GILDER
TECHNOLOGY
REPORT

January 2006 / Vol. XI No. 1

The Prophet's Perplex

Sigma has succeeded in putting all the various media processing apps on one chip, giving it a real edge against Broadcom, TI, Intel, and others.

Inside:

Sometimes *it is possible to predict the future. But then you have to wait..and then wonder…and then wait more…which is a worry and a pain for all the impatient and improvident.*

One tack is simply to file and forget, as I did around a decade ago with such companies as **Digital Fountain**, **Garage Technology Ventures**, the **Kleiner Perkins** funds (with Google et. al.), and some others from deep in the past. I investigated Digital Fountain at the behest of *Forbes* publisher Rich Karlgaard, then launching Garage.com as an online angel capital source and service station, and I served as the first outside investor for both Digital Fountain and Garage.

I thought Digital Fountain would rule the world with Berkeley information theorist Michael Luby's transform: a technology for flawlessly powering files in packets across noisy networks without acknowledgements and with no need for the packets to be received in any particular order. But in a narrowband world no one seemed to care about Luby's invention. I thought Garage could become the global center for angel capitalists seeding the next generations of Silicon Valley companies. But the Millennial crash crimped the angelic wings.

Then there are the companies that I festooned with paradigmatic banners years ago and then forgot. Among those is **MicroUnity**, a company led by Rhodes scholar and physics star John Moussouris. In 1994, I acclaimed MicroUnity as fervently as last year I touted John Trezza's Xanoptix, which by attempting to launch a revolutionary new fab followed in the path of MicroUnity. Xanoptix is now fabless and renamed **Cubic Wafer**. But judging from the experience of MicroUnity, Cubic Wafer may well have its day.

The strategy of this letter, however, is to watch the pot until it boils. This is the task I am now attempting with **Foveon**, **EZchip** (LNOP), **Microvision** (MVIS), **Power-One** (PWER), **Broadwing** (BWNG), **Cepheid** (CPHD), and even my paid directorial potlatch **Wave Systems** (WAVX), which I have been nurturing for 15 years.

Contrary to the epigram, watched pots do eventually boil. Sometimes (Global Crossing, Worldcom, you can supply other names I am sure), they boil over. But sometimes they boil up in value like **Essex** (KEYW) or **Qualcomm** (QCOM). In forecasting, you can predict either the ebullition or its timing. Doing both at once is the prophet's perplex.

Last week I was trying gently to explain the problems of prophecy to one Tom Ditto, a ponytailed actor/writer/minstrel from the 1960s whose peregrinations brought him into my office on the farther shores of the twenty-first century teetering under a mental burden of technical brainstorms. He wanted to make a multimedia opera out of *The Silicon Eye*. He had created new telescopes that resembled synthetic aperture radar. He was a virtuoso of ray optics. Son of the venerable "Mister Transistor" David DeWitt of **IBM** (IBM) and uncle of **EarthLink** (ELNK) and **Boingo Wireless** founder Sky Dayton, Ditto has won several patents on a prize-winning invention: a 3-D input or cursor controller and range finder based on diffraction gratings. As if signing to the deaf, according to Ditto, we will all be controlling our computers and cursors with imperious forefingers in a diffractive field without removing our hands from the keyboard.

Tom's project brought to mind a visit to Silicon Valley I had made a decade ago in late October of 1994 after a near hurricane had wreaked a wilderness on the peninsula. I had flown into San Francisco on the last American flight into the city the night before, grappled in the biting rain across the wind-wuthered parking lot at the eerily darkened Burlingame Marriott, and awoke the next day to consort with tatterdemalion prophets amid the rubble.

Our strategy is to watch EZchip, Power-One, Cepheid, and Broadwing until they boil.

