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Telecosmic Musings at the Marconi Gala

Listening at Telecosm to the speakers from Essex, Intel, and Luxtera, we learned that optics will ultimately win in all communications channels, from the inter-chip to the Internet.

Inside:

Do coarse and kludgey technologies and mediocre or mean people routinely triumph over good ones? Citing the traps of "lock-in," the monopoly loops of positive feedback, and the competitive barriers of "first mover advantage," wiseacres may have reason to disparage as quaint and credulous the idea that in business, technology and life, it is good that prevails.

Setting aside for Dennis Prager the issue of why bad things happen to virtuous people and why evil sometimes prospers everywhere but at **Google** (GOOG), the technology argument usually revolves around such alleged examples of triumphal techno-trash as the Qwerty keyboard, the VHS video, the **Microsoft** (MSFT) OS, and **Intel** (INTC) x86 microprocessor instruction set. All are deemed to have prevailed over more elegant and superior alternatives and seem to show that "dumb and dirty" beats paradigmatic elegance every time.

As apostles of information theorist Claude Shannon, we espouse the paradigmatic elegance of "low and slow" (slow and low-powered parallelism beats fast

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FEATURED COMPANY: EZchip (LNOP)

Following last September's surprise sales slide to $687 thousand from $2 million the previous quarter, **EZchip** (LNOP) has been building momentum, and the window of opportunity to buy at startup prices may be drawing to a close. EZ's network processors or NPUs—programmable chips that process data, voice, and video packets at high speed—should gradually find their way into Ethernet switches and routers across the network, especially in the metro regions, as triple-play (data, voice, video) applications become ubiquitous.

The last of the score or more NPU startups are now falling before EZ's highly integrated NP-2 chip which is available in three interchangeable models and includes all the major line-card functions such as wirespeed 10 Gigabit per second (or 5 Gbps) processing, classification search engines, traffic managers, and Ethernet ports. Traffic managers (TMs) shape and schedule packets, and integrated NPU/TM chips are becoming ubiquitous.

The networking industry is now as innovative as the PC industry was, constantly changing and creating new products. EZchip has survived because it boasts the most flexible and most highly integrated chips, becoming a general purpose solution to the network market much as the MPU (microprocessor) was to the PC. Full programmability enables systems houses such as **Juniper** (JNPR) to differentiate their products from competing vendors, to adapt quickly and economically to evolving standards, and to fuel the proprietary network flavors being deployed by service providers.

Now lost inside **Broadcom** (BRCM) is **Sandburst**'s less flexible 10 Gbps processor with a separate TM chip. Also languishing is hardwired **Greenfield Networks**, which lost a prior win at **Cisco** (CSCO) to EZ. Remaining with just a few design wins is **Xelerated**, whose faster chips (20 Gbps) are less flexible and less integrated—notably absent is a TM. Though not likely a long-term threat, Xelerated may be able to pressure EZ on prices until it reaches its final resting place. By contrast, EZ has now surpassed 90 design wins, including significant potential at four of the five top systems vendors. The Israeli's are confident they will eventually win over holdout **Alcatel** (ALA).

Impending perils

The final and most serious opposition to EZchip by far comes from homegrown NPUs, such as Alcatel's, **Redback**'s (RBAK) internal solution developed through its Siara acquisition of several years ago, and Cisco's Toaster. But internal solutions are costly and require expertise many systems houses don't have. Nonetheless, EZ's ascendance over in-house solutions will be hard won. It's tough to get a big company to bet a billion dollar product on a small startup. EZ has to assure prospective customers that it's not going to succumb to growing pains and that its supply of NPUs will not get swallowed up by a Cisco.

That could be difficult to do without a strategic partner. Now that Broadcom has absorbed Sandburst, **Marvell** (MRVL) becomes the leading candidate to fill that role. Based on EZ's recent progress inside Cisco and considering that Marvell has a design center down the street from EZchip in Israel, we suspect that such a partnership may be in the works. Because Marvell is one of **Taiwan Semiconductor**'s (TSM) largest customers, such an alliance would also help tiny EZ to get the giant fab's attention as sales surge.

But an alliance with Marvell or anyone else would come with strings attached, which we would examine closely. Other hurdles, both perceived and real, remain in EZ's way, and may put pressure on the stock price for several more quarters.

For instance, to finance its sudden growth, EZ recently began drawing from a $6 million line of credit. But EZ may need even more cash. To pave the way for greater liquidity and institutional ownership, LanOptics may soon complete a final swap of equity for the remaining EZ shares. (LanOptics currently holds 60.4 percent of EZchip, its only asset.) It would also be a convenient time for the company to do a secondary offering. This would be good news. As of June, there was no long-term debt on the balance sheet and net cash was $14.5 million, down from $18.9 million in the year-ago quarter. Thus, after burning an average of just $1.1 million per quarter over the past year, the sudden thirst for green liquid portends a coming boom. But beware: markets often view financings as negatives.

