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The Orchestra on the Titanic

Corvis's all-optical Broadwing network operates with superior latency and superior quality of service for lower cost and greater reliability than its optoelectronic competitors

Inside:

On a rainy morning early this month I drove down the broadband Taconic parkway from my house in the Berkshires, past all the **IBM** (IBM) entrenchments on the way, in Fishkill, Yorktown Heights, and Hopewell Junction, past some fifty deer and five concealed police cars, to contemplate the conundrums of connectivity at a recherché conference resort down an endless twisty maze of narrow roads leading to a steep hill in Westchester County near the end of the world. Called the Edith Macy Center and built for the Girl Scouts, it had been commandeered for the weekend by David Isenberg, the guru of "stupid networks" and smart people, who nine years ago defected from **AT&T** (T), which was into smart networks and dumb people. Presenting a bleak, windswept, ananthous, lawnless look, the setting seemed suitable for this tent meeting of telecom scouts, shaken survivors of the crash, surveying the debris for the further pits and minefields possibly hidden beneath the current signs of modest industry revival.

Still predicting doom, the "smart people" of telecom scanned the overcast sky for angels, government guidance, subsidies, socialist saviors from Canada, WiFi, WiMax, or even a random refugee keynote seeking cover from the rain, if the academic doomsayer Eli Noam failed to show, still locked out of his garage at Columbia and presumably wandering around Morningside Heights looking for a key or an umbrella.

I arrived at the center just in time to be greeted like a long lost friend by Isenberg, who was surveying the breakfast area for a substitute speaker. Hey, here I am! Sleepy, but in uniform no less, the only person in the room wearing a dark suit and tie. I offered to tell the group about Korea's telecom breakthroughs and ended up giving the first speech of the day, stitching in the schedule between a dazzling doomladen tour d'horizon by Roxane Googin the night before and a lugubrious jeremiad by Noam arriving an hour or so later.

You've seen **Google**. Now meet Googin, who knows almost as much. Her essential propositions are almost indistinguishable from the *GTR* paradigm—as I said, she is smart—but she follows the logic of abundant bandwidth, constrained storewidth, content-conduit separation, and Moore's law into a cul de sac that she calls "The Paradox of the Perfect Network." The better the network the lower the profit. Since the all-optical network is theoretically perfect—offering infinite bandwidth, reliability, low latency and protocol neutrality—its deployment promises to bankrupt all the telecom carriers.

"Telecom is either a valuable monopoly or a valueless commodity," Googin puts it. Since the communications industry lacks a **Microsoft** (MSFT), with near monopoly power and 600 thousand bugs in each new fenestration of its software to enable endless

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maintenance and upgrade charges, the telecom industry is going broke and all the money is flowing toward Redmond. Speaking after me, however, Columbia professor Eli Noam wasn't so sure about Microsoft. What with their dilutive options, and the Linux option, and the worldwide reach of antitrust vandals, they might not make any money either. Software was becoming as free as bandwidth. Noam was just glad that he had tenure. He agreed with Roxane that there was no hope for telecom. Everyone would go broke.

I concluded that Bob Metcalfe was right when he told me the Internet needs fewer beards and ponytails and more suits. Perhaps information does not want to be free, after all. Free email becomes filthy spam. Free peering becomes peer-to-peer traffic jams. Free bandwidth becomes dribbleware. As Metcalfe pointed out at the time, the basic problem arose in 1996, during the transition from the National Science Foundation (NFS) Net to the commercial Internet, when a "settlements-free" peering process emerged. Peering is the way traffic is exchanged between different "Tier-1" networks. Believed to apply only to the big three—**MCI**, **Sprint** (FON), and AT&T—the settlement-free model soon attracted 50 well-funded new players, including BBN/Genuity, PSINet, and a gaggle of Competitive Local Exchange Carriers (CLECs)mostly riding the wires of the Bell Operating Companies. Soon virtually everyone was Tier-1, and in tears.

