.coms that have quadrupled in value over the last year. But while the U.S. economy eeks forward, then slips back, the Korean and Chinese economies are growing some twice as fast. While the U.S. pretends to have a stock market resurgence—the figment of a commendably reflated dollar—Korea and China are undergoing real equity expansions. U.S. economists still fool themselves that they live in a national rather than a global economy. But when the US stock market goes up 12 percent and the U.S. dollar goes down 20 percent, the real effect is sharply cheaper stocks, not more expensive ones.

Originating in the U.S. is nearly all the technology—the digital subscriber lines, the DSLAMs the cable modems, the optical carriers, the CDMA wireless systems, the chip designs that made Asian broadband possible. But the Koreans and Japanese are now rapidly taking over the industry and the Chinese are rushing up from behind.

The Korean companies in the forefront of this drive are Samsung, the leader, the rapidly privatizing **Korea Telecom**, **Hanaro Telecom** (HANA), and **SKT**, CDMA pioneer and largest Korean wireless carrier. Combining leadership both in DSL, flat panel displays, microchip memories, and CDMA handset/cameras, Samsung represents a total play in Korean bandwidth and will join our list this month. Hanaro is the hero of the Korean saga, entering the industry to push DSL prices well below cost three years ago and forcing KT to follow. As usual, throughout the history of business, lower prices brought higher revenues and ultimate profits. "The elasticity was far greater than we thought," comments a Korea Telecom strategist. KT is now making money on broadband. Close to break even, Hanaro is rushing ahead to VDSL. The Korean government is expected to permit **Lucky Goldstar** (LG) to combine with Hanaro to create a more robust competitor for KT. Most of these Korean companies offer more solid value than the China.coms that have recently experienced fourfold gains.

The second boom?

With traffic up close to a hundredfold in three years, the Korean example shows that when the new broadband connections are deployed, the Internet will undergo a new nonlinear surge comparable to the hundredfold U.S. rocket of 1995 and 1996. Igniting the boom of the late nineties in communications gear, the U.S. upsurge came from a lower bandwidth base than the later Korean one. As countries around the globe begin imitating the Korean and Chinese models, American communications suppliers will gain a second chance for major growth. But it will not be easy. While Qualcomm has broken through in the wireless markets in both Korea and China, all of the ten companies competing for VDSL contracts in Korea are Korean. Led by Samsung, some are even competing for microchip slots with **Infineon** (IFX), **Analog Devices** (ADI), **Texas Instruments** (TXN), **Metalink** (MTLK) and **Ikonos**.

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American carriers managed to handle the first Internet boom with Wavelength division multiplexing (WDM), putting every stream on a different color of light and merging them in an infrared band down the fiber for a hundred miles or so and then converting the dwindling signals back to electronics to do it again. R&R—recovery and regeneration and sometimes 3Rs—with retiming added—meant that the network was constantly translating light pulses into electronic streams and then back again through arrays of lasers and filters and erbium doped amplifiers and down boards of mixers and muxers, serdes (serializers and deserializers), transceivers and analog to digital converters. It all worked well enough to handle the first Internet boom. It provided explosively growing markets for the companies making the transmission lasers and pump lasers, chiefly **JDS Uniphase** (JDSU), and the

TELECOSM TECHNOLOGIES

Ciena	(CIEN)
Corvis	(CORV)
JDS Uniphase	(JDSU)
Avanex	(AVNX)
Essex	(EYW)
Equinix	(EQIX)
Sprint PCS	(PCS)
Qualcomm	(QCOM)
Broadcom	(BRCM)
Altera	(ALTR)
EZchip	(LNOP)
Terayon	(TERN)
National Semiconductor	(NSM)
Intel	(INTC)
Flextronics	(FLEX)
Taiwan Semiconductor	(TSM)
Transmeta	(TMTA)
Analog Devices	(ADI)
ARM Limited	(ARMHY)
Cepheid	(CPHD)
Cypress	(CY)
Energy Conversion Devices	(ENER)
Legend Group Limited	(LGHLY.PK)
Microvision	(MVIS)
United Microelectronics	(UMC)
VIA Technologies	(2388.TW)
Wind River Systems	(WIND)
Xilinx	(XLNX)
Chartered Semiconductor	(CHRT)
Synaptics	(SYNA)
Samsung	(05930.KS)

Note: The Telecosm Technologies list featured in the *Gilder Technology Report* is not a model portfolio. It is a list of technologies that lead in their respective application. Companies appear on this list based on technical leadership, without consideration of current share price or investment timing. The presence of a company on the list is not a recommendation to buy shares at the current price. George Gilder and *Gilder Technology Report* staff may hold positions in some or all of the stocks listed.