Also, it remains to be seen if EZ's 95 employees, fully 70 of them in R&D, will be able to transition from thinking like a private startup to running like a public company handling quarterly calls, GAAP reporting, and other baggage that comes with public status. Furthermore, management hasn't yet figured out how to forecast revenue—not surprising considering that EZ's customers are still trying to figure it out as well. Combine the forecasting challenges with both the likely sales lumpiness of the initial ramp and the liquidity draw, and we are likely to have at least one "disappointing" report over the next two quarters due to a customer inventory correction, balance sheet scare, or margin slip.

Who will hollow out the router?

Such a breather might appear to confirm Andrew Schmitt's recent response to Telecosm Ten's net processor session. The analyst at Nyquist Capital implied that the need for interoperability will quickly drive uncertainty out of the metro Ethernet market. Today, carriers have only a vague idea what features will be required in these new networks, and therefore flexibility rules. Soon, however, the market will become well understood and common features will be codified in silicon. Thus, Schmitt believes the router will be hollowed out not with NPUs, which will handle some 10 percent of exception traffic, but by ASSPs (application-specific standard products) from the likes of Broadcom. (An ASSP is essentially an ASIC—application-specific integrated circuit—sold to more than one company.)

Overlooked by Schmitt is that with every turn of the technology ratchet, the network processor market changes. So much so, in fact, that many in Silicon Valley believe that the demands are too exacting and specialized to support a general purpose NPU comparable to the Pentium. Thus, they disparage EZchip using precisely the opposite argument employed by Schmitt. These VCs and tech gurus expect the market to fragment into special purpose devices from low-end access products (**Wintegra**, **Applied Micro**/AMCC) to high-end coprocessors (**Cavium**, **Raza Micro**, **NetLogic**/NETL), and specialized hardwired Ethernet switches (Broadcom, Marvell).

Entirely hardwired, ASICs must get it right in every detail the first time or require a dreaded "respin," with a renewed gouge of nonrecurring expenses. While an ASIC might gather enough volume in an all-purpose Ethernet switch, with formulaic functions, it is unlikely to fill all the multifarious slots, blades, and interfaces on the rocky and protean shores of networks, where legacies cling and novelties proliferate with the favored protocol of the month contests or with the new virus remedy or encapsulation scheme.

The folks at Greenfield, fresh from Cisco, were sure they had the formula for the perfect hardwired Etherswitch. But Greenfield made not a dent as EZ continued its ascent past 90 design wins, beginning with the NP-1, a fully-programmable, 10 Gbps packet processor with integrated search engine, which began shipping two years ago. Commercial shipments of the NP-2 line, which adds traffic management and Ethernet media access controllers (MACs) to the chip, began during the just completed third quarter. The NP-3, a 90 nanometer version of NP-2, is currently in design and is expected to sample next spring. On its heels will be the NP-4, which will integrate the entire line card including the physical layer and fabric interface. Ultimately, EZ should be able to ease up market into various programmable layer 4–7 applications.

EZ everywhere

Linley Group sees NPU sales reaching $700 million in 2008, including both internal and merchant products. Growing to a third of the market from $10 million in 2005 will be high-speed NPUs. These chips mainly target metro Ethernet to enable the triple-play networks that EZ is also targeting.

But don't count too much on these estimates. You cannot predict future markets by extrapolating current sales or even by surveying intended purchases by current buyers. The deployment of broadband and high definition everywhere is accelerating as today's world of television and data moves toward life after television, where video is just another form of data on the network. Every node in the enterprise and metro will have to switch at 10 Gbps to handle the seachange from narrowband voice and slow data applications to various forms of full-motion video. With ultra-wideband and 802.11n, people will shunt high-definition images amid other data around their households wirelessly. This may bring NPUs to set-top boxes and residential gateways.

These changes will create large markets for Broadcom, **Sigma Designs** (SIGM), **Texas Instruments** (TXN), **Corning** (GLW), **Zoran**

(ZRAN), and much of the rest of our list. It will also create volume markets for 10-Gig NPUs, where EZchip is champion at reading packets, deciding how to distribute them, and converting them to the appropriate protocols at wirespeed. Therefore, expect upside surprises over the next two years.

Discounting the surprises and giving just half of Linley's high-speed market to EZchip, we calculate earnings of $2.91 per share in 2008 (assuming 60.4 percent LNOP ownership of EZ) for an $87 stock price at a 30x price-to-earnings growth multiple. To support such a rise, EZ would almost certainly have to dilute shares somewhat and increase overhead expenses, making the target price a bit high in this example. But considering that this pictures the conservative world void of upsides and EZ ascendancy, it gives us a good feel for the magnitude of EZ's potential.

