

Back to the Caves?

Smart speleologists will cautiously appraise opportunities in National Semiconductor, Synaptics, Essex, JDSU, and Corvis, well before the bears return for their well-earned hibernation

Over the last couple weeks, perhaps because of global warming caused by unusual emissions of CO₂ from a population of human heavy breathers in the District of Columbia—or perhaps just because I have been feeling “the heat of the herd” of bears—I found both my email and my environment teeming with calorific flora and fauna. Along with the welcome announcement that I “am already a winner” in a multimillion dollar lottery came a stream of seasonal email offers to expand and lengthen my member into an authentic full-sized National League baseball bat. Meanwhile an alluring message from “Bad Girl xxx” offered to refinance my mortgage. Popping up several times was a tantalizing, medically approved invitation to augment and beautify my breasts without chemical side effects or unsightly lumps, and a tempting opportunity to win a tax free commission of \$4.7 million (as I recall) for aiding a mysterious West African prince in a complex international monetary transaction—not to mention countless discreet chances to sneak across worldwide webs of glass for streaming video glimpses of the unmentionable body parts of Ukrainian sub-teens. Amid all these exciting and informative distractions—what a tribute to the diversity and creativity of the Internet community under the First Amendment as interpreted plastically by the Supremes—under God!—I almost overlooked several authoritative screeds purporting to explain the telecom crash.

Leaving aside for the moment this septic tanking of email as a cause—and it is indeed a serious factor—I was most impressed by Charlie Burger’s dour analysis of the bandwidth perplex. But before dousing you in his implacable new argument—and then partly rebutting it—I would like to report a contrarian upside signal, namely the proliferation of bears in the Berkshires. If, as consensus has it, the market is dead, capitalism kaput, and the capitalists headed for the pokey, there is no real point in reprising Charlie’s short-term ursine essay. But hark, these creatures are no mere market metaphor or chimera, they are *ursa major*, hulking black shaggy mammals, trudging down Main Street toward Kennedy Park in Lenox, Massachusetts, at midday, sauntering along Hubbard near Bret Swanson’s house on the way to St. Ann’s Church, overturning garbage cans and eviscerating plastic disposal bags near the offices of Fleet Bank in Pittsfield—even intruding into the bedroom of mustachioed film critic Gene Shalit in

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Inside:

- Careful, Arthur
- Corvis, Ciena overshoot
- NSM puts heat on Intel
- Essex rendered powerless

Stockbridge and breaking club rules at the private beach on Stockbridge Bowl. Running last night up a nearby hill, I was stopped by a large black creature in the midst of my path. Bears at the beach and in the bedroom and on the jogging trail represent the end of the line for the down market. The bears have no further room to advance. They offer a powerful contrarian sign that the down market is over and that thronging back to the Berkshires, along with the skiers, will soon come the usual upbeat meese (plural for masculine moose and the ultimate bulls).

Bears ultimately produce nothing and offer nothing. An economy cannot prosper on pessimism. The reason market economies prevail is that they assign all property to optimists who bid highest, and know how to enhance it further. In looking for signs of economic revival, however, we exclude all the usual demand-side economists, who believe economies grow through spending rather than through creating. The demand-siders predict the future by pondering the entrails of “consumer” spending and take heart from the inevitable surge in real estate as investors attempt to escape from equities. Such real estate blips also encouraged the Japanese before their 10-year slump. Rather this apparent mammalian turning point dictates close attention to the sage findings of supply-sider Arthur Laffer, who moves beyond the noise to offer serious evidence for a significant bull market.

In technology and telecom, deflation still rules despite the recent updraft of gold prices

Laffer issues a monthly report that tracks the collective value of all the S&P 500 stocks against the present value of all those companies’ earnings, discounted by the yield of a 10-year treasury note and corrected by the Bureau of Economic Analysis’s adjustments for inventory valuation and capital depreciation. Until June 28, Laffer has seen the market as reasonably valued or even overvalued by this measure. In his latest report, however, written with colleague Marc Miles, he adopts the portentous prose of a turning point. “There are times for flowery words, witty repartee, and dazzling put-downs, but now is not one of them.... Markets ultimately respond to economic fundamentals—and at present the economic fundamentals are *amazingly bullish*.”

“Currently,” write Laffer and Miles, “the market value of the S&P 500 is almost 40 percent below actual discounted earnings”—which they describe as the widest gap since 1996. As they point out, this difference cannot persist. In some combination, either the market will rise some 40 percent, or the interest rate on the 10-year note will rise some 50 percent, or earnings will plummet 40 percent. The only recent record of earnings falling so sharply was the 1970s, when inflation and nominal interest rates were soaring. Laffer sees inflation as nearly nonexistent (he notes with astonishment that “one camp of pundits even worries about *deflation*, i.e., prices literally declining”). Therefore he and Miles predict interest rates

will fall and earnings will increase. They doubt any repetition of the 1980s and 1990s boom, when under the impetus of sharp reductions in tax rates, the economy recovered from the inflationary doldrums of the 1970s and early 1980s. But more tempered growth means lower real interest rates. Thus, they believe that the real under-valuation of stocks is not 40 percent but closer to 60 percent or more.