Setting the stage was frowsy friendly old Eric Schmidt, the over-the-hill sage from **Sun Microsystems** (SUNW), dispatching half-crazed emails to me late into the night. "*The network is the computer*," he wrote me in preparation for a meeting bent over a coffee table sketching schematics on napkins in some woebegone Marriott lounge. "The value added of the network will so exceed the valued added of the CPU (central processing unit) that your future computer will be rated not in MIPS (million instructions per second) but in gigabits per second. Bragging rights will go not to the person with the fastest computer but to the person with the fastest network…"

Yeah, yeah, the Sun mantra already a bromide in the Valley. But then Schmidt crucially enriched his vision. He said the key to the success of the new model would come not in the bandwidth, which would be "virtually free," but in "the associated database lookup, browsing, and information retrieval engines." At the time, Larry Page and Sergey Brin had yet to meet for "Back Rub" and **Google** (GOOG), and Schmidt did not know them. But in his emails and patient expositions, he had their future together pegged almost perfectly, down to the critical role of "search and sort." Nonetheless it was Sun founder Andy Bechtolsheim who put up the initial $100 thousand to get Google off the ground. Schmidt did not become rich or famous for nine or ten more years. The world had plenty of time to write him off as he slid over the edge of Sun's horizon into the protocol muddles of **Novell** (NOVL).

So Schmidt was not at the top of my list for my visit to Silicon Valley. Back then in 1994 I was in the process of writing my "Telecosm" series for Karlgaard at *Forbes ASAP* and hunting for wilder game in the Valley. The wildest game of all was Moussouris, an entrepreneur with a background in entanglement physics and MIPS microprocessors, coauthor of papers with Nobel Laureate Roger Penrose and proprietor of projects for the thousandfold acceleration of software-based media processors.

He had started MicroUnity to exploit the coming wave of bandwidth abundance that would bring video, audio, wireless connectivity, and three dimensional games to every computer. With his first customers slated to be cable companies creating cable modems, he attracted a major commitment from John Malone of **TCI Cable** who wanted a multimedia "supercomputer on a tray." With his promise to do multimedia in software, Moussouris also elicited an investment from Bill Gates.

Over the phone to me, Moussouris echoed Schmidt by contending that the prevailing computers were computing and calculating engines, maladapted for the communications, graphics, and media processing that would be central to an era of bandwidth abundance. Needed would be software programmable media processors that could race at speeds thousands of times faster than the streams of "triple play" multimedia that they would have to digitize, decode, decrypt, render, assemble, and zoom in real time. During that era, Moussouris complained with a sneer, all these roles were performed in "twisty little processors"—application specific custom devices rigidly patterned for one function. These hardwired systems were difficult to integrate into programmable equipment that could adapt to changes in taste and technology and that a consumer would want to buy.

With this observation, Moussouris thrust himself into the midst of my "hard-core/soft-edge" for the *Life After Television* paradigm. *In the center of the network, software will harden. On the edge of the network, hardware will soften*. That was my mantra. At the time, the edge was dominated by hardwired TVs and phones and the core was replete with seven layers of routing, switching, framing, adding and dropping, protocol shuffling, timing, error correcting, rendering, and metering software of all kinds. In my view, the new network core would be hard glass: fiber optic silica with passive prismatic devices shuttling the bits around the network and banishing the some 25 million lines of software code in the central offices of the telephone companies and cable headends.

Read Green's book and you will emerge convinced Verizon made the right decision; all-optical will prevail.

This part of the paradigm I had learned from Will Hicks, the co-inventor of single-mode fiber, and from Paul Green of IBM, who had written the book *Fiber Optic Networks* to prepare the world for all-optical communications. It led to my infatuation with optical companies such as **Avanex** (AVNX) and **JDSU** (JDSU), Corvis and Global Crossing that were supplying the technology to harden the core.

But no less important was the other side of the paradigm—the replacement of hardwired television sets, telephones, radios, and phonographs with adaptable digital devices programmed in software. I was looking for software radios, programmable video players (now called TiVos or personal video recorders), adaptable set-top boxes, reconfigurable communicators, soft-switches on the edge, all subsumed by the personal computer as it evolved into a teleputer or telepod. Here was where Moussouris came in.

Moussouris offered a new insight. He contended that root and branch, hardware and software, the very design and device physics of digital microprocessors such as Pentiums was maladapted to the needs of the net. In accord with the paradigm, my answer was to "soften" those twisty little hardwired processors by coupling them with field programmable gate arrays (FPGAs) from **Xilinx** (XLNX) and **Altera** (ALTR) that could be changed or reconfigured after installation in the system. But Moussouris said no—no combination of these devices could achieve speeds remotely able to handle the multimedia real-time flows of the next-generation of media.