— Charlie Burger, October 18, 2006

(CONTINUED FROM PAGE 1)

and high-powered pipelines) and "wide and weak" (broadband weak signals beat high-powered streams). As a human being we command a world-beating petascale brain consisting of slow and low-powered neurons, synapses, and dendritic trees mostly made of fat and saltwater—fat as an insulator and salt ions as a conductor. It might seem dumb and dirty compared to a Pentium dual core processor. (You can't get slower or lower power than lipid membranes and brackish fluids.) But, as Carver Mead explained earlier this month at the 10th Annual Gilder/Forbes Telecosm Conference, this wetware system achieves exponential processing gain with size and we don't understand it at all. There is nothing like it but a hypothetical quantum computer based on entangled qubits.

Using this unique cranial processor, we were able to see the signature of paradigmatic superiority in **Qualcomm**'s (QCOM) wide and weak CDMA (code division multiple access), still gaining share around the world, John Cioffi's wide and weak discrete multitone digital subscriber line (DSL), now dominant in the local-loop, **Foveon**'s low and slow CMOS imagers from Mead and Federico Faggin, which are finally breaking through into volume markets. And we descried **Essex Corp.** (KEYW) Chief Scientist Terry Turpin's super wide and super weak Hyperfine wavelength division multiplexing (WDM) and other wide and weak optical processors that work with a power efficiency that is 50 thousandfold superior to the performance of digital computers.

Hey, we admire the virtuosity of **Infinera**'s opto-electronic kludges full of filters and converters and high-powered electronics. We are invested in them through Kleiner Perkins and we are not complaining at all. We know that they are being installed even in what was once the sainted all-optical network at **Broadwing** (BWNG), which leaves the list this month ahead of **Level 3 Communication**'s (LVLT) planned purchase of its more nimble rival, expected to close during the first quarter of next year. We have watched Infinera take over the number one position in market share in optical cross-connects and add-drop multiplexers. We know that the industry has practically halted production of all-optical switches. But listening to Terry Turpin, and Kevin Kahn of **Intel** (INTC) and Alex Dickenson of **Luxtera** talk at Telecosm, we learned that optics will ultimately win in all communications channels, from the inter-chip to the Internet.

No one has claimed that the best technologies always prevail under all conditions. Peter Drucker's law still holds: To displace an incumbent system, with all its learning curves, inertial economies of scope and scale, customer loyalty and experience, you need to be not just twice as good or even five times as good; you have to have a tenfold edge. With such caveats in mind, we point out that the rivals to Qwerty, Microsoft, Intel et al. were not even close to twice as good and may well have been inferior by the critical metrics. But Turpin's 50 thousandfold edge will eventually do the trick.

Evoking these thoughts were my recent trips to the West Coast, first for the resurgent revels of Telecosm 10 at the Resort at Squaw Creek near Lake Tahoe, and then for the star-studded gala dinner and symposium of the Marconi Society at the Computer History Museum in Mountain View. At both events, much evidence transpired for the triumph of the paradigm over the kludge.

Named for Guglielmo Marconi the inventor of radio communication, the Marconi Society makes an annual award of $100,000 to a new Marconi Fellow who exhibits brilliance, innovation, experimental virtuosity, perseverance and entrepreneurial ability in telecommunications technology and science. From Qualcomm co-founder Andrew Viterbi and Bell-Lettrist Robert Lucky of adaptive equalizer fame to Ethernet inventor and law-giver Bob Metcalfe and microprocessor innovator Federico Faggin of Foveon, most of the winners over the years will be familiar to readers of this report. All of them triumphed by being better, mostly by adhering to what we call the Telecosm paradigm. In one way or another, they subdued the electromagnetic spectrum to Claude Shannon's information theory in a technology that upheld the low and slow and wide and weak in ways worthy of the fat and seawater motif of the mind.

Epitomizing this theme is this year's winner Cioffi, the Stanford electrical engineering professor whose heroics with DSL and DSM (dynamic spectrum management) were celebrated in the January 2005 issue

TELECOSM TECHNOLOGIES

Advanced Micro Devices	(AMD)
Altera	(ALTR)
Anadigics	(ANAD)
Analog Devices	(ADI)
Broadcom	(BRCM)
Cepheid	(CPHD)
Corning	(GLW)
Energy Conversion Devices	(ENER)
Equinix	(EQIX)
Essex	(KEYW)
EZchip	(LNOP)
Finisar	(FNSR)
Flextronics	(FLEX)
Ikanos	(IKAN)
Intel	(INTC)
Microvision	(MVIS)
National Semiconductor	(NSM)
NetLogic	(NETL)
PMC-Sierra	(PMCS)
Power-One	(PWER)
Qualcomm	(QCOM)
Semiconductor Manufacturing International	(SMI)
Sigma Designs	(SIGM)
Semitool	(SMTL)
Sprint Nextel	(S)
Synaptics	(SYNA)
Taiwan Semiconductor	(TSM)
Texas Instruments	(TXN)
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.

