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The Real Man Paradigm

While niche innovators push the JDSU-Avanex-Bookham module-marts increasingly out of telecom, Corning is reaping the largest windfall from fiber access

Inside:

Our redoubtable "Uniphase"—the inside voice on the *www.gildertech.com* subscriber message board, the Telecosm Lounge — jibes at me as I leave on a tour to tout *The Silicon Eye* (a book about science and technology at **Foveon** and Synaptics, now available for orders at *www.Amazon.com*). "Real men buy optics," he says, "others buy Foveon."

Uniphase more than implies that I have become some epicene fellow traveler of the chippy boutique investments set. "Hey, they are simply fabless! Collects all the light at every pixellated dot!" I say, waving my arms in spastic whirls at the Foveon X3 imager in the Sigma-10 SLR camera. "You'll dimple and die for those recklessly edgy resolutions, those lambent lemony yellows, those luscious ceruleans, not even to mention all those tantalizingly sensual tints of mauve!" Since Foveon is not public, or even lexic these days, and is not purchasable at all except through buying shares in **Synaptics** (SYNA) or **National Semiconductor** (NSM)—not a bad idea by the way—Uniphase as usual has a point.

We used to write about optics all the time, but around the turn of the century the light began to dim. No one built out any real broadband to homes in the U.S. and the bits and bytes began bouncing around in the copious glass pipes like quantum basketballs. Bring up optics, and the all-optical paradigm in my presence, and I would begin sputtering about deflation and regulation and litigation and the moral grandeur of Bernie Ebbers and the superb visionary glow of Gary Winnick and the still transcendent promise of Globalstar as if I were some old codger fretting about the loss of his shares during the Great Depression. Then I would tell you to buy analog semiconductors — **Analog Devices** (ADI), **Texas Instruments** (TXN), **National Semiconductor** (NSM) and Nick Tredennick's programmable gate array stars **Altera** (ALTR) and **Xilinx** (XLNX) and Jay Adelson's **Equinix** (EQIX) hubs full of electronic gear.

The question arises: Was the paradigm ever true? Was Gilder's law, ordaining a three times Moore's law advance for optics, a lie? Was Terry Turpin's **Essex** (KEYW) projection of 16,000 wavelengths on a single fiber thread merely a mythopoeic dream, like Internet traffic doubling every 100 days? Is the upside of optics for communications actually inferior to the promise of ever faster electronic routers from **Cisco** (CSCO) and **Juniper** (JNPR) and the network processor companies such as **Intel** (INTL), **EZchip** (LNOP) and **NetLogic** (NETL)? Could it be true that you can do *dispersion compensation*, of all things, better with electronic devices from **Scintera**

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than with ingenious optical widgets that Simon Cao contrived for **Avanex** (AVNX)? Can **Infinera**, from venture titan Kleiner Perkins Caulfield & Byers, make optoelectronic converters so cheap that all-optical systems are no more efficient than hybrids are? Can **Caspian Networks** manage QoS on trillions of bit-flows so robustly in electronic form that optics becomes almost an afterthought?

Hey, it's a question. My answer naturally, for what it's worth, is that I was right all along. That if broadband had been deployed in the U.S. as it was in Korea and Japan, we would not be talking about a "nuclear winter" in optics. In Korea, about a quarter of GDP is transacted on the Net compared to about 2.5 percent here. With that kind of e-commerce explosion, volumes for wavelength division multiplexing (WDM) gear would have risen enough to drop the price down a super Moore's law curve and WDM colors would be used not just for bandwidth boosts but for cornucopian connectivity. All the router and switch software at the core of the network would harden into glass and the hardware on the edge would soften into programmable and configurable forms such as software radios.

Well, broadband slowly but surely is coming to America at last, full of fits and starts and stammering, but arriving as we expected chiefly through companies such as **Verizon** (VZ) and **SBC** (SBC) and **BellSouth** (BLS) that still command cash flow and unlike the cable companies have no reason to resist the impending era of *Life After Television*. And as broadband comes, the leading technology is our old favorite, passive optical networks (PONs). Now, if these Bells can escape the temptation of going Hollywood again and bailing out the television producers, they might even prevail. But at the moment, for all their luminous good intentions, they show little sign they know what they are doing. Still manifest is an itch to imitate the content-conduit conflicts of cable TV and to adopt the most complex possible technologies, such as "triple play" smart networks full of specialized devices for every brand of momentarily favored media. We can only urge them to read Chris Anderson's *Wired* article "The Long Tail" and take it to heart.

Meanwhile, with **Agilent** (A), **Xan3D**, **ZyCube, Terrazon, Luxtera,** and maybe even Intel, optics is even coming to stacks of chips. Optics, as Uniphase insists, is coming back. So we dispatched our estimable physicist, Charlie Burger, now *Newly Improved*, *with Financial Acumen added!*, to the Optical Fiber Conference (OFC) in Anaheim. Since Anaheim is the nation's worst place to run and I have to hustle my book, I did not join him this time, but reveled in his description of life after the optical crash. As usual he found several fascinating new companies. His record is good. Last time he found Essex.