To build new semiconductor technology that could reach the required speeds to deal with high-definition (HD) images, Moussouris hired James "Al" Matthews from **Intel** (INTC), where he had developed the CMOS (complementary metal oxide semiconductor) process for the 386 microprocessor. Matthews set out to develop an entirely new wafer fabrication scheme exploiting the "anomalously good effects" that he had discovered when he reduced the charge on transistors to below one volt and the gate lengths to below 100 nanometers, levels that even Carver Mead once considered to be on the edges of outlandish. At the same time, Moussouris and his team devoted themselves to developing both a new architecture and instruction set for media processors and the software model to exploit the new instructions.

Now called BroadMX, these schemes were optimized for bandwidth and throughput and simple programming in C or C++. Supplying instructions for a variety of vector, matrix, Galois error correcting, crossbar switching, and convolve operations that obviated as many as 50 steps for real-time processing of multimedia signals, MicroUnity also proposed new hyper-threaded structures to enable programmable microprocessors to perform roles then achievable only in ASICs (application-specific integrated circuits) and the other fixed devices that had to be removed whenever a protocol changed.

After a series of exciting breakthroughs and intriguing experiments with bipolar circuitry, Al Matthews' efforts in the fab began to founder. The reasons remain in dispute. Although the output of his new fab process was close to zero, Matthews still believes he could have achieved acceptable yields for his chips over a span of time not unusual in new semiconductor processes. Every new generation or "process node" for DRAMs or Pentiums, after all, begins with nearly zero yields and takes a couple years to bring to maturity.

But Moussouris was under pressure from venture capitalists. Attempting dual transformations of both process and architecture at the same time, he was violating the industry's most hallowed conventional wisdom. Caught in the prophet's perplex, Moussouris and Matthews knew what to do, but they came a cropper on the timing.

Moussouris was forced to close down the Matthews fab revolution. However, under the name MaskTools, Matthews' photolithography inventions for optical proximity correction and more precise patterning of photoresists yielded ten patents. Spun off and then sold in 1999 to photolithography giant **ASML Holdings** (ASML) of the Netherlands for $21 million, MaskTools kept MicroUnity alive during the years of the Moore's law catchup.

The companies I touted in the early '90s, such as Qualcomm, took a decade to resolve.

To the world, however, MicroUnity had died and Moussouris had failed. The media processor was never launched. Instead, twisty little processors proliferated and were increasingly integrated on single chips with a modicum of adaptability supplied by the FPGAs from Xilinx and Altera for interfaces to a changing world. Even though full software programmability remained elusive, multi-cored twisty little processors from **Sigma Designs** (SIGM), **Texas Instruments** (TXN), and Qualcomm could even do "a triple play" of voice, video and data on one chip. Pentiums moved beyond gigahertz clock rates and Intel adopted hyperthreading technology and multimedia extensions (MFX) that enabled its chips to perform some programmable video functions, though still offloading Moussouris's hard stuff to co-processors and anfractuous little ASICs.

Some six years passed. Then, this October at Telecosm 2005, Moussouris emerged like a ghost from the past with amazing good news. Eleven years after my trip to visit the company in the wake of the hurricane, MicroUnity was doing better than ever as a supplier of intellectual property. The most important purchaser was Intel, which had paid some $300 million for the company's innovations in BroadMX and was apparently incorporating the technology in its new Viiv line of media processors.

I say "apparently" using the technology in Viiv because our editor Nick Tredennick, famed designer of microprocessors, reports widespread skepticism in the Valley toward the idea that the MicroUnity patents represented more than an artful anticipation of advances that were already on their way with Moore's law. "The bar is way too low for patents," he says.

Although Moussouris' BroadX concepts are real innovations, I would feel much better if Moussouris and MicroUnity were putting some of them into practice themselves rather than using the patent lawyers to shake down the actual innovators. But short of a major overhaul of the patent system, urgently needed, the kind of litigation that Moussouris is pursuing has become the American way. TI, after all, extorted

TELECOSM TECHNOLOGIES

Advanced Micro Devices	(AMD)
Altera	(ALTR)
Analog Devices	(ADI)
Broadcom	(BRCM)
Broadwing	(BWNG)
Cepheid	(CPHD)
Corning	(GLW)
Equinix	(EQIX)
Essex	(KEYW)
EZchip	(LNOP)
Finistar	(FNSR)*
Flextronics	(FLEX)
Ikanos	(IKAN)*
Intel	(INTC)
Microvision	(MVIS)
National Semiconductor	(NSM)
NetLogic	(NETL)
Power-One	(PWER)
Qualcomm	(QCOM)
Semiconductor Manufacturing International	(SMI)
Sigma Designs	(SIGM)*
Sprint Nextel	(S)
Synaptics	(SYNA)
Taiwan Semiconductor	(TSM)
Texas Instruments	(TXN)
Xilinx	(XLNX)
Zoran	(ZRAN)

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billions for its pathetic patent for Kilby's lumpy caricature of an integrated circuit with gold wires arching through the air across the top (which ironically Matthews emulated in some of his bipolar chips).