EZchip (LNOP)

10 GIGABIT NETWORK PROCESSORS

JULY 24: 7.208, 52-WEEK RANGE: 3.79 – 8.70, MARKET CAP: 52.6M

EZchip announced NP-2, the next generation in its world-leading network processor family. NP-1, now in production at IBM's 130-nanometer plant, enjoys more than 20 design wins among 10 major vendors, with the first significant revenues expected in the third and fourth quarters of this year. NP-2 will take advantage of 90-nanometer technology to achieve new feats of integration. The new chip, scheduled for release in the fall of 2004, includes two traffic managers for core routing functions, IPSec and SSL security features, and TCP offload capabilities important for storewidth devices. Consistent with the lead NP-1 enjoys over the current competition, one NP-2 chip likely will replace three or four dozen chips in a competing solution. Like NP-1, system cost and power consumption are accordingly reduced by some 80 percent. Intel is the last remaining competitor in the integrated net processor space but remains two generations behind.

Synaptics (SYNA)

TOUCH-SENSORS, FOVEON IMAGERS

JULY 24: 13.603, 52-WEEK RANGE: 3.13 – 14.90, MARKET CAP: 320.8M

Synaptics, the market leader in touchpads and other human interface technologies, acquired NSM Technologies of Hong Kong. Not to be confused with National Semiconductor, NSMT is a small outfit that chiefly provides Synaptics with sales, support and infrastructure in the fast-growing Asia-Pac marketplace. Terms were not disclosed, but in general any move toward China is a good one.

Reports earnings July 31.

Altera (ALTR)

PROGRAMMABLE LOGIC DEVICES

JULY 24: 18.009, 52-WEEK RANGE: 8.321 – 20.00, MARKET CAP: 6.896B

Second calendar quarter sales were $205.3 million, a 5 percent increase over the previous quarter. Earnings were $.09 per share, a penny better than expectations. The company's top-of-the-line Stratix field programmable gate array (FPGA) won EDN's Digital IC of the Year and, along with Cyclone family, is the company's fastest growing product. Altera has also made a quick transition to the 130-nanometer (.13 micron) technology node and has shipped some 300,000 advanced geometry chips, the most in the programmable logic industry.

Sprint PCS (PCS)

NATIONWIDE CDMA WIRELESS NETWORK

JULY 24: 6.25, 52-WEEK RANGE: 1.75 – 6.48, MARKET CAP: 6.396B

PCS announced stealth deployment of Wi-Fi hotspots around the country for the last year and, in conjunction with Wi-Fi enablers Wayport and Airpath, plans to turn up service at 800 locations by late summer and 2,100 by the end of the year. The new PCS service is meant to be a stationary compliment to its existing CDMA 2000 mobile data network, dubbed Vision.

Report earnings July 28.

Ciena (CIEN)

METRO WDM PLATFORMS

JULY 24: 5.569, 52-WEEK RANGE: 2.41 – 7.74, MARKET CAP: 2.423B

Ciena appointed its current chief of metro networks, Dr. Jianhui Zhou, to the position of General Manager of operations in China. Zhou, who graduated from the Beijing University of Posts and Telecommunications and earned a Ph.D. in applied physics from Caltech, will try to make inroads in what the company calls "the most vibrant and robust telecom market in the world today, and also potentially the most competitive."

Ciena may not have as pure a telecosmic vision as competing systems-house Corvis (as detailed in this issue), but its ocular clarity currently beats that of Avanex and JDSU. CEO Gary Smith talks about "strategic investment and R&D" in addition to expense "management." Massive cost-cutting, according to Smith, is not the answer to the telecom slump; optimal competitive strategy is. In a good sign for Ciena, one Wall Street analyst laments, "Meaningful reduction in R&D expenses have eluded Ciena."