Maybe, I will be able to make it as a real man yet.

— George Gilder

Panning for Gold in the Broadband Slough

Is fiber optics coming back at last? Well, for the first time in three years, George sent me back to the Optical Fiber Communications Conference (OFC). My presence at this event, held this year in Anaheim, next to Disneyland, offers a sign that the expanding filigree of fiber-to-the-home (FTTH) or premise (FTTP) or whatever-other-extension of copper (FTTX)—all portend a possible dawn of optics in the desert, taking the network one more step toward the paradigm of an all-optical cloak of many colors spreading its broadwings and infrared wavelengths on the horizon. For my Broadwing (BWNG) update, turn to page 4. For the proliferation of infrared wavelengths on the horizon, I offer the following report.

At almost every panel and public event, Verizon, SBC, and BellSouth preened to be seen as first in fiber access. Verizon led by pledging to pass the premises of a third of its 53 million landline subscribers in three years. SBC plans to make a fiber-DSL combo called FTTN (fiber-to-the-node) available to 18 million homes over the same period. Calling this a new dawn for investors, however, would be misleading. The market is murky, with still many homes to pass, standards to be agreed on, technologies to prove themselves. For Telecosm plungers, we advise caution; too many "opportunities" rest on sand.

Avanex and JDSU meet Fiberxon

Outside the glint of glamour in the first-mile, Anaheim's optical desert stretched out forbiddingly. After carefully contemplating the fearsome prospect that I might show up for my appointment, **Bookham** (BKHM) skipped town, taking the first flight back to England. **Ciena** (CIEN) was nowhere to be found. **JDS Uniphase** (JDSU) casually dismissed optics for 2005, anticipating only single-digit growth in overall optical communications sales, including FTTx revenues. Wavelength managers, called ROADMs (reconfigurable optical add drop multiplexers) are among JDSU's hottest products now. But forget it. JDSU has concluded that there's more opportunity in the non-communications half of their business, where they will be seeking to do new acquisitions.

"What am I doing here?" was a logical question to ask myself as I slipped out of JDSU's booth and over to the Avanex beachhead. With flight back to England not an option, CEO Jo Major faced me with the "facts": There are just too many suppliers. We need more consolidation and more restructuring. (Jo, talk to JDSU, they've been doing it for five years running.) Thanks in part to its

acquisition of **Corning's** (GLW) components business, Avanex is #1 in sales of interleavers, dispersion compensation modules, and EDFAs (erbium doped fiber amplifiers). And thanks to a three-year supply agreement (now half over) with **Alcatel** (ALA), Avanex supplies 70 percent of the OEM's needs in areas where Avanex is "fully competitive." Yet despite Alcatel's strong position in both the growing submarine market and SBC's Project Lightspeed, Avanex flounders far from profitability, with a return to the equity markets anticipated.

Avanex components are increasingly becoming commodities with negative margins at current low volumes. To listen to CEO Major, technology is no longer a differentiator. But according to Corning, the cost of a fiber lay is now about $1,000 per home passed, down from $4,000 to $5,000 four or five years ago. With these steep learning-curve advances, someone must be innovating and reaping rewards. Trudging through the slough, I began to collect some specimens. For example, while Avanex, JDSU, and Bookham have been busy restructuring, transceiver company **Fiberxon** of Santa Clara has generated positive cash flows for nine straight quarters. And not just because the company manufactures in low-cost China. CEO Li Hsu, a Silicon Valley veteran, touted Fiberxon's innovations, with transceivers offering burst mode, dynamic range, and overall performance for everything from 10 Gigabit Ethernet and Fibre Channel to wavelength division multiplexing of many colors down the fiber and FTTx, Sonet, cable TV, and test equipment.

Breaking through widely in Asia, Fiberxon has so far captured all of the GePON (Gigabit Ethernet passive optical network) transceiver business in Japan, where FTTH deployments have marched far ahead of the rest of the world. With sales soaring to a projected $60 million this year (over half of Avanex's total 2004 sales) from $38 million in 2004 and $5 million in 2002, Fiberxon is eyeing an IPO on the Nasdaq early next year. It joins our page 5 list of companies-to-watch.

Wading deeper down the optical supply chain, I moved inside the transceiver and to the laser with **Eblana Photonics** of Dublin. Out of Bell Labs, founder and CEO James O' Gorman returned to Ireland in 1990 with the goal of transforming source lasers from a cottage industry to mass manufacturing. With a gnomic twinkle and liveliness that seemed to anticipate a pot-o'-gold windfall, O' Gorman explained how he is driving down the cost of access optics using simple Fabry-Perot lasers. Traditional DFB (distributed feedback) lasers emit light at a wavelength defined by the size of a grating etched over the lasing cavity. By contrast, O'Gorman uses cavity length to define the lasing modes and then chooses the desired lasing wavelength using a photonic bandgap structure etched onto the chip. With light able to reflect back into the cavity without changing the lasing mode, gone is the need for optical isolators. The result is a circular beam ready to couple to the fiber without passive reshaping, which in competitive devices from JDSU et al adds complexity and reduces power.