This free peering system essentially sucked the money out of the bandwidth business at the very time that the doubling-every-90-days Internet traffic panic, real in 1995 and most of 1996, collapsed to its current rate of annual doubling. Then, as a coup-de-grace, even the cash-cow of voice telephony went into the swoon that is accelerating today with **Vonage**, **Skype**, Free World Dialup, **Packet8**, and all the other vendors of IP telephony, software, and services. Whee! It's free. The cable companies may relish it today but they will get theirs. Free IP TV is on the way. After all, information wants to be free. Troped Farooq Hussain at the Isenberg conference, the carriers "are like the orchestra on the Titanic. What can they do? Nothing except to just keep playing. No new business model can redeem the current situation. They all will make it worse."

GigBE, the next-gen Pentagon network, is a vast new set of pipes taking away the government market that was once a stable source of funds for several carriers. **Equinix** (EQIX) is pushing every telecom transaction into an auction won by the lowest bidder (and Equinix). Using dark bargain basement and septic pipeline fiber and eminent domain, "community broadband" municipal and even rural networks are usurping the local exchange carriers. After auctioning off cellular and PCS spectrum for top-dollar billions, the FCC is now turning around and giving away unlicensed bands to all comers. Whee! It's free. For violating the rules of Special Mobile Radio and interfering with public services across the country, **Nextel** (NXTL) is winning choice new cheap spectrum with no auction. MCI is emerging from bankruptcy lean and mean, and nearly debt-free, like a horny creature from the dark lagoon.

No traffic jams here

Meanwhile, back in Great Barrington, we have our own comeback story, Charlie Burger, and he has the latest estimates of average U.S. Internet backbone traffic as supplied by Prof. Andrew Odlyzko of the University of Minnesota. According to Odlyzko, total Internet traffic over the U.S. backbone links continues to approximately double, having reached somewhere between 120 to 250 PB for the month of December 2003. The broad range of values indicates the uncertainty in these measurements. No government or industry group collects detailed stats and the carriers themselves are very secretive. Odlyzko gets his data primarily by monitoring publicly available traffic statistics for Internet exchanges and especially end users, supplemented with occasional public announcements by carriers and with data provided under nondisclosure by carriers and end customers.

Equinix CTO, Jay Adelson, tells us that if we only count Tier-1 backbone traffic, we may be missing what's really going on. Certain Tier-1 backbones (the long-haul links of the largest carriers) have reported traffic decreases in 2003–04. If you only look at these backbones, you would think that overall Internet growth has slowed or even reversed. But the traffic has shifted away from those Tier-1 carriers onto other networks, mainly due to peering. If **AOL** (TWX) peers with **Cox** (COX), and its traffic used to go through **Level 3** (LVLT) on its way to Cox, now Level 3 loses AOL's traffic destined for Cox. It gets shifted directly to an Equinix Internet Business Exchange. So, the more peered traffic between content and user, the more Tier-1s get displaced, a trend which MCI might want to think about in its reincarnated position as the nation's number two carrier. Adelson, whose company provides protocol neutral storage and peering exchanges for the largest networks and content companies, tells us that almost 50 percent of **Yahoo** (YHOO) traffic never touches a Tier-1 backbone now, and instead goes straight to your PC from Equinix.

Seasoned with Adelson's insights, we continue to rely on Odlyzko's inclusive view of the network. Since December 2001, we have not heard from our other key Internet traffic source, Larry Roberts of Caspian Networks, whose traffic estimates were based on tallies from Tier-1 carriers and had come within the lower part of Odlyzko's range. Roberts's silence today may reflect the diversion of traffic from these networks to Equinix.

The network is only as fast as its slowest link. With Charlie's **Verizon** (VZ) ADSL (asymmetric digital subscriber line) connection, available in Housatonic, Massachusetts, for just the past half-year or so, he can still only dream about uploading 100 or 200 MB video clips of the latest family activities to his children in college. His theoretical 1.5 Mbps link usually downloads at around 500 kbps, but upload speed in the asymmetrical world is only 128 kbps. Today, he can do 10 times faster what he used to do with his previous arteriosclerotic dial-up service, which is mostly to search and download web pages. But he would only attempt to upload video files before leaving for vacation or when he wants to freeze his PC.