In the past several months, Smith's vision has begun to unfold as Ciena added gigabit and 10-Gig Ethernet connections and tunable transceivers to its long-haul transport system and acquired Wavesmith Networks—a startup that manufactures edge multiservice aggregation switches—in an effort to displace legacy ATM switches from the likes of Lucent. "The core we will leave to our friends Cisco and Juniper," said Steve Chaddick. Better to have said Corvis instead of Juniper or Cisco, but for Ciena the advantage remains unchanged. Not surprisingly, Ciena's one growth area (yes, it actually has a growth area) is Metro products, including the metro version of the CoreDirector optoelectronic switch (called MetroDirector) and metro transport (formerly ONI).

MEAD'S ANALOG REVOLUTION

NATIONAL SEMICONDUCTOR (NSM)
SYNAPTICS (SYNA)
SONIC INNOVATIONS (SNCI)
FOVEON
IMPINJ
AUDIENCE INC.
DIGITALPERSONA

COMPANIES TO WATCH

ATHEROS
BLUEARC
CALIENT
CELOXICA
COVENTOR
COX (COX)
CYRANO SCIENCES
ENDWAVE (ENWV)
NARAD NETWORKS
POWERWAVE (PWAV)
QUICKSILVER TECHNOLOGY
RF MICRO DEVICES (RFMD)
SAMSUNG
SiRF
SOMA NETWORKS
SYNOPSYS (SNPS)
TENSILICA
TRISCEND

JDS Uniphase (JDSU)

PROGRAMMABLE LOGIC DEVICES

JULY 24: 3.146, 52-WEEK RANGE: 1.58 - 4.71, MARKET CAP: 4.499B

The company reported falling sales for the second calendar quarter and predicted another drop this quarter. Net sales for the June quarter were $161 million compared to $222 million in 2002. The pro-forma loss was $.02 per share, better than the previous quarter's $.06 loss, the result, the company says, of global restructuring efforts. JDSU expects revenue of $145-155 million in the September quarter but says it can break even in the December quarter. JDSU's treasury, which still contains $1.23 billion in cash and short-term investments, only mildly mitigates this sad story of the Telechasm, where non-communications products now outsell telecosmic ones.

Look for JDSU at the seaside arcade this summer as its revenue pinball continues to ring and light and bounce its way down the market maze. As recently as 2000, this acutely reflexive optical components giant was scrambling to increase production fourfold every 18 months and a year later was scrambling to decrease production just as precipitously. But knee-jerking to the market mallet does not lead to long-term growth. Innovation does. Cutting expenses hurts, but it is not hard-squeeze every vendor, renegotiate every lease, incinerate employees, install low-flush toilets, raise the thermostat (you know, you do this yourself at home). By contrast, growth strategies are daunting, requiring much more analysis and creativity-like changing careers or building a house.

Essex (EYW)

OPTICAL PROCESSORS

JULY 24: 5.40, 52-WEEK RANGE: 1.50 – 5.85, MARKET CAP: 48.2M

Essex received its first patent on the Hyperfine Wavelength Division Multiplexing (WDM) technology developed by CTO Terry Turpin. Numerous other patents based on Hyperfine are still under review. The company also announced two new stealthy contracts, one issued by the General Services Administration for consulting on a range of software and signals intelligence engineering, and the other a $2 million contract by an undisclosed government agency. The second contract covers research in radar signal and image processing as well as the application of hyperfine WDM to achieve privacy in an all-optical network.

Avanex (AVNX)

ADAPTIVE PHOTONIC PROCESSORS

JULY 24: 3.59, 52-WEEK RANGE: 0.63 - 4.95, MARKET CAP: 248.4M

Reports earnings August 4.

Broadcom (BRCM)

BROADBAND INTEGRATED CIRCUITS

JULY 24: 22.90, 52-WEEK RANGE: 9.52 – 29.96, MARKET CAP: 6.414B

The company reported record quarterly revenue of $377.9 million, up 15.4% sequentially and 46.3% year-over-year. It was the eighth consecutive quarterly increase. Pro forma earnings were $29.6 million, or $.10 per share, but a goodwill impairment from the ServerWorks acquisition led to a GAAP accounting loss of $831.7 million. Shares dropped by more than 12%. Analysts also worried the ServerWorks division is losing market share to Intel. Nevertheless, sales of Broadcom's bread-and-butter broadband cable and set-top box chips were strong, as were sales of its newer Wi-Fi chipsets. Amid an otherwise good quarter, the company's pursuit of the nonexistent EDGE wireless market is a distraction.