These advances mean that fabless Eblana can use standard IC toolsets and processes and avoid the custom labs and equipment prevalent in optics. For the moment, O'Gorman has no plans for an IPO. By contrast, Bristol UK–based **Phyworks** contemplates an IPO by year end. Boasting customers that include **Finisar** (FNSR), Agilent, **Sumitomo**, Intel, and JDSU, fabless Phyworks is helping to push 10 Gbps optics into metro, local area, and access networks by designing different transceiver functions such as retiming, drivers, and receivers onto single CMOS chips instead of the multiple silicon germanium chips typically used. But Phyworks may well be purchased before it can get to market. Rival **Broadcom** (BRCM) is a possibility if it cannot outdo the Phyworks product.

Corning's edge

While niche innovators such as Fiberxon, Eblana, Phyworks, and others push the JDSU-Avanex-Bookham module-marts increasingly out of telecom, our old favorite Corning is reaping the largest windfall from fiber access. Last year, Corning's telecom revenues of $1.54 billion were fully 40 percent of the company's total sales and chief producer of cash flow. Of that, $165 million was FTTx related—54 percent more than Avanex's total revenues for the same period and 44 percent of JDSU's total communications sales. And the fiber extension builds have barely begun. Japan may be taking a breather (fiber sales were down 40 percent last year), with **NTT** (DCM) having already passed the midway point of its FTTH build-out, which comprises some 50 percent of the global total. But Verizon has only passed 1 million of 53 million subscribers in the U.S. and plans to be just a third completed in three years as they increase the pace of homes passed, now up to almost 50,000 per week. **RHK**'s Dana Cooperson told us at OFC that only 2 percent of all broadband connections worldwide are currently FTTx, leaving a huge potential market. With China's long-haul build-outs basically completed, they are now aggressively turning to inter-regional networks and access, aided by Fiberxon and **Teknovus**. And Eastern Europe and Russia are just getting started, with long-haul builds now in the works.

Relentlessly driving down the cost of optical access, Corning is supplying preconnectorized (factory spliced) equipment to save labor, which accounts for half of the cost per home. Preterminated install was critical to Corning's gaining a "significant" portion of the Verizon access builds, with bend tolerant fibers to arrive shortly.

Corning's large effective area (LEAF) fiber reduces the cost per build by better handling fiber nonlinearities and dispersion, which decrease the distance lightwaves can travel in glass before getting lost in the noise.

TELECOSM TECHNOLOGIES

Advanced Micro Devices	(AMD)
Agilent	(A)
Altera	(ALTR)
Analog Devices	(ADI)
Broadcom	(BRCM)
Broadwing	(BWNG)
Cepheid	(CPHD)
Corning	(GLW)
Equinix	(EQIX)
Essex	(KEYW)
EZchip	(LNOP)
Flextronics	(FLEX)
Intel	(INTC)
JDS Uniphase	(JDSU)
Microvision	(MVIS)
National Semiconductor	(NSM)
NetLogic	(NETL)
Power-One	(PWER)
Qualcomm	(QCOM)
Semiconductor Manufacturing International	(SMI)
SK Telecom	(SKM)
Sprint	(FON)
Synaptics	(SYNA)
Taiwan Semiconductor	(TSM)
Terayon	(TERN)
Texas Instruments	(TXN)
Wind River Systems	(WIND)
Xilinx	(XLNX)
Zoran	(ZRAN)

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.

Agilent (A)

PARADIGM PLAY: MICROCOSMIC OPTICS, CDMA POWERAMPS

MARCH 24: 22.61, 52-WEEK RANGE: 19.51 – 32.70, MARKET CAP: 11.11B

Well known as a leader in fiber-optic test and measurement and transceivers, Agilent is also a leading supplier of CDMA duplexers and amplifiers. Making further inroads into the amplifier market in February, Agilent acquired Wavics, a fabless Korean-based designer of power amplifier modules for mobile handsets worldwide. The company also opened a mobile marketing and development center in Seoul to support its ascendant Asian customers. Also in February, Agilent sold its camera module manufacturing business to Flextronics; Agilent will continue to develop image sensors and processors for camera modules, optical mice, and other emerging applications in the consumer, medical, and industrial markets. On the test and measurement side, a recent restructuring drove January-quarter profits up an order of magnitude on only 3% higher sales. Test equipment is just over half of Agilent, with the semiconductor group and the life sciences and chemical analysis group about evenly splitting the other half. Life sciences and chemical analysis is currently Agilent's star, contributing to almost half of company profits at just under a quarter of sales.