Broadwing (BWNG)

REMOVED FROM LIST

OCTOBER 18: 15.54; 52-WEEK RANGE: 5.30 – 16.44; MARKET CAP: 1.36B

Removed from our list this month

Cepheid (CPHD)

PARADIGM PLAY: MICROELECTRONIC MACHINES FOR DNA IDENTITY

OCTOBER 18: 7.24; 52-WEEK RANGE: 5.83 – 11.21; MARKET CAP: 395.36M

Cepheid's short-term prospects look much like its long-term past. The decade-old maker of systems that perform real-time genetic analysis using bio-microarray chips has never made a penny. Earlier this year, buoyant management had expected to cross over to profitability by December. Amid recent disappointments, they now have pushed the date back to "sometime" during 2007.

For the second quarter ending June, product revenue fell 7% from the year-ago quarter, led by a drop of 29% in industrial sales as the government reduced funding to Cepheid's educational and research lab customers. Also decreasing were sales of biothreat products, down 17% after the U.S. Post Office finished installing its nationwide anthrax detection system using GeneXpert.

Descending along with revenue, gross margin slipped into the upper 30s from the low 40s, where it had held over the past year or so after having fallen earlier from the upper 40s. Operating loss nearly doubled compared to a year ago, and with FDA clearances taking longer than expected, these losses should now continue into next year.

Sounds awful, doesn't it? Actually, these downers are merely lost pocket change compared to Cepheid's potential. For example, the 7% slide in product sales came to a little over $1m off year earlier sales of $20m. Also adding up to just $1m was the 29% loss of industrial sales, down from the previous year's sales of $3.9m. Similarly, biothreat sales fell only $2.5m and operating loss increased just $3m.

Compare those losses to the $1b Staph test market Cepheid is trying to break into using its GeneXpert automated genetic sampling and analysis system. Patients infected with antibiotic-resistant Staph have to be isolated quickly to keep the life-threatening infection from spreading through the hospital. Today's culture-based diagnostics take up to two days to complete. That's lethal compared to Cepheid's molecular diagnostics, which flag the threat in real time. Still being tested, the product should reach the FDA by December.

In another forward-looking move, Cepheid is in the process of acquiring Actigenics, a small French firm pioneering in microRNAs. A newly discovered class of RNAs that affects gene expression and regulation, microRNAs may help Cepheid develop a broad range of proprietary markers for cancer, infections, and inflammations.

These are but a few of Cepheid's long-term ambitions in a world increasingly fearful of terrorists and global pandemics. In the meantime, helping to keep the company afloat over the coming quarters will be the Group B Strep capability on GeneXpert, recently cleared by the FDA, and follow-on sales of anthrax text cartridges to the post office, expected to begin by year's end.

At around $7.50 per share, Cepheid is going for an enterprise value of 3.8x projected sales for 2006. That's too risky for those counting pocket change. For the more farsighted, the bet is that Cepheid will outpace established companies such as Roche, Applied Biosystems, and Bio Rad in the marathon market for molecular diagnostics. No certainty, but a high-reward possibility.

National Semiconductor (NSM)

PARADIGM PLAY: ANALOG LEADER AND IMAGER PIONEER

OCTOBER 18: 24.38; 52-WEEK RANGE: 20.56 – 30.93; MARKET CAP: 7.90B

Is National Semi falling apart? During the first fiscal quarter of 2007 (ending August), sales fell 5.4% sequentially and are forecast to fall another 2% to 5% this quarter to about $523m. By contrast, last year revenue rose 10% to $544m heading into the normally busier holiday season. Falling also is fab utilization, which slid sequentially from 87% to 77% on its way to an expected sub 70% this quarter.

Don't worry, National isn't cracking up. It's just that CEO Brian Halla has been busy shaking off the bad fruit of digital diversions and low-speed, legacy linear. Falling to the ground during the first quarter were $11m in fab support for divested digital businesses and $20m of commodity amplifiers and power-management products for cell phones and interface products for LCD televisions, where excess inventory has now been worked off. This quarter, foundry support should drop another $25m as owners of the divested units continue to transfer manufacturing to other sources. Excluding the foundry droppings, sales are forecast to trend flat heading into November as distributors pare their inventories to bone and sinew.

Continuing to ripen is the succulent fruit of precision, power-efficient analog. Sales of data converters were up 40% over last year's quarter, boosted by low-power analog-to-digital converters for temperature sensors; for application-specific analog front-ends in copiers, printers, and scanners; and for portable battery powered devices in industrial, medical, and consumer products. National introduced a new dc-to-dc converter

that powers mobile televisions, WiFi and other wireless processors, camera and video processors, and MP3 players. A mobile phone leader is already using the converter to lengthen MP3 run-time from 12 to 20-plus hours.

Power management sales ascended 10% year on year, propelled by products for high-voltage devices. Many new consumer and industrial products in markets as diverse as automotive and security are powered by sources which are either higher voltage or are prone to voltage spikes during normal operations. Also growing 10% were sales of high-speed interface products, which focus on analog signal conditioning, position timing, communications infrastructure, and video.