Careful, Arthur

Laffer evades what is the key source of the relatively high long-term rates and steep yield curves of today. Neither inflation nor investment demand governs these numbers. Instead, high long-term rates reflect sharply higher premiums for risk. The heightened risk stems from wars, domestic and international: a relentless war on wealth conducted through runaway litigation, public and private, and a threat of hot war overseas that will likely be accompanied by domestic terror. In addition, dismissing deflation as a problem, Laffer does not entertain the possibility of a continued swoon of earnings accompanied by a risk-racheted elevation of the rate on the 10-year note. In the world of technology and telecom, deflation still rules despite the recent updraft of gold prices, now partially correcting for the 40 percent rise in the dollar since 1996. Because technology is the leading-edge of innovation, its continued doldrums portend more treacherous stock markets than Laffer understands.

Nonetheless, he makes a plausible case for a coming bull market. If the U.S. can avoid war or rapidly win it, we can expect a grand resurgence in the markets. The issue is how this move will affect the now stricken prices of Telecom stocks. As shown by a new study of sectoral market dynamics from the National Bureau of Economic Research, all else being equal, the Telecom players should outperform the rest of the market by some 6 percent, since they suffered more than any other group from the deflation. But if the massive flight of capital from communications has permanently damaged the prospects of the all-optical network, the Telecom companies may continue to underperform for several more years. Therefore we must address the incredibly focused bearishness of nearly everyone in this field, and hence, in optics and optoelectronics, and finally in communications semiconductors—the areas where we remain focused.

Broadly considered, communications comprises 17 percent of the U.S. economy and perhaps 70 percent the market for high technology. Telecom carriers are the single largest market for communications equipment of all kinds and thus for the optical and semiconductor components that represent the technological base for the Internet. When the telcos zero out their capital budgets, the effect cascades through the entire tech economy, including the creators of capital equipment for manufacturing electronic and optical components and the venture capitalists who finance the Telecom.

We have long maintained that the hope for the future is broadband, high-speed links to homes and offices. Currently snarling broadband are the multiple regulatory mazes of

Washington and the imitative coils of 50 state capitals, along with the complementary depredations of city governments everywhere, with each deployment of fiber and every technology advance facing a gantlet of special taxes, price controls and tariff rules, zoning covenants, conduit fees, sharing mandates, and universal service gouges. It has been our contention that a revival of broadband can lift up the entire technology sector. Charlie Burger's cautionary thesis is that even though growth in the number of total U.S. Internet users has leveled off since the beginning of 2001, the number of broadband users (chiefly cable modems and digital subscriber lines—DSL) has been rising at a rate of nearly nine million per year and now comprises more than a quarter of active residential links. Judging from the pace of adoption of other consumer electronics products, such as CDs and color TVs, 25 percent penetration represents an important tipping point that can trigger a new boom, with the technology spreading at a steadily accelerated rate. We are very near Peter Huber's inflection point, where above 20 percent total penetration of households (not just of active links) spurs a race toward universal adoption.

Corvis, Ciena overshoot

Charlie projects that if broadband were to surge to an aggressive 75 percent penetration of residential users and virtually all business users by January 2005, the result would be an awesome tide of some 1,292 petabytes per month of backbone traffic, about 9 times the current monthly rate and some 492 petabytes above the projection of today's 2 times annual growth rate. Charlie adopts Andrew Odlyzko's well-documented estimate that broadband users expand their time on line by 50 to 100 percent and download 5 to 10 times more data. The 492 petabytes of extra traffic generated by Charlie's accelerated broadband penetration could be handled by just an additional 570 wavelengths—by that time perhaps one or two **Corvis** (CORV) systems.

Charlie has metro covered as well. Eighty percent of links are in metropolitan areas and do not pass over the long-distance plant. Including metro users dictates a three-fold further increase in lambdas, since the Regional Bell Operating Companies (RBOCs) estimate that only 25 percent of traffic leaves the metro. This means just 19 additional lambdas for each of 50 American cities. Double it for redundancy and double it again for competitive carriers and you get 80 lambdas per city.

In Clayton Christensen's terms, optics seems to overshoot the actual market for communications—for the moment. Low end, gigabit Ethernet and coarse wavelength services can suffice. The power of the technology, Charlie speculates, may explain both **ONI's** (ONIS) revenue free-fall before the **Ciena** (CIEN) merger and why WDM metro sales have not lifted **JDS Uniphase** (JDSU) and **Avanex** (AVNX) above their red ink thresholds. Cash poor, conservative, fiber-rich carriers may hang tight with **SONET** (telco optoelectronic networks) until pressed to deploy many more backbone lambdas. Gigabit Ethernet and 10 gigabit Ethernet can cre-

ate a market for communications semiconductors from **Intel** (INTC) and **EZChip** (LNOP). But the small incremental need for lambdas to handle accelerated broadband would not be enough to push **Corvis**, **JDSU**, **Avanex**, **Corning** (GLW), et al. to profitability.