Overall, Agilent looked a bit like Kansas in the January quarter—just plain flat year over year and predicting flat EPS and sales for April. But with net cash of $800m, up from $130m a year ago, Agilent has the financial strength to withstand cyclical tornadoes and the technical virtuosity to achieve upside surprises as a "nanotech" player. The stock trades at a forward PE multiple of 22 (through April). *–CB*

Analog Devices (ADI)

PARADIGM PLAY: ANALOG EVERYWHERE, SOFTENING RADIOS

MARCH 24: 35.80, 52-WEEK RANGE: 31.36 – 50.98, MARKET CAP: 13.34B

Combined sales to suppliers of automated test equipment and wireless handsets swooned $100m during the second half of 2004, accounting for most of the $137m drop in ADI's revenues from last summer's $718m high to January's wintertime low of $581m. Going forward, wireless should be buoyed by 3G. And just in time, as inventory days, at 130, are well above ADI's target range of 100 to 110. A veteran independent device manufacturer (IDM) of 40 years with a meaningful share of the world's analog design talent, ADI is a well-run firm trading at a forward PE for 2005 of 31 (based on management's outlook) with no long-term debt attached and $2.5b in net cash. *–CB*

Broadwing (BWNG)

PARADIGM PLAY: THE PARAMOUNT ALL-OPTICAL COMPANY

MARCH 24: 4.15, 52-WEEK RANGE: 4.02 – 20.80, MARKET CAP: 278.86M

As AT&T and MCI race each other downhill into the arms of SBC and Verizon, passing them by is Broadwing as it begins its long ascent to the heights. Sporting a balance sheet other networks surely envy, Broadwing reported sequential revenue gains across the board during the last quarter of 2004. Most notably, sales of communications services grew 5% not counting revenue added from Focal. Gross margin held steady near 31% despite integration costs. Now shy of operational breakeven by a narrow 4% of sales and promising yet more savings to come, Broadwing should soon tip to cash flow positive. But to remain there would be akin to skating on thin ice. Crucial going forward, therefore, is success in winning big Forbes 500 companies to exploit the huge capacity of the world's only all-optical backbone.

With the normally subdued Dr. Huber buoyant on the conference call, perhaps the Fortunate Few are finally knocking on his door. Big companies need virtual private network (VPN) channels separate from the public Internet. Using Tellabs' 8860 multiservice edge-routers, the carrier simply lights another wavelength to make it happen.

Despite the good news, Broadwing shares continue at a distressed enterprise value of 0.22x forward revenues, assuming zero growth. By imputing the woes of the roly-poly giants to lithe Broadwing while fretting unduly over the convert dilution, a myopic Magoo market has created a buying opportunity. With a mere 14% sales growth, Broadwing becomes a billion dollar a year company and a more than quadruple over today's price at a reasonable enterprise-to-sales multiple of 2. *–CB*

Cepheid (CPHD)

PARADIGM PLAY: MICROELECTRONIC MACHINES FOR DNA IDENTITY

MARCH 24: 10.15, 52-WEEK RANGE: 6.16 – 11.54, MARKET CAP: 429.15M

"Is it anthrax?" Now, thanks to Cepheid's GeneXpert, U.S. postal employees get the answer in a little over half an hour rather than waiting until the next day. GeneXpert may be the world's only fully-integrated and automated genetic analysis system, and it is currently being sold to the biothreat market through a Northrop Grumman–led consortium developing an anthrax tester for the USPS. Driving Cepheid's 4Q sequential revenue increase of 44% were the Northrop sales, followed by sales of ASR (analyte specific reagent) primer and probe sets for identifying B. pertussis and HSV. Four ASR products began shipping in the quarter, and Cepheid plans to introduce at least 10 more in 2005, among other clinical releases. Not surprisingly, management anticipates a revenue surge of 55% this year. However, Cepheid is wisely increasing spending on R&D and manufacturing to accelerate delivery of clinical products, deferring profits until 2006 in pursuit of long-term growth. An early leader in lab-on-a-chip technology, Cepheid is trading at a two-thumbs-up enterprise value of 4.8x forward 2005 revenues. At that premium, you may want to enter gently or risk waiting for a lower price, with the understanding that the stock may well hold its value and should be viewed as a long-term play. *–CB*

MEAD'S ANALOG REVOLUTION

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

COMPANIES TO WATCH

AMEDIA (AANI.OB)
ATHEROS
ATI TECHNOLOGIES (ATYT)
BLUEARC
COX (COX)
ENDWAVE (ENWV)
FIBERXON
LINEAR (LLTC)
LUMERA (LMRA)
ISILON
LENOVO
MEMORYLOGIX
NOVELLUS (NVLS)
POWERWAVE (PWAV)
SAMSUNG
SEMITOOL (SMTL)
SIRF
SOMA NETWORKS
STRETCH INC.
SYNOPSYS (SNPS)
TEKNOVUS
TENSILICA
VIA TECHNOLOGIES
XAN3D

Corning (GLW)

PARADIGM PLAY: FIBER TO THE EXTENSION

MARCH 24: 10.86, 52-WEEK RANGE: 9.29 – 13.19, MARKET CAP: 15.31B

Added to the list this month.