Overall, sales of standard linear products increased sequentially to 76% of revenue from 74%, and Halla expects that their share of the pie will soon surpass 80% and eventually top 90%. To ascend further in standard linear, National must excel in process technology as well as in circuit design. For instance, Halla plans to continue blazing the trail in small format packaging. He is also upgrading some of his Texas fabs from 6-inch to 8-inch wafer production for better yields.

By focusing on value-added linear and complex processing, Halla managed to grow gross margin to a record 62.7% during the August quarter despite sliding sales and falling fab utilization—or, more accurately, because of it. Climbing on gross margin's coattails, operating margin reached 35.5%, aided by improving expense management. (All financials reported ex options.) Aided yet further by $285m in stock buybacks, earnings per share increased by two-thirds over last year's first quarter, to 40 cents.

Heading into the holidays, gross margin may slip a bit but should stay north of 61% for earnings of about 36 cents. Thus, based on first-half prospects, we are looking at an earnings run-rate for fiscal 2007 of $1.50. At its recent $25, therefore, the stock is trading at just 16.6x forward earnings through next August. Adding to the stock's attractiveness, National has managed to hang on to its $509m of net cash while funding capex out of cash flows, buying back stock, and paying dividends.

Even more attractive are National's long-term prospects. Back when PCs were driving demand, semiconductors made up 10% to 20% of device content. Today, semis comprise 40% of the content of the products propelling demand. Increasingly that content is analog, particularly standard linear for enhanced displays, improved audio, better wireless, and longer battery life. Needed in every flat panel screen and in every high-resolution graphics systems will be National's low voltage, differential signaling devices that function in low noise, low power analog at over 2 gigahertz speeds. The high-definition heyday for this technology looms ahead even while China emerges with its 400m new consumers with cell phones and other gadgets, in addition to other emerging nations consuming at an accelerated pace.

The standard linear market is growing 15% annually and Halla expects National to continue to ascend significantly faster than that as these products generate an ever greater share of revenue. Masking National's remarkable progress to date have been the loss of sales from the divested units and, more recently, the transition to a leaner inventory model. Taking a conservative outlook, if National were only to grow at the same rate as the market and reach its target 65% gross margin (already being achieved in its standard linear lines), it could easily earn $1.87 next fiscal year. With a reasonable PE ratio of 20x, that bumps the stock up almost 50% to $37 by next fall, with plenty of potential on the upside.

Don't look for an explosive 5- or 10-bagger here, and don't expect a huge pop in the next few months. But long-term, National will help to anchor your telecosm portfolio with reliable, steady growth.

Semiconductor Manufacturing International (SMI)

PARADIGM PLAY: MAINLAND CHINA'S BIGGEST SILICON FAB

OCTOBER 18: 6.21; 52-WEEK RANGE: 6.16 – 8.41; MARKET CAP: 2.27B

In less than six years, Taiwan transplant Richard Chang has husbanded his Shanghai-based fab into the fourth largest in the world by sales volume. But despite Semiconductor Manufacturing International's impressive run, this mainland upstart must yet surmount significant obstacles as it tries to establish itself in a daunting industry.

Still manufacturing mostly 8" wafers and only recently ramping 90-nanometer production in its lone 12" fab, Chang borrowed $600m in June to finance expansion, mostly into advanced processes. Though he is already burdened with $820m of net debt, up from $652m a year ago, Chang expects to borrow more next year as cash flow from operations continues to fall short of capital spending by some several hundred million dollars.

This puts SMIC at a huge disadvantage to long-established rivals who are funding major cutting-edge projects out of continuing operations. Worse, the capital chasm could deepen with time—fixed costs increase exponentially for each new process generation, and advancing fabs must generate ever-larger production runs before they can turn a profit. Thus, it's the supers such as Intel, Samsung, AMD, and Taiwan Semiconductor who are now rushing into 65-nm production and firming up dates for initial 45-nm processing.

The supers' lead then snowballs as shrinks and other advances make them more efficient and as they supply both the creators of novel products and their established customers, who are able to take advantage of the expanded capabilities made possible by the new chips. As the supers sail on, they leave in their wake a sea of capacity in the older processes, which they can exploit at economies of scale far beyond those of smaller foundries.

Despite the challenges, SMIC's costly capital investments are bearing some fruit. During the second quarter ending June, sales surged 30% over the year-ago quarter while gross margin grew from 3.4% to 13.6% and net loss, excluding a one-time tax benefit, shrank from $40m to $16m. Looking ahead, 90-nm sales are expected to account for 7% of revenue during the third quarter, up sequentially from 1%.

But other short-term trends are not so heartening. The net loss of $16m during the second quarter was up sequentially from $14m as operating expenses continued to rise. Down sequentially was fab utilization, easing to 93.5% from 94.9%. Facing a flattish revenue trend going into the third quarter, Chang has warned that gross margin may decline to around 10% and that fab utilization may fall further to 90%. Increasing will be sales of commodity memory products even as SMIC struggles to boost sales of advanced DDR2 memory and more profitable logic chips.