Qualcomm (QCOM)

CDMA INTEGRATED CIRCUITS, IP, SOFTWARE

JULY 24: 37.21, 52-WEEK RANGE: 23.21 – 42.89, MARKET CAP: 29.374B

June quarter revenue was $921 million. Excluding the Strategic Initiatives division, revenue was $891 million, and earnings were $.33 per share. Cash and equivalents now total $5 billion. Citing strong revenue and cash flow growth, the company increased its dividend by 40 percent, from $.05 to $.07 per share, payable to shareholders of record as of August 29. In the field, China Unicom launched mobile data services in Shanghai and Guangdong based on QCOM's BREW software, and Verizon Wireless reported average incremental revenues from its BREW-based "Get It Now" services were $7.50 per month, excluding extra airtime charges. Also, Saigon Postel launched the first CDMA2000 network in Vietnam, and the company sampled the 6500 chipset, which allows roaming between CDMA2000 and GSM/GPRS networks.

Terayon (TERN)

BROADBAND CABLE MODEMS, HEAD-ENDS

JULY 24: 4.41, 52-WEEK RANGE: 1.10 – 4.70, MARKET CAP: 325.1M

Cox Communications (COX), the nation's fourth largest cable operator, tapped Terayon's advanced DOCSIS 2.0 cable modems to enable high-speed Internet access throughout Arizona. The deal runs through the end of the year, with an option for 2004-05. Three other major cable companies already use the Terayon modem. Phoenix is Cox's largest market. Separately, Doug Sabella, a former Lucent and Tumbleweed Communications executive, joined the company as COO. Reports earnings July 30.

Intel (INTC)

MICROPROCESSORS, SINGLE-CHIP SYSTEMS

JULY 24: 23.97, 52-WEEK RANGE: 12.95 – 25.50, MARKET CAP: 156.6B

Second quarter revenue was $6.8 billion, up 1% sequentially and 8% year-over-year. Earnings were $896 million, or $.14 per share, double last year's second quarter. The Asia-Pac division set an all-time revenue record and now accounts for 41% of the company total. The company announced it is partnering with wireless equipment maker Alvarion to develop silicon products based on the 802.16a "WiMAX" standard. Using various frequency bands in the 10-60 GHz range, some line-of-sight, some not, WiMAX promises wireless data links up to 70 Mbps at up to 30 miles. It is designed to connect Wi-Fi hotspots as well as provide dedicated last-mile links to homes and businesses. Intel has already made a successful entry into the shorter-range Wi-Fi market with its Centrino laptop computer chipset. On July 8, the company acquired Vancouver's West Bay Semiconductor, maker of 2.5 Gbps framers and data mappers for next-generation Sonet and Ethernet-over-Sonet optical networks.

Cypress (CY)

BROADBAND SOLUTIONS, VOICE OVER IP

JULY 24: 12.57, 52-WEEK RANGE: 3.60 – 14.82, MARKET CAP: 1.467B

The company announced quarterly revenue of $203.1 million, up 12% sequentially. Pro forma earnings were $.03 per share. First revenue was achieved on the company's new 72-Mbit SRAM, manufactured in Cypress's proprietary 90 nanometer technology, which yields the highest density SRAM on the market. First revenue also came from the new 16-Mbit one-transistor (1T) pseudo-SRAM (PSRAM), a high-density but low-cost memory device used in mobile phones. Clocking chips for digital still cameras may be Cypress's fastest growing product line. Sony and Fuji alone bought 2.2 million clock chips last quarter, and volumes are expected to grow 30% this quarter. Cypress also has combined onto one chip all of the timing functions of Sony's PlayStation 2 game machine.

Samsung (05930.KS)

DSL, FLAT PANELS, MICROCHIP MEMORIES, CDMA HANDSETS

KOREAN STOCK EXCHANGE, U.S. ADR COMING SOON

Add to the list this month.