Equinix (EQIX)

PARADIGM PLAY: WHERE STORAGE AND BANDWIDTH CONVERGE

MARCH 24: 41.69, 52-WEEK RANGE: 26.50 – 46.39, MARKET CAP: 977.42M

Equinix shares have held up well in what has otherwise been a sluggish late winter for tech and telecom. In February, the company modestly increased guidance for 2005 sales. The midpoint of the new range of $205-$210m would be a 28% increase over 2004. Comparing the December quarters from 2003 and 2004, we find that sales grew from $31.5m to $42.6m, an increase of more than 35%. But *cost of sales*—or expenses tied to achieving those revenues—grew just 6.4%, from $32.6m to $34.7m. Indeed, 80% of the company's costs are fixed, and 95% of its sales are recurring. The company is thus highly leveraged for growth. With low churn and low variable costs, each new customer and dollar of sales will add substantially to the bottom line. Wall Street today values the company at an apparently rich price-to-sales multiple of 5.84 (and a forward-looking December '06 PE of 67). Investors have thus come to understand the attractive Equinix financial model that we have advocated for years. The company's market value, however, is still under $1b, and although its share price could fluctuate in the short-term, we think that with physical assets of almost $350m, net debt of just $50m, a strong Asian presence, and a virtual monopoly position at the heart of the U.S. Internet, Equinix will continue to grow in value over the coming years. *–BTS*

EZchip (LNOP)

PARADIGM PLAY: TWO GENERATIONS AHEAD IN NET PROCESSORS

MARCH 24: 7.90, 52-WEEK RANGE: 4.77 – 15.17, MARKET CAP: 73.08M

Adding four new customers and supplying two existing purchasers going into production, EZchip sales grew almost 23% sequentially in the December quarter. With great technology, low expenses, cash in the bank, and numerous design wins (44), the chief variables in the EZ equation are: (1) the growth of the Internet infrastructure market in all its forms – optical, aggregation, 10 Gig Ethernet, wireless, data center, storewidth; and (2) the success or failure of specific EZ-based products in the carrier and data center marketplace. Until more customers are buying larger volumes of chips, smoothing out the price differentials, margins will go up or down from quarter to quarter. Nevertheless, margins are, and should remain, high–near 60%.

Although in our October '04 report we estimated a quarterly break-even sales mark of $4m for 2005, the number now looks closer to $5 or $5.5m. In any case, we hope that EZ will be spending more by 2006.

We believe the company has almost 10 design wins for its forthcoming chip, NP-2, many from large, well-known quipment companies, some of which have resisted its 10 Gbps NPIc as still ahead of a market dominated by 1G applications. The scheduled sampling of NP-2 at Taiwan Semi has slipped by a quarter, to 2Q05, which for such a large and complex chip is par for the course. Assuming no major further delays, the backlog of NP-2 customers signifies that several NP-2-based products will enter the market in 2006. Powerful and inexpensive enough to use on high-volume line cards, the NP-2 separates the company from Intel as a direct competitor. And the NP-3 is on its way. *–BTS*

NetLogic Microsystems (NETL)

PARADIGM PLAY: CUSTOM LAYER 3 AND 4 PROCESSOR

MARCH 24: 12.69, 52-WEEK RANGE: 5.92 – 15.00, MARKET CAP: 223.06M

Taking market share from producers of content addressable memory (CAM) suppliers Cypress and Integrated Device Technology (IDTI), NetLogic won seven new slots at Cisco and other customers in the December quarter, bringing to 17 the number of programs generating sales. It boosted revenues 23% sequentially to $15.2m, and gained its first quarterly profit at an EPS of $0.05. Going forward, expect continued growth as seven design wins last quarter brought the total to 37, including new programs ramping at Hitachi, Juniper, and Foundry. NetLogic also plans a lower-cost version of its knowledge-based processors (CAM3 technology). If we extend to a full year management's forecasted sales growth of 4% for the current quarter and rely on company gross margin forecasts, EPS should reach $0.38 in 2005, which yields a forward PE of 33 at the current share price. But upside surprises, such as the last quarter's, could boost earnings well past our crude estimate. *–CB*

Wind River (WIND)

PARADIGM PLAY: WINDOWLESS REAL-TIME OPERATING SYSTEMS

MARCH 24: 14.91, 52-WEEK RANGE: 8.17 – 16.34, MARKET CAP: 1.21B

After a three-year decline in which revenues tanked 53% and market share was lost to competitors such as Microsoft and Linux distributors, Wind River has finally begun reasserting itself as a leading vendor of real-time operating systems. In a significant change to its 17-year-old subscription policy, in fiscal 2005 (ending January) the software vendor began offering royalty-free licenses for its proprietary operating systems, and companies with low-margin, high-volume products, such as Samsung, are finding the one-time, higher initial fee much more palatable than eternal royalty payments. Thus Wind River made its first profit in five years as revenue for fiscal 2005 increased 16% over 2004 with an EPS of $0.09, compared to a loss of $0.31 per share in 2004. The stock now trades at a seemingly pricey forward PE of 55 based on management's EPS estimate of $0.27 for fiscal 2006. The valuation likely reflects the company's projected EPS growth rate of 194% along with the healthy balance sheet—net cash for the year increased from $123m to $147m even as Wind River repurchased half of its $150m outstanding convertible debt. More importantly, driving growth over the coming decade should be the paradigmatic proliferation of real-time operating systems for embedded applications such as net processors and cell phone handsets that must perform complex operations without discernable delays. *–CB*