The power of WDM, Charlie speculates, may explain why JDSU and Avanex are mired in red ink

Accelerated broadband adoption, Charlie affirms, will have a profound affect on the overall economy, especially on productivity, and will generate lots of revenue for some enterprise and access network vendors, such as **Cisco** (CSCO) and **Extreme** (EXTR). But it may not significantly boost the companies which provide fiber-optic components and systems to long-haul and metro backbones. He believes that such companies will have to retrench their revenue targets far below present assumptions. **JDSU**, for example, will have to adapt itself to a run rate 33 percent below its current target.

So much for the next two years or so, the statistical horizon of Charlie's study. But Charlie has always kept us focused on the longer-range future of optics where he is much more bullish. However, here also bears lurk. In comments on the technology crash in the July *Wired*, Google CEO Eric Schmidt adds a further note of gloom: "The error George made is to assume that the economics of surplus are positive for investors, when in fact surplus means cutthroat price competition, over-provisioning, and all the things we are seeing happen in the telecom sector."

Before we all retreat to caves and surrender our homes and gardens to the bears, however, let us reprise the basics of new technology adoption. Without going back to the invention of the steam engine and weighing the early prognosis for electric motors in toothbrushes and disk drives, the model for the Telecosm is the microcosm. When Carver Mead showed in 1969 that 10 million transistors might be put on a single sliver of silicon and that they would run cooler, faster, better, and cheaper, he was prophesying what at the time seemed an impossible glut of electronic capacity. Indeed, Gordon Moore of Intel in the mid-1970s observed that "beyond memory devices, no one knows what to do" with the then thousands of transistors possible on a single chip.

In *Microcosm* and more recently in *Wired*, I have recounted the story of the 1211 transistor at Fairchild Semiconductor, a UHF tuner which was the first mass-market solid-state product. Initially sold for \$150 apiece to the military, the 1211 eventually made its way into all the world's billion television sets for \$1.05 apiece and finally for 15 cents. At the time, the idea of supplying a transistor to each of the world's billion sets seemed a climactic dream to Bob Noyce, Gordon Moore, and Gerry Sanders then together at Fairchild. Today, of course, instead of a total market of a billion television sets each with one transistor, every single set contains billions of transistors which sell profitably for a

TELECOM TECHNOLOGIES



JDS Uniphase (JDSU)

ACTIVE AND PASSIVE OPTICAL COMPONENTS

JUNE '02 MONTH END: 2.67 52-WEEK RANGE: 2.24 - 13.60 MARKET CAP: 4.0B

WINGING IT—Will we recognize JDSU when it emerges from its downturn chrysalis? Will we even find it? Lately, the company seems poised for flight—right out of the Telecom. Non-telecom sales surpassed 25% of revenues in the March quarter, buoyed by products which include commercial lasers for printing and biomedical, interference-based pigments for currency anti-counterfeiting and high-end paint, and optics for large-screen projection. Indeed, non-telecom rose from 12% of sales during the first 9 months of fiscal 2001 to 23% during the same period this year. But before you revel in newfound revenue, it's merely a statistical chimera—pigments and projectors have simply fallen more slowly than amps and add/drops, from \$315M during the first three quarters of fiscal 2001 to \$202M this year. Still...until telecom comes calling again, JDSU may have found its life preserver.

Intel Outside: With JDSU's market cap hovering around \$4B, could \$122B Intel be interested? Just think, the Intel of the Telecom may turn out to be none other than—Intel.



Avanex (AVNX)

ADAPTIVE PHOTONIC PROCESSORS



JUNE '02 MONTH END: 1.94 52-WEEK RANGE: 1.57 - 10.50 MARKET CAP: 134.8M

WHISTLING DIXIE—Avanex appears to be in time warp. With the Oplink merger delayed from June till ?, with now-former-employee Simon Cao's much-awaited consulting relationship yet to be announced, and with the latest company news release dated 30 May, we wonder if Avanex has been cryogenically frozen. Ominously, with its brain having escaped preservation, the high-end components vendor may reawaken a phantom of its former self. But take heart. The Avanex *vision* has not died, and we eagerly await Simon's reincarnation in yet another corner of the Telecom.



Ciena (CIEN)

WDM SYSTEMS



JUNE '02 MONTH END: 4.19 52-WEEK RANGE: 3.60 - 43.15 MARKET CAP: 1.8B

DOUBLE WHAMMY—No sooner had long-haul WDM systems company Ciena merged with our paradigmatic metro WDM systems vendor ONI (which formerly occupied this space) on 21 June, than we were warned of an impending revenue collapse. CEO Gary Smith used the term "down meaningfully" when describing Ciena's sales outlook for the July quarter. Better if he had said "doubly meaningfully," since even flat quarter-to-quarter revenues of \$87M would have meant a 19% drop based on last quarter's \$108M of combined Ciena/ONI revenues and an 83% freefall based the duo's \$526M zenith last summer. *Barron's* sees a potential Cisco takeover.