The key lesson is that innovation takes time. The companies and technologies that I touted back in the early 1990s at *ASAP*—MicroUnity, Qualcomm, **Arraycomm**, TI digital signal processors, **Sprint**'s (S) CDMA (code division multiple access) wireless PCS, **Ciena** (CIEN) all-optical network technology, and an array of other optical ventures that merged or misted up too fast for me to recall the names today—took close to a decade to resolve (or dissolve) their markets and their market caps.

Born in 1997, Digital Fountain was one of the most luminous and most discouraging of all. Based on "Raptor code" technology invented by Michael Luby and critically enhanced by chief scientist Amin Shokrollahi, a "digital fountain" suggests the analogy of a water fountain. Just as you drink from the spout at the time of your choice without any concern for which water molecules you imbibe, in what order, so you receive packets from a digital fountain without any concern for their order or timing. With a small overhead (less than 2 percent), any collection of packets suffices to enable creation of the file. Luby's complex algorithms for coding and decoding comprise a mathematical blender that can spout packets from the fountain all day and all night, all essentially homogeneous, like the elements of a hologram or the flow of a stream. Segmenting the file as necessary, the fountain can even supply real-time streaming video and audio.

Perfect for a hard-core/soft-edge world, where the center of the network is content neutral and the edge conducts all the programmable processing, fountain codes obviate an intelligent network.They remove any need for elaborate multicast software in every router or switch and enable a dumb network system of broadcast and select. They enhance the all-optical network. They entail no software to coordinate transmissions from many servers distributing the same packets. They allow peer-to-peer or broadcast or multicast strategies at will.

At the time of my investment, I was chiefly concerned that wireless systems in particular could not function with constant TCP (transmission control protocol) acknowledgements and resent data. I foresaw Qualcomm as a critical path licensee. With the need to coordinate thousands of transmissions for every multicast or broadcast download, the wireless Internet could never displace television and its advertising model. Communicating complex software or other information to automobiles would be nearly impossible. It seemed to me that these Raptor codes were crucial to the success of *Life After Television* and for Qualcomm's wireless broadband vision.

This prophecy was wrong. With MediaFlo, Qualcomm adopted a broadcast system based on running a separate network at 700 megahertz almost on the television model. Digital Fountain survived only with contracts from large software companies such as **Siebel Systems** (SEBL) and **PeopleSoft** (now **Oracle** [ORCL]) that had to send huge files around the world. These communications took forever with TCP-IP waiting for acknowledgements for every packet from remote recipients suffering from the sloth of light-speed consuming hundreds of milliseconds across the oceans.

Finally, in 2005, Digital Fountain has come to a boil. **Sumitomo Electric Networks** and **NTT DoCoMo** (DCM) in Japan are launching IPTV cable video services based on the technology and **On2 Technologies** (ONT) has adopted it for large transmissions across the Internet. Both **XM Satellite Radio** (XMSR) and **Sirius** (SIRI) have licensed the system for digital radio transmissions to automobiles. Qualcomm still remains aloof, but GSM has fallen. The 3G Partnership has licensed the system as a mandatory part of the GSM standard for all video downloads and streams to GSM EDGE and WCDMA phones. And the world's broadcasters have adopted Digital Fountain for data broadcasting to portable computers and television sets under the DVB-H (digital video broadcasting-handheld) standard.

By changing the balance of advantages between point-to-point and broadcast-and-select technology, Digital Fountain potentially enhances the powers of every computer on the Internet. In order to transmit large files of multimedia or software to substantial audiences, whether through the air or over wires, the broadcaster no longer needs to master the intricacies of digital multicast or specify a schedule for downloads or reserve the frequencies of a cable channel or broadcast band. The recipient can join the distribution at any time and interrupt the flow at will. As long as a sufficient number of packets is accumulated a complete file can be rapidly decoded.