MRV Communications

Although **MRV Communications** (MRVC) was not present at the Optical Fiber Conference, some tout the company as a key player in the fiber-to-the-home (FTTH) market and sole-source of Verizon's ONT (optical network termination) unit which is mounted outside the homes of subscribers to the carrier's FTTH network. Called a "triplexer," the bi-directional ONT takes light coming from the fiber and breaks it into voice, data, and video for use in the home, where video is transported the final feet over coax, voice over copper, and data over Ethernet.

Ouch! Don't these guys know about convergence?

Despite the Verizon business, MRV remains chiefly a WDM systems integrator for metro and virtual private networks (VPNs), including Ethernet connectivity. Networking sales are Euro centric, with MRV claiming market leadership among major European carriers. Revenues in this segment were $227.2m last year for an 84% share of the company's total sales, with a gross margin of 38% and operational income of $4.7m.

The remaining 17% of revenues, $46.4m, came from optical components as supplied by MRV's Luminent OIC subsidiary. In addition to the triplexer, products include transceivers for metro and access networks. With a gross margin of only 14% and an operating loss of $9.8m, components are a commodity business under pressure from competitors such as Avanex, Bookham, JDSU, Agilent, Finisar, and Sumitomo, not to mention Fiberxon. At $24m, triplexer sales comprised just over half of components sales. MRV expects Verizon to increase its business by

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about 25% this year, pushing triplexer sales to $30m or about 10% of management's expectations for total revenue, up slightly from 9% in 2004. However, there are many competitors, some of them innovative startups, in the FTTH triplexer market from which Verizon could draw, thereby subduing these not yet impressive numbers.

Thus, even though total sales are expected to increase to $300m this year from $272m in 2004, MRV will continue to hover around breakeven as it did in the fourth quarter of 2004, with profits held in check partly by commodity components. MRV has a strong balance sheet, but at $3 a share the market remains skeptical, trading at an enterprise value of only 0.86 times forecasted sales for 2005.

Bottom line: Returning from Iraq or Afghanistan or the Tora Bora caves of the Harvard faculty, real men might take a gander at MRVC as a value optics venture with a triple-play upside in the unlikely event that the triplex does not converge onto Ethernet.

Dispersion occurs because light of different wavelengths travels at different speeds in fiber strands, resulting in the widening and overlapping of different WDM channels as they propagate, until they become indistinguishable. Corning's LEAF fiber enables light to travel farther with more WDM channels in the C-band (between 1530 and 1565 nanometers). Because many network components, most notably optical amplifiers, are band dependent, it costs less to crowd more lambdas in the C-band than to open new bands. When the route becomes congested, you can light up a new fiber with cheaper C-band equipment.

Nonetheless, Corning is also pioneering in the other bands for the purposes of Raman technology, which uses the entire fiber as a distributed amplifier. Every textbook on WDM optics contains a bifurcated attenuation chart, showing a low attenuation window between 1310 nanometers and 1380 nanometers and a still lower attenuation window between 1520 nm and 1625 nm. In between, presented as an eternal fact of nature, is an attenuation mountain centered around 1400 nm, where infrared light is blocked off by resonant microscopic water molecules in the fiber itself. Banishing the water in all its fiber products, Corning offers long-haul LEAF fiber with a low water peak for Raman amplification, which requires optical pumps in the 1400 nm region. Perfected in Broadwing's network, Raman extends the reach of optical signals some 5,000 kilometers without regeneration. And for applications such as local area networks (LANs) and access networks too short for nonlinearities and dispersion to matter, Corning can fulfill **Lucent's** (LU) old "AllWave" dream of 1999, and transcend the C-band, using the entire spectrum from 1310 nm to 1625 nm for transmission.

Not surprisingly, Corning sold more fiber volume last year than its nearest two competitors combined, gaining market share and raising telecommunications revenues by 8 percent during 2004 while worldwide fiber demand held flat and fiber prices decreased by more than 10 percent. With Corning's other telecosmic division, display technologies (LCD glass for laptops, desktop, mobile, and TV), growing an even faster 87 percent, Corning obviously should never have left our list. Although our readers last year benefited from the *Whitebox Technology Observer's* recommendation of the stock near its lows (we formerly included the *Whitebox* letter with our own), we let Corning slip away. We are bringing it back belatedly now.

At $11 per share Corning stock has a moderate trailing PE of 24.4 after earnings growth in 2004 of 350 percent to 45 cents per share. Its long-term debt is down from $5 billion at the end of 2001 to $2.7 billion at the end of 2004. Another $482 million is slated to go this year from cash, short-term investments, and receivables of $2.5 billion, and up to $270 million in stock (for a minor 1.7 percent dilution at the current price). Corning believes it will return to investment grade status this year after a hiatus of four years. They win the prize as the optical giant that best survived the crash.