Essex (ESEX.OB)

OPTICAL PROCESSORS



JUNE '02 MONTH END: 3.40 52-WEEK RANGE: 3.15 - 8.25 MARKET CAP: 18.2M

THREE'S A CHARM—Terry Turpin has inked another co-marketing agreement similar to the one with FiberSpace (see April GTR), this time with Opticalis. The optoelectronic startup claims to have figured out how to generate multiple laser lines from a single source for "cost-effective channel multiplexing and routing within metro/access networks." Apparently, Turpin agrees. The triad—Essex, FiberSpace, and Opticalis—are forming an informal ultra-dense WDM consortium: Essex has the muxing technology with Hyperfine, FiberSpace has the stable laser locking method, and Opticalis has the inexpensive source.



Corvis (CORV)

WDM SYSTEMS, RAMAN AMPLIFICATION, EDGE SWITCHES



JUNE '02 MONTH END: 0.65 52-WEEK RANGE: 0.65 - 4.63 MARKET CAP: 238.4M

TRICKLING IN—Still the WDM technology leader for long-haul networks (poster child Broadwing recently claimed a 4x decrease in operating and capital costs due to its Corvis deployment). CEO and optical guru Dr. David Huber awaits the broadband flood with relish while counting on \$612M in cash to carry his company through the narrowband drips.



StorageNetworks (STOR)

DATA STORAGE MANAGEMENT, SOFTWARE



JUNE '02 MONTH END: 1.96 52-WEEK RANGE: 1.20 - 17.86 MARKET CAP: 193.1M

STAYING THE COURSE—This *Network Magazine* storage services "product of the year" award winner maintains its ambitious pace in the race towards profitability as gross margins head in the right direction. This week StorageNetworks announced successful completion of the beta program and general availability of its STORos enterprise storage software, ahead of schedule. With the recently signed licensing agreements from Ford Motors and TechTarget, STORos is now deployed at over 100 companies.



Scale Eight

MASSIVELY PARALLEL GLOBAL STORAGE



PRIVATE

IT TAKES A VILLAGE—Joining up with the good guys, Scale Eight did its part in the war on spam this month, adding the previously stealth junk mail fighters, Cloudmark, to its steadily lengthening customer list. Scale Eight's globally distributed file system is integral in the worldwide distribution of Cloudmark's open-source, collaborative spam-filtering software system.



Mirror Image Internet

GLOBAL CACHING AND STOREWIDTH PLATFORM



PRIVATE

INSTACONTENT—Improving its bottom line and alleviating customer woes over dawdling downloads, Barewalls.com joined the long list of e-retailers to deploy Mirror Image's *instaContent* global distribution service. Since then, Barewalls has experienced a 10% swell in traffic.

Hind Sight is 20-20: We're betting that the wayward Mirror Image employee(s) that headed up I-495 to Cereva a while back are wishing they could turn back time. (Unable to secure additional financing, the Marlborough, MA based storewidth startup aimed at accelerating content delivery, closed its doors for good on June 25.)

KEY

DEBT WARNING



CASH RICH



INTELLECTUAL PROPERTY



IPO WATCH



NEW ADDITION TO LIST



MERGER & ACQUISITION



TECH BREAKTHROUGH



ADDITIONAL FINANCING



CUSTOMER WIN



MEAD'S ANALOG REVOLUTION

National Semiconductor (NSM)
Synaptics (SYNA)
Sonic Innovations (SNCI)
Foveon

Impinj
Applied Neurosciences
DigitalPersona

COMPANIES TO WATCH

Analog Devices (ADI)
Beamreach
Cablevision (CVC)
Comcast (CMCSK)
Cox (COX)
Endwave
Samsung
Seven
Xilinx (XLNX)



Equinix (EQIX)

SECURE INTERNET BUSINESS EXCHANGES

JUNE '02 MONTH END: 0.35 52-WEEK RANGE: 0.31 - 3.53 MARKET CAP: 33.7M

TRANSFORMING THE INTERNET—Equinix's Internet Business Exchanges (IBXes) have become the major hubs of the Internet, co-locating 75-plus networks. Every major top-tier backbone provider has acknowledged Equinix's Internet Core Exchange service as the means by which they will conduct all future network peering. While most of its co-location competitors flop and flail with less than 10% of available square feet in use, Equinix IBX centers boast 44% usage rates. Expect that figure to rise as single-network co-location becomes obsolete. Flight or fight? Watch out for \$265M debt overhang, but this is a Telecom outperformer, with fast growing quarterly sales of over \$20M.