Who will be the biggest winner from this new system? Just as Intel and Viiv may be the biggest winners from MicroUnity, I still would bet Qualcomm will be the major beneficiary from Digital Fountain. Why not? Perhaps Qualcomm's biggest problem is inducing the GSM carriers to upgrade their two billion GSM cell phones to WCDMA as planned. Luby's invention gives WCDMA a kick and a killer app, radically improving its multimedia performance across existing GSM networks, which after all still comprise 80 percent of the world's cell phones and all of the ones not currently based on Qualcomm's system.

With the world googling toward digital fountains, media processors, all-optical networks, and universal search and sort, what companies will prevail beyond the current giants Qualcomm and Intel? As we do our year-end pruning of the list, we have a few ideas.

The Twisty Path to the Paradigm

Back in the early 1990s, when I conceived my all-optical paradigm—the hardening of the core—under the guidance of Paul Green of IBM and Will Hicks—it was an intoxicating time. All my guides agreed that as an information carrier the silica glass of passive optical technology was intrinsically tens of thousands of times more capacious than copper and silicon.

Summing up the paradigm was "sand and glass and air," which John Gage of Sun reduced to merely sand and air: Opaque sand (silicon), transparent sand (silica glass), and transparent air. With paradigmatic wireless dominated by Qualcomm's CDMA and the network moving toward packets, Green was a triple player, since he was an inventor of the RAKE receivers at the heart of CDMA cell systems and a master of digital packet protocols at IBM. Also joining the paradigms was Sherwin Seligsohn, then Chairman and CEO of InterDigital, Qualcomm's ill- fated competitor, who told me, "It's all photonics. A wireless channel is simply an optical path with a lower frequency photonic signal insulated by air."

The paradigm is still essentially right. The electronic action will be at the edge. The optics remain mostly at the core. But now, in his new book *Fiber to the Home* (Wiley, 2006), Green has changed his mind about the timing. With telecom and networking companies stubborn in their resolve to plow deep into the bogs of the "intelligent network," Green now believes that his all-optical technology will prevail first in passive optical networks (PONs) for last-mile links to homes and offices.

In his book, he sums up the case for and against PONs. Against all-optical PONs are possible problems of security and interference in the shared medium channel, a lack of electrical power on board for *lifeline* and 911 services that politicians cherish and mandate, and a lack of standards for analog TV, also beloved of politicians. Also against PONs is the apparently inexorable advance of digital subscriber line (DSL) as outlined by John Cioffi (*GTR January 2005*) whose **ASSIA** offers a variety of bonded and high frequency solutions that reach up to 200 Mbps over some 5 km spans. Against DSL, however, according to Green, is its protocol specificity, its drastically limited reach, its power requirement at the optical line terminal or DSLAM (access multiplexer), and its complexity of signal processing (all that convoluted orthogonal frequency division muxing).

By contrast, passive optics commands vast potential capacity and unique simplicity, with no electronic harness and increasingly evident low cost compared to DSL (if any provision is made for DSL's long-term maintenance and for PON's increasingly simpler installation and more forgiving technical tolerances). Read his book (perhaps skipping the thickets of text on the details of the various PONs standards) and you will emerge convinced that **Verizon** (VZ) made the right decision: all-optical networks will eventually prevail in the metro and all the way to the basement and the curb, if not on the side of every residence.

In this new regime of ascendant optics and IPTV, which companies will prevail? Charlie Burger and I have some ideas and some reservations.

Three Outs

For two decades **Wind River Systems** (WIND) thrived by collecting royalties on its proprietary VxWorks operating systems that live inside the embedded devices proliferating at the network edge. But with more and more embedded products becoming commodities and with the rise of open-source Linux, royalty revenues have been eroding. So Wind began selling royalty-free licenses and Linux-based products while relying for revenues on applications tools, test benches, and other services to help engineers design embedded devices. The strategy is working for Wind, once again profitable. But it blows the company off our radar screen tracking developers of real-time operating systems and into the sea of software service companies. With the stock trading at a rich forward PE for the current year of 52, now is a good time to remove Wind from our list.

Unlike JDSU, Finisar is proving you can make money in optics.