Ethernet challenges Alcatel and Tellabs

Though Corning potentially benefits from all types of fiber extension builds, management estimates that fiber-to-the-home could rake in double the sales of a combined fiber to the curb or node, which rely on DSL over copper wire to connect from the fiber termination to the home. As a rough guide, FTTC, currently being deployed by BellSouth, terminates fiber within 500 feet to serve 30 to 50 customers. The FTTN in deployment by SBC terminates 3,000 to 5,000 feet from the premise and serves about 400 customers. Verizon justifies its more expensive FTTH builds by adding operational expenses and services into its economic model from the start and by stressing aerial over trenched lines. In new housing developments, all three Bells will stretch fiber to homes, since the cost of building and maintaining a FTTH infrastructure from scratch is now cheaper than laying and maintaining copper.

FTTx deployments typically use PONs of couplers, splitters, and triplexers to shunt and shuttle infrared light between the telco central office and nodes, curbs, or households through a tree of glass. Verizon, BellSouth, and SBC are currently deploying BPONs (Broadband PONs) from Alcatel, which are based on the asynchronous transfer mode (ATM) preferred by the telcos, who can leverage their entrenched ATM infrastructure. BPONs run at 622 Mbps downstream and 155 Mbps upstream. Divide that by 32 households and it yields around 19 Mbps downstream and 7 Mbps upstream (real broadband at last, though short

of the widespread two-way 40 Mbps to 100 Mbps being deployed in Korea and Japan).

At OFC, however, the Bells apparently changed course, announcing their commitment beginning in the second half of 2006 to evolve to Ethernet-based networks and the IPTV standard. Capable of up to 2.5 Gbps in each direction, GPONs (Gigabit PONs) use ATM for voice, Ethernet for data, and proprietary encapsulation for video. Divided by the planned 64 households, a GPON-based FTTH network yields a symmetrical 39 Mbps per household. Served by **MRV Communications** (MRVC) triplexers (see page 5 box), this seems like a kludge. Watch for these companies to follow the Asians with a pure Ethernet solution before the GPON is deployed.

Alcatel is the major supplier in the U.S. and Europe both for DSL and PON. But, real men should watch out. While Alcatel plans its migration to GPON, the world is shunning it and two new private ventures, **FlexLight Networks** and **Optical Solutions**, are already shipping products with speeds up to 100 Mbps, building positions in the smaller carrier market. Also pressured by the Bell waffles over ATM and Ethernet are **Tellabs** (TLAB) and Ciena, which also remain ATM-based as the clock ticks away. For the moment, though, Verizon has sole-sourced Tellabs BPON optical gear and is using Ciena's ATM switch (from the WaveSmith acquisition) to aggregate the FTTP network traffic.

Meanwhile, with one huge waffle-prone exception, the Asians offer simpler systems more compatible with the Internet. In Japan, NTT has supposedly committed to a plan to spend some $48 billion to reach 20 million households by 2010 with gigabit Ethernet passive optical networks (EPONs), which use Ethernet protocol for data, voice, and video. However, NTT's national post office origins were showing in Anaheim earlier this month, when Hiromichi Shinohara, NTT's director of access labs, began waffling like an American Bell. He said that the Japanese phone company will be moving to an ATM based GPON architecture. Oh, well. We say these guys have no idea what they are doing. Real men beware.

This field remains entirely unsettled. For example, through a partnership with **Hitachi** (HIT), **Wave7 Optics** offers an ATM product which up to now has also allowed it to be the largest systems vendor to Japan's NTT. Following on the heels of revenues of $25 million in 2004, the company expects to become cash flow positive by the end of this year. Contemplating an IPO no earlier than next year, management also believes it is a strong acquisition candidate. Unique among FTTx OEMs, Wave7 offers a hybrid active and passive architecture, enabling a symmetrical 31 Mbps per customer on average with the option to dedicate up to 500 Mbps for demanding subscribers.

Amedia gets active

Currently, none of the major global telcos are considering fully-active architectures, dubbed ESON (Ethernet switched optical network). But the major FTTH projects in Utah, **UTOPIA** and **iProvo**, are building ESONs supplied by **World Wide Packets** at speeds of 100 Mbps symmetric per home, well-beyond Verizon's long-term plans. Also in the actives camp is **Telco Systems** of Foxboro, Massachusetts. Because an ESON is actively switched, it essentially provides a dedicated, secured fiber connection to each customer. World Wide Packets can supply symmetrical connections up to 1 Gbps.

Competitor **Amedia Networks** (AANI.OB), a public company, offers an active Ethernet platform through a partnership with Lucent where the technology had been under development for years, providing symmetric 100 Mbps capability to subscribers up to an industry-leading 90 kilometers from the central office. Both VDSL and ESON line cards can coexist in an Amedia aggregation switch, enabling a seamless transition from copper to fiber. Contract manufacturing of products by our favored **Flextronics** (FLEX) began the end of last year and they are currently undergoing evaluation and field trials. Amedia expects its first sales before the end of June.