Sprint PCS (PCS)

NATIONWIDE CDMA WIRELESS NETWORK

JUNE '02 MONTH END: 4.47 52-WEEK RANGE: 3.50 - 29.05 MARKET CAP: 4.4B

BLASTOFF—A survey of 51,000 mobile phone users by Telephia Inc. and Harris Interactive found that nearly one-third of U.S. subscribers plan to upgrade their handsets within a year to take advantage of new features. We believe that all aspects of Sprint PCS's 1x launch are coming together perfectly. Q2's softness is the result of a significant slowdown in advertising and promotions, and the decision by business and consumer subscribers to wait for the launch of the 1x data network. Look for a major ad/sales blitz soon.

Mobile Malone: The *New York Times* reports that through some crafty negotiations several years ago, Liberty Media's John Malone may parlay his 19% ownership of Sprint PCS into a claim on Sprint's telephone directory business or even control of FON itself. It's all very complicated, but we'll be watching.



Qualcomm (QCOM)

CDMA MICROCHIPS, IP, SOFTWARE

JUNE '02 MONTH END: 27.49 52-WEEK RANGE: 24.50 - 68.87 MARKET CAP: 21.2B

MORE MILESTONES—Japan's KDDI topped one million cdma2000 (1x) subscribers on June 23, less than three months into its launch. Qualcomm's BREW software, an open environment for new data applications, also hit the million mark with over one million BREW-enabled handsets sold and activated since November 2001...Sneaky Nokia continued planting stories about Qualcomm troubles in China, but China Unicom says it is consulting Sprint PCS and Qualcomm about an upgrade from IS-95 to cdma2000, which would more clearly differentiate its network from the GSM competitors...Speaking of Nokia, AT&T, who continues to be fined for failing to institute mandated e-911 services on time, is blaming Nokia equipment and suggests the Finnish company should pay the fee instead.



Altera (ALTR)

PROGRAMMABLE LOGIC DEVICES

JUNE '02 MONTH END: 13.60 52-WEEK RANGE: 12.70 - 33.60 MARKET CAP: 5.2B

FINALLY—On July 1, the Semiconductor Industry Association (SIA) reported the first semiconductor sales growth YoY since December 2000. Programmable logic devices, or PLDs, led the way, growing 115%, albeit from a very depressed base...IBM announced it intends to integrate Xilinx FPGA cores on ASICs...and Altera began shipping high-end Stratix chip, with which it hopes to leapfrog some of Xilinx's popular products.



EZchip (LNOP)

10 GIGABIT NETWORK PROCESSORS

JUNE '02 MONTH END: 6.90 52-WEEK RANGE: 2.70 - 16.45 MARKET CAP: 50.3M

80% RULE—EZchip's latest white paper, entitled "Reducing Router Chip-count, Power, and Cost by 80%," details its NP-1 chip's competitive advantages. You can find the paper at <http://www.ezchip.com/html/linktowhitepaper.html>.



Broadcom (BRCM)

BROADBAND INTEGRATED CIRCUITS

JUNE '02 MONTH END: 17.54 52-WEEK RANGE: 17.06 - 53.35 MARKET CAP: 4.7B

SERVER I/O KING—Broadcom's ServerWorks division retains its 80% market share of I/O chipsets for Intel-based servers from IBM, Compaq, and Dell. It also accounts for more than 20% of total BRCM revenue. In conjunction with expected widespread upgrades from Pentium III to Pentium 4 servers, distant number two Intel is bringing a new competitive I/O solution to market (its last try flopped), but Broadcom does not expect much share erosion. The company is on track to meet or beat quarterly estimates.



Terayon (TERN)

BROADBAND CABLE MODEMS, HEAD-ENDS

JUNE '02 MONTH END: 1.33 52-WEEK RANGE: 0.86 - 14.75 MARKET CAP: 96.7M

OOPS!—CableLabs's decision not to certify Terayon's DOCSIS 2.0 CMTS (head-end) sent the stock reeling, but CEO Zaki Rakib assured investors that he didn't expect to be certified and that the product is the only one of its kind and is on track for certification later this year. He reiterated TERN's lead in DOCSIS 2.0 and said the company will more narrowly focus its efforts on the next-gen cable standard, possibly cutting back or even shedding some of its telecom product lines to achieve the operational efficiencies necessary given the slow-down in the cable industry. Rakib said Broadcom is 6-9 months behind in DOCSIS 2.0 and TI is not on the map. Even if Broadcom develops a strong product, Rakib said, everyone wants a second source so Terayon will be assured a position in the market. Interest from the cable MSOs in DOCSIS 2.0 is high, he asserted, and Terayon has shipped 2.0 modems to (or received orders from) three out of the top five U.S. MSOs.

Take Away: Terayon's sales and stock will struggle in the short-term, but the company's technological leadership in a promising market has not diminished.



Texas Instruments (TXN)

DIGITAL, ANALOG, MIXED-SIGNAL PROCESSORS

JUNE '02 MONTH END: 23.70 52-WEEK RANGE: 20.10 - 38.50 MARKET CAP: 41.1B

MODEMS GALORE—CableLabs certified four TI-based cable modems in the latest round of DOCSIS 1.1 qualifying. TI also announced the world's first monolithic 18-bit, 500 kilo-sample-per-second analog-to-digital converter. The company now trades at five times forward looking sales, a steep discount to the 9.6 average price-to-sales multiple of its direct peers.