CONTINUED FROM PAGE 3

semiconductor houses selling mixers, analog to digital converters, and digital signal processors, namely Texas Instruments and Analog Devices. But the second Internet boom of broadband video, wireless imaging, and ubiquitous wireless data now happening in Korea and Japan remains stillborn in the U.S. The local loop remains fractured, in a copper cast and a legal straitjacket. Backbone carriers compete on price, while the lords of the last mile maneuver in Washington.

Nonetheless, the three-year ascent of Korea from also-ran to bandwidth colossus shows the way to a new Internet boom in the U.S.

With Peter Huber's critical mass of 20 million broadband subscribers having been surpassed this spring, the transition to 100 million subscribers will occur before 2010, according to Huber, by which time the Telecosm will have undergone an all-optical transformation. But well before then it will jump to its new energy state or broadband paradigm with a rush that will be completely missed by technologists, Wall Street analysts, and companies nursing older optical technologies. It happened before.

PARADIGM ONE: 1870-1990—Bandwidth Abundance

During the pre-Internet age, telephony thrived on bandwidth abundance, at least when measured against the modest demands of voice. Bandwidth was wasted as a matter of course. Most of the capacity of a telephone network lay fallow more than 95 percent of the time as people used their phones an average of 20 minutes a day. In a world of bandwidth abundance, circuit switching—connecting the two parties over a line devoted entirely to their call—made sense.

With circuit connections, switches could even be slow. An operator could route the calls manually.

PARADIGM TWO: 1990-2003—Bandwidth Scarcity

As the Internet rose and data became dominant, users put their computers online for many hours at a time. Even as absolute bandwidth soared, it grew scarce relative to demand. Confronting a regime of bandwidth scarcity, the titans of telecom in the 1990s had to learn how to economize on bandwidth. With guidance from Bell Labs, they had mastered the secrets of statistical multiplexing—digitizing calls, distributing them in time slots, and combining many calls onto a single long-distance backbone connection. Then from the Internet they laboriously learned the rules of packet switching, cutting up every message into many packets, each bearing a separate address. While a circuit-switched phone network sets up the call in hundreds of milliseconds, a packet switched network functions like a multi-megahertz post office. The envelopes are switched not in minutes or even milliseconds but in microseconds. Load-balancing data across the network, packet switching is optimal in a regime of scarce bandwidth. It was an era of superfast switches, "grooming" the data and distributing it through the pipes.

Overlaying the redundant and voice optimized SONET facilities of the phone companies, which operated on the physical and transport layers, was a parallel system of **Cisco** (CSCO) and **Juniper** (JNPR) routers. Sixty-four kilobit SONET voice carriers bore 1550 byte Ethernet frames enveloping IP packets. With separate quality of service functions, transport protocols, and service recovery provisions, the routers managed the Internet Protocol packets on "layer three," the network layer, handling all the final IP addresses on the Internet. In this era, the hardware and software piled up in triplicate in optolectronic nodes, ISP hubs and telco central offices across the country, and Moore's law processing speed compensated for bandwidth scarcity and network complexity.

PARADIGM THREE: 2004 to 2010?—Abundance Redux

The next paradigm shift—from today's relatively narrowband net to Peter Huber's high-speed broadband world of streaming video phone calls and billions of cell phone digital cameras—will spark yet another non-linear traffic surge and another transformation of the technology regime. That is the message from Korea and China. As explained in last month's GTR, if another 100-fold paradigm shift were to occur during 2004 – 2005, long-haul backbone network capacity needs balloon to 188 exabytes per month (188 x 1018 bytes) to handle the traffic during December 2005 without disruption. But Korea took three years, so extend it another year, to December 2006. Measured in terms of today's all-optical technology, that's 363 separate **Corvis** (CORV) systems sporting 160 OC-192 lambdas apiece. By comparison, if today's U.S. long-haul Internet backbone were combined into one seamless network, just three Corvis systems would suffice.