Also ascendant on our list has been **Agilent** (A), climbing some 48 percent since last December. Now in the processes of paring itself into a test-and-measurement house, the H-P spinout this month sold its semiconductor business to two private equity firms that have since named it **Avago**. Agilent has scheduled a spring IPO for its automated test unit with its system-on-chip and flash memory testers, and awaits proceeds from the sale of its 47 percent share of LED company **Lumileds**. Gone are promising and market-leading technologies such as CDMA duplexers and amplifiers, fiber-optic transceivers, and vertical cavity surface emitting lasers (VCSELs). Gone too is the potential to extend optical communications to terabit speeds, and the promise of fused-chip technology to eliminate the bottleneck between the external bandwidth of chips and on-chip bandwidth on John Trezza's Cubic Wafer model. And gone from our company portfolio is Agilent.

Also gone is JDSU. With the acquisition of privately-held Acterna, JDSU has metamorphosed from, well, JDSU, into Acterna, which now contributes almost half of company-wide revenues. By refocusing from optical components, now a third of sales and still losing money, to Acterna's communications test-and-measurement gear, JDSU could well become profitable during 2006. Thus, even though shares have ascended to a rich enterprise value of 3.3x forecasted sales, they may continue to rise in 2006 if JDSU earns those elusive first pennies. But after more than six years as the telecosm's largest optical components company, JDSU has yet to figure out that business but instead continues down the brute-force path of downsizing to catch up to its shrinking prospects. Will this pot ever boil? Harboring doubts, we leave it for others to watch and instead refocus on a truly innovative optical components company, **Finisar** (FNSR).

Greener Pastures (FNSR)

Unlike JDSU, Finisar is proving that you can make money in optics. In the October quarter, this nimbler, smaller, and more focused rival eked out a few bucks before taxes and restructuring charges. For January, the company projects a GAAP profit on continued rising revenue. Over the past seven quarters, trailing-twelve-month revenues have been increasing at a remarkably steady 21 percent compared to JDSU's lackluster wanderings. Yet with about a quarter of the sales of JDSU and despite its ascendance, Finisar is awarded only about 14 percent of the market cap of its bulky competitor, even after a rapid 28 percent appreciation of the stock over the past two weeks. Except for the more alert participants in on our Telecosm Lounge who noted our Finisar "noggin nod," most of us missed out on the first market spurt, but more are coming.

Focusing on the metro and last mile, Finisar's forte is 10 to 40 gigabit transceivers and transponders, partly self-developed and partly acquired through purchases of **Infineon**'s (IFX) optical division last January and **Big Bear Networks**' transponder technology in November. The company also produces passive devices for multiplexers, optical amps, and optical add/drop modules. It still pursues linear optical amplifiers from its paradigmatic Genoa acquisition (long a Telecosm favorite).

Shunning contract manufacturers, Finisar builds its own devices, enabling the company to hone manufacturing for a relatively small group of specialized players, including **Cisco** (CSCO) as a 10 percent customer (with 61 percent of revenues coming from the top 10). Much of the recent restructuring, completed last quarter, was directed toward that end; gross margin has improved 40 percent since April and SG&A has decreased by almost a quarter of sales.

A Storewidth Play

A promising sector is SANs (storage area networks) where such customers as **Brocade** (BRCD), **EMC** (EMC), and **QLogic** (QLGC), among others, have told Finisar they plan to double the size of their installations over the next year and continue to add gear at a compound rate of 70 percent per year for the next several years. Finisar sees a large, unsatisfied need for products to monitor SANs, given that IT managers often resort to trial-and-error to solve performance problems.

Management is also bullish on non-datacom uses for VCSELs, such as optical mouse applications. Growing the laser and photodetector in a stack, Finisar can make a very small low cost integrated device that includes special algorithms from **Philips** (LPL).

A major concern for investors are $250 million of convertible notes, which could add up to 100 million shares at today's price, a 33 percent dilution. The good news is that the first $100 million is not due until 2008 and the last $150 million until 2010, when a significant portion could hopefully be paid in cash (assuming continued company growth) and the rest paid at a higher stock price, decreasing the dilution. In the short-term, Finisar is highly liquid, with cash and receivables more than double current liabilities.