National Semiconductor (NSM)

SINGLE-CHIP SYSTEMS, FOVEON IMAGERS

JUNE '02 MONTH END: 29.17 52-WEEK RANGE: 19.70 - 37.30 MARKET CAP: 5.2B

WHAT'S UP AT FOVEON?—After Foveon's recent fourth venture round, National's direct ownership is still 40%. But Sigma's SD-9,

the first camera to feature Foveon's X3 single-chip imager, will not be available until September, as the two companies refine both signal processing software and the graphical user-interface. The X3 runs impeccably, but as a radical disrupter Foveon wants its first product to be a knockout not just in its demonstrated image quality, but also in overall simplicity and convenience, enabling the technology to move down market. In these applications—such as single chip cameras and camcorders for cheap, ubiquitous super-high resolution surveillance—other companies cannot follow at all.

Stock Dip: With no grasp on Wall Street of Foveon's explosive long-term potential (which National shares as both 40% owner and only manufacturer), the recent one-third dip in price offers a buying opportunity.



Synaptics (SYNA)

TOUCH-SENSORS, FOVEON IMAGERS



JUNE '02 MONTH END: 7.54 52-WEEK RANGE: 7.54 - 20.75 MARKET CAP: 174.8M

PASSWORD PLEASE—Synaptics is combining its leading touchpad interface with the AuthenTec's fingerprint sensor, offering notebook OEMs a complete integrated biometric security solution OQQ's new "ultra-personal computer" also will feature a high-resolution display with Synaptics touch-screen features.

Financial News: Synaptics was added to the Russell 2000 Index on July 2....its six-month IPO lockup expires on July 28.



Narad Networks

GIGABIT ETHERNET COAXIAL CABLE NETWORKS



PRIVATE

IT PINK SLIP—IBM aligned with Narad to offer a wide range of outsourced IT services to small and medium-sized businesses (SMBs) over coaxial cable networks. IBM's \$35-billion Global Services group has been looking for new markets, and the \$100-billion SMB opportunity just pried open by Narad is a perfect fit. Via Big Blue's Java-based Websphere platform and Narad's Gigabit Ethernets, enterprises will buy storage, hosting, security, applications, database, and e-business services.

Real Deal: IBM has over 30 engineers working on the Narad project. Many of them from the Pervasive Computing division in North Carolina, whose Websphere is racking up wins versus Microsoft's .NET and Sun's Sun ONE programs. Separately, Narad reports a \$10-million sales backlog but has not identified customers.



Soma Networks

BROADBAND WIRELESS ACCESS, NETWORK SOFTWARE



PRIVATE

CUSTOMER NO. 2—Always On Network became Soma's second publicly-announced customer, saying it will deploy Soma's broadband wireless system this month in Oregon, and follow with roll-outs in Idaho, Hawaii, and the U.S. Virgin Islands. Japan NTT started a much larger, nation-wide roll-out in June, hoping to sign up 1 million subscribers in the next 12-18 months.

Pardon My Reach: None of Soma's competitors (IP Wireless, Navini, BeamReach) can match its open software platform that enables easy provisioning of services and new applications. But BeamReach is pushing the air-interface envelope with its adaptive beam-forming smart antennas, which focus signal energy on individual users, yielding a claimed spectral efficiency of 10 bits per second per hertz and an astounding range of 21 miles. Experts, however, question the system's cost and whether it is really non-line-of-sight—and say there won't be a real product for at least 12 months.

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few millionths of a cent a piece. More important, a personal computer market emerged in the early 1980s and this month, according to Gartner Group surveys, it reached a cumulative total of a billion sales. The PC offers Fairchild's successor company, Intel, between 40 and 60 percent margins on hundreds of millions of microprocessors, each of which holds some 10 million transistors, and provides an additional market for billions of transistors on dynamic random access memories (DRAMs).

DRAMs enabled such companies as Micron (MU) and Samsung to become global leaders and made the Japanese semiconductor firms and capital equipment suppliers such as Nikon (NINOY) and Mitsubishi (MSBHY) world leaders in sophisticated manufacturing. DRAMs offer narrow and heavily contested margins. But they still represent a source of huge wealth to the world economy and to semiconductor suppliers in the U.S. and Asia. From those transistors, tiny crude switches sold by the thousands 40 years ago, has emerged a \$380 billion electronics industry that largely determines the economic and military power of men and nations.

The thesis of the Telecosm is *not* that with Senator Hollings's kind permission after consultation with Jack Valenti and Michael Armstrong, the households of the world will be linked to T-1 line equivalents for \$50 per month, fulfilling the industry through an additional jittery stream of pay-per-view movies and Ukrainian porn. The thesis is that underway in communications is a process of global transformation fully analogous to the rise of the microcosm and complementary to it.