Long-haul links are only one part of the end-to-end network. All backbone traffic must first traverse the smaller metropolitan area networks. The Great Unknown, metro traffic seems to have eluded estimates. Among RBOCs, consensus has been that only 25 percent of metro traffic passes into the long-haul networks. Based on that guesstimate, aggregate U.S. metro traffic exceeds backbone traffic by four times. Returning to our sample paradigm shift, by December 2006 total metro network traffic would equal 100 exabytes per month (2 exabytes per month in each of 50 U.S. metro areas). Thus, each metro network would need to transport an order of magnitude more traffic than today's entire U.S. Internet backbone network and each would require the bandwidth

equivalent of four Corvis long-haul systems. Then all these numbers should be more than doubled again, to cover the explosive growth of traffic around the globe.

The Corvis Era

But as elegant and efficient as the Corvis technology is, national carriers will not purchase 363 separate Corvis systems, nor will regional networks install 200 Corvis bandwidth equivalents in metro networks nationwide any more than they will multiply giant SONET add-drop multiplexers to handle the broadband paradigm. Today's hybrid optoelectronic network will give way to a rainbow of light, and traffic will flood toward the low cost, low delay, coherent systems that use Corvis gear. First and foremost that means the Broadwing (BDWGP.PK) network that Corvis essentially stole from Broadwing for $97 million (see *Whitebox Market Observer,* July 2003, for the salacious details.) "Listening to the technology," in the way of Carver Mead, we discover that the primary rule of a broadband network becomes: multiply lambdas (wavelengths) for connectivity, not bandwidth. The SONET ring architecture once imperative for network protection and restoration will die under the impossible burden of adding an entire ring of SONET boxes for every new lambda or wavelength (color) of light, followed by more rings of Cisco and Juniper routers, DSLAMs and cable modem terminators, and other boxes galore. Attempting to bear the Net traffic of entire cities on a few score light beams, the networks of the future will choke in a multitrillion-dollar, multi-million laser, multi-hundred-thousand box router-switch-SONET-IP electronic, optical, and protocol conversions morass. The new networks will instead require millions of addressable colors of infrared light. The bits will ride on wavelength lightpaths bearing their own routes and their own addresses.

Combining leadership both in DSL, flat panel displays, microchip memories, and CDMA handset/cameras, Samsung represents a total play in Korean bandwidth.

WDM, which sends many colors of light down a single fiber thread, is ushering in a tide of fabulous bandwidth abundance. In a world of bandwidth abundance, bandwidth-wasting circuits become ideal once again. Rather than economizing on bandwidth by chopping everything into packets and multiplexing them into time slots, the mandate is to waste bandwidth. As in the old telephone system, the approach is circuits that last the duration of the "call."

In this case, the system software sets up wavelength circuits between terminals at the edge of the fiber network where the wavelengths are finally converted back into packets or launched into the fiber "cloud." But the reach of wavelength circuits will steadily expand into metro area networks, across corporate campuses, and finally into enterprises and even neighborhoods. Many of the giant routers will go away, replaced by millions of smaller routers, hubs and service nodes in homes and businesses. Cisco is preparing for that world with its low end nodes and with Linksys and Aironet for Wi-Fi and beyond. **Intel** (INTC) is preparing with Centrino for wireless access and Gigablades for direct optical access from servers. Meanwhile, on the ever ramifying backbones, passive optical switches can shift and shuffle wavelengths scarcely faster than the operators of yore. The slow switch Corvis era will begin.

Among those with a low titillation threshold in optics, the continuing promise of the Telecosm makes for titillating reading. Just don't get taken in by it. None of this will happen. It's merely the fancy of cloud-nine cranks who refuse to accept defeat even after being proven wrong. The survey takers and market forecasters and Spitzered analysts assure us that David Huber et al are cranks. Unfortunately for the wise guys, however, it is a logical fallacy to assume their arguments are correct merely because they are getting the right answers. Anyone can win at Russian roulette—for a while.

Paradigm III leaders

David Gelernter, another Telecosmic crank, tells us that no matter how certain its eventual coming, we normally fail to envision an event whose exact time and form of arrival are unknown. We tend not to believe in the next big war or economic swing. We certainly don't believe in a repeat of the two-year, 100-fold network traffic jump of 1995 – 1996, and so we plan our businesses according to the current trends.

From JDSU to **Avanex** (AVNX), from **Bookham** (BKHM) to **Oplink** (OPLK), everyone talks of emerging as "a survivor of the downturn." This hackneyed phrase focuses attention backward instead of forward, turning problems into business plans and companies into pinballs bouncing among the obstacles of the day.