How likely is a double to $4.40 over the next two years? At that price, an EPS (earnings per share) of say $0.15 would result in a generous PE of 30. But EPS would be more than doubling in that case, lending credibility to the valuation. Compromise on shares and increase the count by 50 million to 350 million and our EPS of $0.15 is supported by net income of $53 million or revenue of $438 million based on the company's long-term expectations for margins. That's 13 percent *below* the top-line growth of the past two years. Thus, even if Finisar's climb slows a bit, significant stock appreciation is possible over the next several years, not counting the potential for a serious VCSEL upside.

Shrinking the Copper Link (IKAN)

During the last 6 years over 540 million ADSL (asymmetrical digital subscriber line) ports have been shipped, serving 100 million subscribers. But as Green points out, ADSL speeds and range are grossly inadequate for the coming high-definition visual paradigm with interactive gaming, file-sharing of rich-quality videos and photos, IPTV in HD format, and HD videoconferencing rushing onto the net. Enter VDSL and one of its fabless pioneers, 5-year veteran **Ikanos** (IKAN).

> Ikanos is worth the risk to buy into VDSL, but keep a sharp eye on the competition.

ADSL is always deployed from the telco central office, whereas VDSL exploits the continuing penetration of fiber and optics ever closer to end-users. Deploying VDSL lines over the ever shrinking last mile or half mile of copper separating subscribers from the fiber, or even from the basement of a high-rise to individual tenants, telcos can offer multiple HD channels and IPTV before the consummation of fiber to the home. Think of VDSL as a valuable broadband stopgap until Paul Green's optical edge becomes ubiquitous a decade hence.

Using Ikanos chips and software, symmetrical 100 Mbps speeds are possible in high-rises. At 1,000 feet, Ikanos VDSL enables 140 Mbps of aggregate speed programmable for different architectures, such as 100 Mbps down and 40 Mbps up or 70 Mbps down and up. At 3,500 feet, which includes about two-thirds of the U.S population, aggregate speed stays at a still lofty 55 Mbps, where 45 Mbps down is sufficient to deliver four portals of HDTV at MPEG2 compression (8–10 Mbps each), combined with an upstream speed of 10 Mbps, which allows you to deliver rich HDTV-like video content back into the network.

There are about a billion copper lines installed worldwide and some 40 percent of all DSL deployments will likely be VDSL by 2008. Assuming that the average selling price for VDSL products will drop to today's ADSL prices, the eventual market opportunity is around 2.5 billion ports or $17.5 billion.

As of November, the company lists itself as the market leader in VDSL sales for 2005 with three serious competitors: Infineon, **Conexant** (CNXT), and **Broadcom** (BRCM). If Ikanos captures only one-tenth of the estimated 2008 market, it would rake in $400 million of revenues, not unrealistic given that the company is now passing the $100 million run-rate milestone. Take a generous quarter of the 2008 market and you're looking at $1 billion. Using management's long-term financial model, $400 million of sales would push EPS to $1.87, which at a PE of 25 more than triples share price to $47.

But buyer beware. Both Infineon and Conexant are selling cutting-edge VDSL2 products, and Infineon has already exceeded Ikanos' level of integration and has the ability to manufacture in volume (dropping out of the DRAM market in order to focus on these opportunities). TI could also come on strong with talent inherited from discrete multitone DSL inventor John Cioffi's Amati design team. Ikanos does not have a fully-integrated customer premises device, and so it may be reduced to creating central office DSLAM chip sets, where its advantage may not be great. Its lead comes almost entirely from its agility and focus and early product launches. That lead, when asserted in Korea, rapidly gave way to **Metalink** (MTLK) earlier this year. When manufacturing paladins at Infineon and TI begin pumping out highly integrated VDSL chips using advanced semiconductor processes, prices could easily fall below today's ADSL values. Ikanos has a narrow window.

Fortunately, the current market valuation reduces the potential impact from these downside possibilities. Revenues on a trailing-twelve-month basis have been steadily climbing over the past two years at a rate that brings 2008 sales to about $150 million. So, assuming that Ikanos moseys along and takes virtually no part in a coming rush to VDSL, it could still earn $0.60 in 2008, which would support today's price at a PE of 23. That's pretty good downside protection for a company that claims 70 percent of all VDSL ports shipped to date. We conclude that Ikanos is worth the risk to buy into a potential VDSL heyday, while keeping a sharp eye on the competition.