Is Chang left with an investment case? Very possibly. His is the biggest foundry in the fastest growing nation with potentially the largest domestic market for all manner of digital devices. To compete effectively against the superfabs, Chang could become expert in niche technologies and offer value-added services that would be too distracting for the big boys to bother with. Also helping will be partnerships, such as the one recently made with Qualcomm to manufacture power-management chips. Chang won't get much of a sales boost from the agreement, but it's a first step inside Qualcomm, which also benefits by getting closer to its Chinese customers.

With the right strategy, Chang may succeed, but he may not make much money doing it. If you still want to play the China card through SMIC, don't buy yet. Enterprise value at the recent $6.25 is 2.2x estimated sales this year, with no profit in sight. *— Charlie Burger*

Is Ikanos a Sunday driver?

If a driver has a string of no-fault accidents, his insurer will often raise his rate on the premise that he is a menace on the road, forcing other drivers into unexpected and difficult situations. The probability that he is a good driver with "bad luck" is against him.

Ikanos (IKAN) has been getting banged up lately in its own series of supposedly no-fault accidents: Japanese carriers are working through inventory, and the Koreans are about to slow down their orders as well. Together, that will take a deep cut out of almost two-thirds of Ikanos's revenues. Also delayed was a major Taiwanese deployment. Then there was the collapse of the **Deutsche Telecom** (DT) rollout in Germany following the regulatory mandate that they share their pipes with anybody who comes along. **KPN** (KPN) of the Netherlands is also pushing back deployment plans. That should nip the recent upswing in European demand that had pushed the region to a quarter of Ikanos's sales.

Ikanos accepts blame for one of its crashes: newly released fifth-generation VDSL2 chips struggled out of production during the third quarter because backend testing took longer than expected. As a result, initial demand could not be met. We have been assured that the problem was not with the chip itself and that the manufacturing issues are resolved. Which makes the revenue forecast for the fourth quarter even more remarkable. The anticipated $25 million falls a walloping 42 percent short off earlier expectations, slides 32 percent sequentially from the new third-quarter guidance (lowered some 12 percent itself due to the fifth-generation manufacturing problems), and perhaps most significantly drops under the year-ago quarter by 12 percent.

Given this unraveling, what is the probability that Ikanos is an expert driver?

The scuttlebutt out of Silicon Valley is that the company accelerated too quickly into VDSL2 before the standards were settled, forcing it to pump the brakes on its new chip. The delay, in turn, gave competitors such as **Texas Instruments** (TXN), **Infineon** (IFX), and **Conexant** (CNXT) an opening.

Manufactured at a higher density than Ikanos's earlier central-office chipsets, the fifth-generation product is optimized for IPTV and includes additional quality of service features with symmetrical 100 megabit per second capability up to a thousand feet. Ikanos's previous speed limit at that distance was an aggregate 140 Mbps, such as 100 Mbps down and 40 Mbps up or 70 Mbps symmetrical. But the newest silicon out of challenger Infineon supports eight speeds of VDSL2 up to a symmetrical 100 Mbps at the same thousand feet as Ikanos. On the surface, it looks as though the technology race is currently tied between the two.

It's not that simple, however. When designing their products, systems houses evaluate many chipset features. These include integration, power dissipation, processor capabilities, filters, converters, and flexibility. A chipset that beats out a rival's at one systems house may lose to that same rival at another vendor, depending on variations in system architecture. In the features race, Infineon's silicon has usually been more integrated than Ikanos's, while Ikanos claims to be the most programmable, allowing systems integrators greater ease in developing a single line card for all carriers and service plans.

Once the bandwidth enters the home, the challenge becomes doing the routing, implementing security and quality of service, handling video and voice in the transport layer, and distributing each of the traffic types to the high-definition televisions, PCs, and phones strewn about the house—all at 100 Mbps. Using technology acquired from **Analog Devices**'s (ADI) Fusiv line earlier this year, Ikanos now has chipsets for triple-play residential gateway modems. In this market the company is coming up against Texas Instruments, which claims to be number one. And TI aims to stay on top with its new single-chip, feature-rich home gateway using 90-nanometer geometry. As with Ikanos, TI's chip works with both the ADSL (asymmetric DSL) and VDSL2 standards.

On the demand side, market researcher Dell'Oro believes that shipments of VDSL ports into telco central offices have recently dropped back to 2005 levels. One culprit is likely Japan's NTT—the carrier that showed us earlier this year at the Optical Fiber Conference (OFC) how it can tie its broadband fiber into knots and bows and still get the signal through, helping to make fiber to the apartment units cheaper than running VDSL2 up from the basement over the installed copper.

In the main, however, fiber's march toward the end user should be good news for Ikanos since VDSL works optimally only in the last thousand feet and beats ADSL in speed only within the last mile. But when fiber goes all the way to the home, a la **Verizon** (VZ) and NTT, the news bodes bad for Ikanos. On the opposite end, at distances beyond a few thousand feet but under a mile, the decreasing bandwidth advantage of VDSL over ADSL may not justify the added cost to deploy the newer technology.