The Telecosm is inherently more promising than the microcosm was. Rather than tiny crude switches embodied in Boolean algorithms or storage domains, the communications industry trafficks in paths of light that link human beings and their machines to one another. Wavelength division multiplexing today stands about at the point in its history that semiconductor electronics had reached at the time Gordon Moore raised his question about the usefulness of more than a few thousand transistors. The sometime skeptics of the Telecosm, who imagine that this deflationary crash refutes the cornucopian promise, spurn the full purport of Gordon Moore's law and repeat Gordon Moore's mistake.

Charlie's use of Internet traffic as the measure of demand for lambdas recapitulates Moore's view of basic engineering efficiency as a measure of the demand for transistors. As transistors became asymptotically free, they found prodigal uses, as they were employed to store addresses and phone numbers, render sounds and colors, play chess or Doom, and supplant gears and brake chains in automobiles and other mechanical systems, not just in existing products or personal computers but in cell phones, cameras, email processors, transactional machines, barcode counters, and smart cards and recorders that morphed into new combinations and multiplied ubiquitously. Transistors became not just a prosthetic for the old economy but a propeller for an entirely new industrial age.

As wavelengths become asymptotically free, they will be wasted in similarly unexpected ways, enabling global simulations and experiences and transcending the isolation of human beings in time and space. Counting the number of lambdas needed to accommodate some extrapolation of current bandwidth consumption is tantamount to counting the number of computers needed in the mainframe world of 1960 or the number of steam engines needed in to run mines and factories in 1790.

Repeating Carver Mead's projection of exponential advances in the microcosm is Terry Turpin's extrapolation of tens of thousands of wavelengths in every fiber thread. Just as Mead showed that transistor performance would improve apace with miniaturization, Turpin shows that lambdas become cheaper, cooler, and better as they are multiplied on single fibers. But unlike in the microcosm with its potential of billions of transistors on a single silicon sliver, the Telecosm does not require billions of lambdas in a single fiber. It requires billions of lambdas in a global economy that increasingly functions through analog optics and analog spectral processing.

NSM puts heat on Intel

Now the Mead and Turpin visions are converging. Both men see that the most powerful force in optronics is analog processing. Both see that the digital world generated by Moore's law has hypertrophied into a frying pan planet of devices that are too complex and power-hungry to be cheap and ubiquitous. The original magic of Moore's law fed on the fact that on silicon chips functionality grew far faster than complexity did. Now Moore's law is dwindling in importance as the process of putting more digital transistors on a single chip imposes a steadily rising burden of how to take the heat out. Power dissipation rises in proportion to the cycle rate in hertz. Thus, a gigahertz processor, all other things being equal, will use and emit 10 times more heat than a 100 megahertz processor. What is not equal is voltage. Heat dissipation rises (or falls) by the square of the voltage. Therefore, microprocessors have compensated for the higher clock rate by lowering the voltage. But as the voltage drops, leakage on the gate tends to increase. Since voltage declines far more slowly than clock rates increase, power usage in Moore's law devices ekes up inexorably. The International Road Map for Semiconductors shows state-of-the-art devices soon dissipating close to 150 watts on every chip, equivalent to several lightbulbs.

Heat has become an insuperable obstacle to the continued pursuit of Moore's law in portable, handheld, satellite borne, rack mounted, or other power limited applications. Indeed, last month a group of mischievous supercomputer engineers fried an egg with the thermal output of a Pentium 4 processor, offering the prospect of an Intel-inside cogeneration and cooking product that can heat your house and your coffee while you wait for the device to gigachurn and chomp through the ultra-DES public key encryption codes that authenticate your right to download your email (in much the way that DoCoMo (DCM) 3G phones in Japan

found their most reliable and popular functions as hand-warmers for attendees at outdoor sporting events).

As the Pentium 4's clock speeds have risen, from 1.5 gigahertz in late 2000 to 2.5 gigahertz today, Intel's quarterly profits have plunged from \$2.9B to \$936M. Most of Pentium's 2 billion hertz are wasted, says Brian Halla, CEO of analog-centric **National Semiconductor** (NSM). His Geode processor runs at only 266 MHz, but also consumes just one watt, versus 55 watts in a Pentium 4. The numbers suggest Intel is overshooting the market, as we have long predicted. The very day Intel pre-announced contracting revenues of between 5 and 10 percent last month, National was reporting 13.5 percent quarter-over-quarter sales growth, also besting analog competitors TXN and **ST Micro** (STM), who grew 10 percent. So serious is CEO Brian Halla about the low-power paradigm enabled by new analog breakthroughs, he says in two years "we will be known chiefly as a power management company." From single-chip Geode processors that eliminate the cooling fan required by a Pentium, to high-res, low-power flat panel displays, to battery-saving Foveon cameras—not to mention low-power cellphone chip sets (albeit GSM)—National is in the sweet-spot of the analog trend, where in order to win clients, models must be mobile, wireless, or thin.