While demand soared in the spring of 2000, JDSU scrambled to increase production by a factor of four every 18 months. A year later, JDSU was scrambling to decrease production just as quickly. But growth is not a reflex action. It demands creativity, vulnerability, risk-taking—a vision for the future. What will be the next market or paradigm? How large? How can we create a significant advantage over the potential competition and increase revenues? Long-term investors look for return on capital, not perceived growth through cutting costs.

JDSU has introduced approximately 75 new products over the past year. A sampling includes a temperature tunable source laser, a WDM source laser for CATV, a credit-card sized EDFA (erbium-doped fiber amplifier), test and measurement instrumentation, and standard

amplifiers that reduce costs and have short lead times because they are built on a simplified platform that is scalable and flexible for a wide variety of applications. All of these modules are up-to-date but none will lead the way in the broadband network. Module platform manufacturing is not uncommon in the optical components industry, and **Corning's** (GLW) components operation (now part of Avanex) has become adept at it for many product lines, now also including amplifiers, which until a year ago were virtually all more-expensive custom models. Mini EDFAs were pioneered by Nasser Peyghambarian at **NP Photonics** and by several other startups working on EDWAs (erbium doped waveguide amplifiers) and can be had now from Corning as well. Temperature-tuning of DFB (distributed feedback) lasers is a first-generation technology with limited wavelength selectivity. **Agility** and **Santur** have much more advanced tunable modules already on the market and Intel may be ready with its tunable transponders by early next year.

Nearly half of JDSU's new products are for transmission, compared to less than 20 percent in previous years. And while the company's portfolio of transceivers and transponders is one of broadest in the industry, including products for enterprise, SAN, metro, and edge applications, the world's volume leader in fiber-optic transmission sales is still **Agilent** (A), not JDSU. JDSU has never shown a strong interest in tunable source lasers since they are too far into the future for immediate revenues and represent too much risk. The "Components Superstore" shows no signs of nearing breakthrough research in this area or in other Paradigm III technologies such as broadly tunable transponders, high-channel count multiplexers (Avanex and Essex), or Raman amplification (Corvis).

JDSU's pattern of growth by M&A is really "growth" by buying up someone else's customers. It is an expensive and time-consuming strategy which diverts attention and resources toward integration and slashing expenses and away from innovation. Did JDSU really grow over the years it acquired the likes of E-TEK and SDLI? We can probably never know, since growth would be hopelessly hidden in the complex accounting of acquisitions.

With the disadvantage of a $1.2 billion cash cushion and a clean balance sheet, JDSU can rest on its laurels from the boom and continue along the path of least resistance. Over past year the company has acquired LA Label to extend capabilities in product authentication and security where JDSU sees itself as a global leader. JDSU has also acquired the transceiver/transponder unit of **OptronX** to extend transmission product line in metro and short-reach applications and the data communications unit from **IBM**. Most recently, it acquired TriQuint Semiconductors' undersea pump-laser packaging technology, enabling the development of entire pump modules.

The eternal life of excess network capacity has become the zeitgeist of the Telecosm, and many companies have been seduced by it. However, when bits and bytes surge once again and functionality reemerges as the watchword of networks, carriers and OEMs will not judge their suppliers by the success of their cost containment programs or even by their profitability. In that day, the "survivors of the downturn" will be the innovators who were ready for the upturn of the broadband network. Today that means Corvis more than any other technology

The trillion-dollar challenge that can truly unleash the Telecosm is access, last mile connections to homes and offices. The value of networks in a time of bandwidth abundance comes not from capacity but from connectivity. As Paul Green puts it, "There are terahertz of potential bandwidth at the core of the network and many gigahertz of potential bandwidth in the internal links of computers. But between them is a bottleneck, where even cable and DSL (digital subscriber line) operate at speeds thousands of times slower. If this bottleneck can be broken, the entire industry will be awash in demand." The key, therefore, to the prospects of optical technologies and fiber-optic networks is the connectivity of light.

—George Gilder and Charlie Burger, July 25, 2003

Got Questions?

Visit our subscriber-only discussion forum, the Telecosm Lounge, with George Gilder and Nick Tredennick, on www.gildertech.com

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