Life After Sigma? (SIGM)

A *Life after Television* company, Sigma Designs makes media processors of the sort we've been heralding in various forms for ten years. Although well short of Moussouris's reconfigurable dream, current media processors entail an exacting mastery of some six video standards, including the multi-gigabit per second high-definition algorithms and the capability of performing several complex steps of compressing, decompressing, coding and decoding at real-time speeds orders of magnitude greater than the streams themselves in order to process them for window-in-window, synchronized audio, pause and reverse, and all the other expected video aerobatics. To manage and decode a 19 Mbps HDTV stream, for example, with all the motion estimation and compensation and bloc filtering and color rendering, can take some 300 giga ops per second and memory bandwidth of some 500 giga ops.

Sigma plunged into this market early and has succeeded in putting all the various standards on one chip, giving it a chance to achieve a real edge against Broadcom, TI, Intel, and others, who assumed that they could wait until standards were all settled and the market was clear. In a bid to increase its lead by integrating yet more communications capabilities on its chip, Sigma last week announced an agreement to purchase **Blue7 Communications** for $14 million in common stock. The sale is expected to close by the end of February, and would add about a million shares at the current price for a mere 4 percent dilution.

With Blue7's low-power, ultra-wideband wireless network technology potentially reaching speeds of 480 Mbps, about an order of magnitude greater than Wi-Fi, Sigma will be able to stream HD signals all over your house, from laptop to desktop, from IP set-top box to digital TV. Prior to the announcement, Blue7 was planning to begin volume production of its first chip during the second half of next year. Critically, Blue7's all-CMOS strategy should ease the integration of ultra-wideband into an omnibus, low-cost Sigma chip and compete with TI's rival ultra-wideband technology.

Still, it could be a bitter fight with the likes of Intel and its Moussouris connection. The establishment may still be vindicated, as IPTV is still a viscous business, full of politics, despite all the hype. But global deployment is accelerating at last.

Well financed and already close to profitability, Sigma Designs is virtually debt free with net cash of almost $25 million, up over 20 percent during the past year. The sales trend has not been as stellar. Excepting a slight dip to $6.4 million in April, quarterly revenues have stagnated around $8 million over the past two years, with trailing-twelve-month sales holding around $30 to $31 million.

Pushing enterprise value to 9 times annualized sales for the October quarter and 7.5 times forecasted January sales, investors have already begun banking on a rapid ramp of Sigma's media processors. Today's high valuation poses serious downside risks. For instance, even moderate sustained revenue growth of 25 percent per year would support a share price of only about $6 or $7 based on the company's projected operational expenses. But a huge upside is still quite attainable; the price could easily double to over $28 if revenue ramps 50 percent annually for the next three years, with the double coming long before that, once investors come to expect it. An "awesome run" over the next four or five years could make this a bonanza.

So an investment today in Sigma is really a dual bet. First, it's a bet that TI, Intel, Broadcom, and others will not be able to catch up in media processor technology before the market heats up. And, therefore, it is also a bet that the IPTV market will rise rapidly, even in the face of the broadband dearth in this country. Considering Sigma's valuation and history, that's a pretty stiff bet. Amid the current uncertainty surrounding IPTV deployments, with surges of optimism followed by solemn contemplation of the morass in Washington, there is a likelihood of buying opportunities ahead. They will be worth it for the upside potential, as long as you place this in your most risky portfolio to ensure you a life after Sigma.

Meanwhile, Tom Ditto should hang in there with his diffractive 3-D range finding technology. It may never be used to move cursors. Training billions of people to think through their forefingers will take time and incur resistance. But the deeper concept may well find a variety of other applications. All of us must live with the prophet's perplex.

— George Gilder, with Charlie Burger
December 21, 2005

Online Bonus

For additional analysis on **Agilent** (A), **Analog Devices** (ADI), **Broadcom** (BRCM), **Cepheid** (CPHD), **EZchip** (LNOP), **JDS Uniphase** (JDSU), **Microvision** (MVIS), **NetLogic** (NETL), **Semiconductor Manufacturing International** (SMI), **SK Telecom** (SKM), **Taiwan Semiconductor** (TSM), **Texas Instruments** (TXN), **Wind River** (WIND), and **Zoran** (ZRAN), further financials details on newly added companies, **Finisar** (FNSR), **Ikanos** (IKAN), and **Sigma Designs** (SIGM), and a bonus report on network services processor pioneer, **Raza Microelectronics**, logon to the subscriber homepage at www.Gildertech.com with your GTR subscriber ID.

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