Bad news often follows bad in the corporate world, and it might be prudent for investors to wait on the sidelines until after next week's call—or even until after fourth quarter's results—before entering the stock or adding to their positions. Better to buy in at a higher but rising valuation than to rush into a stagnant or still softening situation.

In a sign of gathering competition, Ikanos's quarterly research and development expenditures have doubled to $12 million over the first half of this year, accompanied by a 9-point drop in gross margin to 45 percent. As expenses mount, it will become harder for Ikanos to wring out a profit from each dollar of sales, also under pressure from competitors. At the recent $8.16 per share, the market is giving Ikanos an enterprise value (market cap minus net cash) of 1.3 times its projected fourth-quarter revenues (annualized). That's no bargain if Ikanos turns out to be a Sunday driver.

For those already in, the low of $7.23 hit the day after the preannouncement is probably a good marker for the short-term bottom, barring a startling confession next week. Ikanos has a strong balance sheet with net cash of some $110 million or about $4.20 per share, should continue to flirt with breakeven operationally even after the recent debacle and expenses, has many design wins with a broad base of carriers which may soon include **AT&T** (T), and is still a solid contender technologically in broadband copper. We will continue to watch this one closely.

— Charlie Burger

of the *Gilder Technology Report*. When Cioffi barged into the 1993 ANSI (American National Standards Institute) meeting with a better low and slow way of doing DSL, he was faced with an entrenched modulation technology called CAP (carrierless amplitude phase) modulation, supported by the Bell system's Western Electric and the entire industry. Used in nearly all the nation's fast modem trials over some ten thousand lines, it exploited the same quadrature amplitude modulation (QAM) used in voice band dialup modems. CAP translates bit streams into symbols with different amplitude and phase combinations. CAP-16 can use sixteen different combinations of amplitude and phase, each bearing four bits. At 250 kilohertz, the system added up to an entire megabit per second, equivalent to a business T-1 line. By jacking up the clockrate into the megahertz, CAP could reach several megabits of data per second.

Cioffi said Whoa! Slow it down. Make it parallel. Use the magic of Fourier transforms to divide the "carrierless" band into multiple carrier frequencies each running at a comparatively viscid four kilohertz. It's sixty-four times slower. It's radically lower power. Occupying a 256-KHz band with sixty-four 4-KHz sub-bands (each bearing some 20 kilobits per second), a Cioffi system could also reach one megabit of data per second.

The difference was that his low and slow discrete multitone system could scale. In a speech at the Marconi event, for example, Cioffi showed how his system, extended by the DSM of his new company **ASSIA**, could reach speeds of a gigabit per second over the same twisted pair phone lines. That's roughly a thousandfold better than the old CAP system.

So what is going to happen to our **Ikanos** (IKAN)? Cioffi said he holds some shares, but the company fumbled in the transition to VDSL2 and now faces competition from **Conexant** (CNXT), which bought the old Globespan company from **AT&T** (T), and **Texas Instruments** (TXN), which bought another Cioffi startup, Amati. For further details, consult Charlie Burger's Ikanos report (opposite page).

In general, though, optics is still wider and weaker even than discrete multitone, and all Cioffi's heroics, low and slow though they are, represent a transitional phase between the copper cage and a crystal cathedral. Without DSL, the Internet would have foundered long before Google's good works. But over the next five years, passive optical networks (PONs) will bring the all-optical paradigm increasingly into the local-loop. Charlie Burger tells of watching a **Nippon** (NTT) optical virtuoso show that he could connect fiber not just to the apartment building but up the riser into the bedroom and tie it in bows. Ikanos may still be a buy. Much of the world and most of the continental U.S. is still unsuited for fiber-to-the-home. The more fiber is extended to neighborhoods the greater the need for VDSL. But be careful.

At the Marconi meeting, I also met last year's winner, Claude Berrou, the inventor of the turbo codes that are used widely by Qualcomm and other wireless players to expand transmission close to the Shannon limit by incorporating feedback loops in the channel. "A telecommunications receiver," he said, "which was seen in the past as a unidirectional succession of elementary processes, becomes more and more like a cluster of processors that exchange and mutualize their pieces of information." It is an application of "belief propagation," which uses "probabilistic data fusion" in which "three associated processors work together in order to make them merge toward a single representation."

This approach will help us mimic the brain, he said, with "this continuous flow of sodium and potassium ions through cell membranes" and "loopy circuits" that "is called thought."

Berrou is a brilliant man and his speech defies distillation. But his reflections converged with Carver Mead's and pointed to the brain as the still inscrutable but inescapable challenge facing information science.