With only 16 employees and an office inside Bell Labs (but soon to move down the road), the year-old company, still awaiting its first dollar of revenue, doesn't burn much cash. Through the third quarter of 2004, Amedia had spent $57,000 in capital investments. At the end of the same quarter, total liabilities were only $180,000 with cash reserves of $3.5 million. Cash burn from operations, including capital expenditures, are averaging $1 million per quarter. Thus, only a few million dollars in sales could have a significant impact on the bottom line. At $1.24 per share, the market cap is $20 million, and net income of only a $1 million per quarter would yield a low PE of 5.2 at the current price with potential to double or triple. Amedia joins our page 5 companies-to-watch-list as we await further announcements and sales. Real men might contemplate it now.

The telcos argue that deployment and maintenance costs for passive architectures are less than those of actives (e.g., when it gets hot, lasers can become a problem), but last year iProvo was installing its ESON at an average of $1,500 per premise (including fiber) compared to the installation costs of about $1,000 quoted by Corning this month. This price is continuing to drop because the technology uses readily available Ethernet components, which are sliding down the learning curve of short-reach optics driven by innovators such as Fiberxon and Eblana. In addition,

passive components are not without their own maintenance issues, and every PON terminates with active devices at the premises. With active elements between the premise and core switch, system faults can be remotely detected and isolated in ESONs, whereas in PONs several truck rolls may be required to isolate the problem.

Meanwhile, advances in DSL technology may enable FTTC deployments to compete head-to-head with ESCONs. **Ikanos** and **Metalink** (MTLK) have demonstrated 100 Mbps symmetrical VDSL2 for short distances, such as the basement of high rises and from the home to the curb. The new chips will hit the market soon with customers eagerly waiting in Seoul, Tokyo, and Hong Kong. Also promising VDSL2 chips this year are Texas Instruments (TX) and Broadcom (BRCM). Already widespread in Korea, Ikanos has a contract with SBC worth $100 million with the potential going forward much greater. Their IPO filing is current.

Discrete multitone DSL inventor John Cioffi (*see GTR, January 2005*) has called with news of 200 Mbps DSL, which for distances of a few hundred feet can enable Gbps over four twisted pairs, faster than most FTTH deployments. Cioffi has a new company, **Assia** (misspelled horribly in our January issue), to pursue this super DSL technology, which could push the BOCs ahead of cable for the first time in the bandwidth race and obsolete most of the grandiose plans announced in Anaheim. Meanwhile, **SolarFlare Communications** is developing semiconductors for 10 Gbps Ethernet transmission over twisted copper pairs and is cooperating with Broadcom, **Marvell** (MRVL), Intel, Cisco, and **Sun** (SUNW) on standardization for 10GBASE-T technology. SolarFlare claims to have demonstrated the world's first CMOS device capable of 10 Gbps transmission over long distances of copper using its proprietary signal processing algorithms.

Will the telcos escape the cable noose?

Verizon wants to compete with cable by using smart compression technology from **Microsoft** (MSFT). They would be better off using fiber's huge potential bandwidth to carry whatever new content becomes popular, whether 3-D football, video teleconferencing, or massively parallel multiplayer games. If they optimize their system for television content or any other specialized service, they will lose to the onrush of new conduit technology.

The Bell PONs may already be obsolete. According to Dave Burstein's *DSL Prime* e-letter, Cisco is demonstrating gigabit (shared) cable modems in Korea. Claiming that the technology will soon work well and inexpensively, Burstein surmises that **BroadLogic** is the chip vendor, with investments from **Time Warner** (TWX), Cisco, and Intel. Japan and Korea are ready to buy, along with U.S. cable companies. Adding to telco woes, it's much harder for them to roll out video services than for the cablecos to roll out voice. Time Warner Cable and **Cablevision** (CVC) covered their entire networks in VoIP in several months. Time Warner counts 40 million subscribers.

As a broadband Internet supplier, however, cable still gags on its huge stake in television content and advertising, which give it an incentive to keep away from superfast links that allow faster-than-realtime downloads of movies, photos, 3-D games, and other streams of high-definition images. All companies that try to combine content and conduit in vertically integrated cages will tend to create sub-optimal networks for the coming age after television.

There's gold in the broadband bog, but most of it is still hidden in a muddy muddle of paradigmatic optical niches (still under development) and companies (many still private) and promises (mostly years away). In the *GTR*, we try to identify technologies with a fundamental edge that will increase over time. Unique inventions such as those offered by Essex or EZchip or **Qualcomm** (QCOM) have a chance for long-term dominance that is unlikely to be achieved by companies swiveling from one opportune chip to another. Racetrack veterans warn novices that you can beat a race, but you can't beat the races. In last-mile optics, we prefer mostly to sit on the sidelines until we like the odds of winning, continuing to pan the slough until the nuggets begin to break loose from the mire.

— Charles Burger, with George Gilder, March 25, 2005

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