And with a price-to-sales multiple of just 3.0, National's stock compares favorably to most of its analog rivals: **Maxim** (MXIM), 13.8; **Linear** (LLTC), 18.9; **Analog Devices** (ADI), 6.9; **ST Micro**, 3.9; and **Intersil** (ISIL), 4.55.

The plummeting price of digital has impelled the binary model of computation beyond its natural bounds, to the point that digital machines have become kludges that sweat watts and giga-shuffle bits to perform such obvious analog fortes as image processing, pattern matching, and wavelength routing. Whether in a computer or on a network, analog devices can function at least 10 thousand times more efficiently than digital devices. In programmable applications involving buffering, storing data, and fetching data, digital is indispensable. But whenever a special purpose can be embodied in an analog device, it will perform far more cheaply and efficiently.

Skeptics of the Telecosm, who imagine that this deflationary crash refutes the cornucopian promise, repeat Moore's mistake

The apparently inevitable triumphs of the digital camera and the digital switch, for example, represent forced and factitious stopgaps on the way to analog solutions that respond to the physics of the media. Neither an image nor a path, a camera or a map, a spectrographic calculator or a retinal recognizer, a routing scheme or a pattern matcher is intrinsically digital at all. For example, everywhere in the world of image processing, from the surveillance of the Tora Bora caves to the elimination of interference in wireless telephony, fast Fourier transforms (FFT) signify a grand triumph of digital math. Translating noisy nonlinear masses of real world signals into simple sines

and cosines—and back—FFTs parse infinities and infinitesimals into mindbending mathematical simplifications to reduce calculations that would normally take minutes to the microsecond spans required for real-time operation. Yet, in analog form, these calculations happen naturally and instantly. Your ears and eyes do it constantly.

A digital router or switch takes in volumes of digital information about network topology and specific addresses and churns them through digital algorithms. But an optical wavelength combines both destination and path in its own spectral signature that can be instantly parsed in analog form by passive optical devices. Similarly a camera receives light waves and converts them into digital form for elaborate processing taking millions of steps. But an image is both a perfect analog rendition of itself and its own simplest representation and can be manipulated elegantly and instantly by an analog image plane or can be transformed naturally by superposition of other analog images.

The all-optical network is the ultimate analog device, replacing trillions of power hungry digital transistors across labyrinthine webs. Even security concerns can be banished to the edge if digital translations are not performed. Flashing across an all-optical network in full analog form, where every amplitude and phase bears a spectral message, a signal or an image cannot be tapped without detection. It is naturally encrypted between its end points, perhaps even to the satisfaction of Senator Hollings.

Essex rendered powerless

Thus, Terry Turpin of Essex (ESEX.OB) might provide image processors for satellite surveillance equipment that use virtually no power, or spectronic gear that instantly nulls out all the interference in a code division multiple access (CDMA) cell, or create passive optical processors for wavelength division multiplexing that obviate billions of digital steps in computation of protocols and routing tables and network addresses. Mead similarly can contrive an analog chip that can instantly and powerlessly perform all the millions of steps in the computation of a digital camera image or a retinal recognition or a speech spectrometer.

What does all this have to do with calculations of the superogatory overreach of WDM? How does this analog paradigm affect the sweltering “heat of the herd” of digital

bears? What it means is that the new paradigm is just at the beginning of its evolution. All-optical technology now is a long-distance system that has overpowered the needs of a backbone network. The real opportunity is to extend this overpowering technology from the center, where it has rendered bits per second too cheap to meter, to the multitudinous edges wherever an analog input must be matched, searched, parsed, or passed on, in every cellphone, camera, counter, point of sale terminal, ATM, and computer—all the sensory transducers of the global information economy. That means optics everywhere and the analog paradigm as ubiquitous as the digital paradigm now is.

For storing, computing, morphing, and manipulating information, digital electronics still surpasses analog. Carver's Foveon camera ultimately converts its analog images to digital form where they can be shared and expanded or reduced and stored at your convenience, with an ultimate real-time of mind-speed processing at a rate of 25 bits per second. Turpin's Hyperfine mux-demux passes on its murky time domain analog signals to be translated to digital form to be used and processed in all the multifarious ways people use information. But before the digital moment arrives, a typical glyph or image will pass through billions of passive optical devices that pass it through the network core in endless iterations of amplification and duplication and redundancy into metropolitan mazes where they whirl around cities, sometimes passing into wireless forms for cellular transfer and sometimes racing into neighborhood webs of glass and light and spectral homescapes and office networks that end in particular computers and other devices which finally resort to analog to digital conversion. After that digital conversion will proceed the efflorescence of activities that we know as the information economy. Then the bits are converted back into analog form wherever human beings must perceive them. At every level, a new market will beckon for the agile and creative forces of the Telecom now retreating to the apparent safety of caves. But smart speleologists will cautiously appraise opportunities in National Semiconductor, Synaptics, Essex, JDSU, and Corvis, among other Telecom stars, well before the bears return for their well-earned hibernation.

George Gilder
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