At Telecosm, Mead told us (I paraphrase some of his words):

"*As you are driving down a dark road on a dark night, you often make decisions on whether to steer or break on the basis of a handful of these nerve pulses. We may sense that it is a little hard to see, but we are not aware that we are processing information in a completely different way than when we are watching TV in a lighted room. The brain can handle this vast dynamic range of information coming in. It is able to make intelligent decisions on the basis of a few lonely photons or in the midst of a flood of light. We have no computer system that operates like this. But a very few such elements in the brain of a fly allow it to elude the swatter and collect food and maneuver with an agility that outperforms all our most advanced yotta yotta processors…*

"*What is happening, according to the experts, is an averaging mechanism. But such a system could not have evolved. The molecular or chemical gradients already in the brain could do the job as well…*

"*The only other device we know about with this exponential processing is the quantum computer. No one can build one yet. But a quantum computer also hypothetically attains this exponential effect with parallelism. In the end, we will have to make more and more parallel systems.*"

I urge you to listen Carver's speech. (http://blog.gildertech.com). Delivered in the quiet hypnotic, low and slow tones of its polymathic author, it climaxed Telecosm 10 and impelled us toward all the Telecosms of the future.

– George Gilder, October 18, 2006

From Telecosm 10: Is the Dream of the All-optical Network Dead?

Terry Turpin, Essex Chief Scientist: We are talking about problems that are transcomputable. Super computers have maxed out. Moore's law really ended with the Pentium 3. Pentium 4 is mostly memory. We have reached the point that when you reduce size of features by factor of two you no longer get a factor of two in performance. Scale will no longer get us there.

In optical processing, the light flows through lenses, prisms, and holograms, which are the primitives of optical computing. Info is now transmitted optically. When you can process data optically, you typically get an efficiency gain of 50 thousand.

In fact, in needle-in-a-haystack problems with huge piles of data, optical processors can reduce the workload by a factor of one billion.

All problems involve both processing and communications and it is hard to tell the difference. There are two major paths of advance under way. One is opaque networks where the lights go out at every node. At every node it is necessary to do optical to electronic to optical conversion through all seven digital layers. It entails vast compute power and is limited by dispersion and the speed of the electronics.

The alternative is transparent networks characterized by optics all the way. It works at thousands of times lower power with optical computers potentially processing thousands of wavelengths in parallel. At Essex, we are putting our own money into these transparent optical technologies.

David Welch, Infinera: Communication is only about bits. It's not about wavelengths; it's about bits. Bits are where people create money and differentiation in the services they provide… I need to know what is in the bits in order to manage my network the most efficiently.

At Infinera we started out with the problem of the optical network and said, "What are the problems with it?" One of the problems is too many discrete optical components. We decided to spend our time and research dollars developing the ability to integrate these components onto two small chips. These chips are on the order of a few millimeters in size and we have taken fifty or a hundred different optical components and integrated them on to these parts. Now we have a chip that integrates over 100 Gigabits of information at the transmit and receive level. We've dramatically improved the space, the power, the cost, and the reliability of the system by doing integrating rather than manually assemble the parts. We've created a technology that can transform the information from the optical realm to the electronic realm without having to pay a big tax. I can now apply these services and the management done at the bit level, done cheaply in electronics, into the optical layer as I want.

The world used to design optical networks based on a cost structure. Now we can design optical networks based on a revenue structure…I can bring in electronics anywhere it adds value to the network. I can integrate layer 2 services onto layer 1 and Ethernet and packet management service onto the layer through the management of the bits and the only way you can do that is by transforming the information from the optical domain into the electronic domain.

Charlie Burger, *GTR*: Is WDM dead? It seems as through Infinera is saying that it is dead—that we're going long and strong, 40 Gig, 100 Gig, 400 Gig, fewer channels.

When WDM began in the 90s it was going on a Moore's law-like trajectory—4 channels, 8 channels, hundreds of channels. We were talking about thousands of channels being optimal with Terry Turpin and his Hyperfine technology. You don't hear about that anymore. Several networks are talking about 160 channels. I believe Verizon has the capability, but no one's going beyond that and it seems as though we're moving backwards.

Welch: WDM is very strong. We have an integrated WDM system on a chip. On that chip there are 10 wavelengths and 10 channels and you can take those 10 wavelengths and interleave them with more and more of these 10-wavelength channels.

Burger: You said lambdas are limiting. Why?

Welch: In the extreme case, what happens is, if I have a 10-Gig optical carrier and I want to sell a 1-Gig VPN service to someone wanting to route its info through the network, I will invariably end up having to reserve an entire wavelength for that 1-Gigabit circuit I'm trying to establish and that will be a waste of bandwidth.

Fred Leonberger, former JDSU CTO: Most of the developments now in the optical space, in fact, are at the access side. I read a quote from an NTT vice president stating that he expects fiber to the home users to surpass DSL users within another year, and they're looking at 30 million fiber to the home users within three years.

And that's being repeated around the world. Verizon has a very large rollout going on right now, and the key components in the optical domain have come way, way down in price. You are also going to see that there is going to be another generation of access technology that will be based on WDM, because you can do a much better job with WDM passive optical networks than you can with the GPON systems we're using today.

Got Questions?

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

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