Korea gets high on speed

Compared to what's available in Japan or Korea, Charlie doesn't have a broadband connection, he has a faster-than-dialup

(FTD) connection. The same is true for most of the rest of the U.S. The Pew Internet and American Life Foundation tells us that 55 percent of U.S. Internet users (one-third of all adult Americans) now connect via broadband at home or at work. But, when compared to Korea and increasingly the rest of the industrialized world, the real answer is near zero percent. The leader in true broadband connectivity is South Korea. Their largest private carrier, **Korea Telecom** (KT), tells us that they now offer VDSL (very high speed DSL) at speeds up to 50 Mbps—what we call broadband (ADSL), they call "light service."

Estimating backbone traffic for Korea is at least as challenging as estimating it for the U.S. We can estimate an upper bound by noting that TeleGeography reported that around March 2003, Korea's total international bandwidth was 15.3 gigabits per second—the maximum rate at which the fiberoptic network in place at that time could transport bits out of the country. Internet traffic in Korea is heaviest (peaks) between 9 p.m. and 2 a.m., the period when most of the serious home users are online. The ratio of this peak period of traffic to the average traffic through the day in Korea appears to be somewhere around 1.47x based on traffic patterns at a major Korean Internet exchange. This tells us that the bandwidth cited by TeleGeography (15.3 Gbps) could handle, at most, an average traffic flow of 10.4 Gbps, which, when multiplied by 1.47 yields 15.3 Gbps, a flow of bits that would have saturated Korea's international lines and caused massive QoS problems that to our knowledge have not been reported.

A high percentage of Korea's Internet traffic remains within its borders, by most counts somewhere between 80 and 85 percent. We will take the higher estimate, 85 percent, and assume that only 15 percent of Korean Internet traffic becomes international. Thus, if the average flow of Internet traffic out of Korea was 10.4 Gbps as calculated above, then total traffic was 69 Gbps or 22.5 PB of Korean backbone Internet traffic during March 2003. Since the U.S. has 6 times the population of Korea, we multiply 22.5 by 6 and get 135 PB per month compared to Odlyzko's mid-point value of U.S. traffic last March (extrapolated) of 130 PB. Our Korean traffic estimate is likely on the high side of truth since we assumed bitrates that would have jammed the international network and also assumed a high value for domestic versus international traffic. As of a year ago, then, it appears that South Korea was generating, at most, little more Internet traffic, proportionately, than the U.S.

With all of their broadband prowess, how can this be? In answer, we first note that our traffic estimates for Korea do not give us growth rates. In the U.S., as FTD flowers apace, backbone traffic continues to double yearly (or may even be slowing down slightly). In Korea, VDSL was still a fairly recent innovation as of March 2003, and 50 Mbps is a new offering in the last month or so, probably only in select locations. A recent study by IBM and *The Economist* shows Europeans leading the world in incorporating Internet technology into their daily lives, but South Korea is moving up fastest by far. The estimate may capture the rate of change while missing the pervasive role of the net in Korean life and somehow overlooking Japan, where Yahoo now offers 45 Mbps for $27 a month.

So, what do Koreans use VDSL for? According to our source inside KT, of their 5 million customers, 1.5 million are on one of five VDSL plans (4, 8, 13, 20, or 50 Mbps; all of these services except 50 Mbps are offering symmetric speed, meaning both upload and download speeds are the same) and 3.15 million are on the light-service ADSL (1.5 Mbps), similar to Charlie's Verizon plan. Only 350,000 are on 8 Mbps ADSL. Apparently, you are either satisfied with emails, browsing, and jerky, low resolution video streaming, where "light" service will do, or you want to leap to sending video clips to friends and download a movie or two while your family watches several channels of HDTV. Try that in the U.S.

According to KT, peer-to-peer (the swapping of files such as music, photos, and video among residential Internet users) is the main reason subscribers move up to VDSL, which also explains why traffic peaks later in the evening when users are at home and why the ratio of outgoing to incoming traffic on residential broadband links is 116:100. Even in America, where asymmetric broadband predominates, Sprint has cited that two-way file sharing programs make up 21 percent of its traffic. Humans are social, and so future Internet growth may be fueled by swapping of video clips of family events, which you can't do on the FTD plan.

The end user doesn't care about capacity or average traffic; he cares about latency. He doesn't care about bandwidth so much as connectivity. Data traffic is bursty, and most people have daily schedules, which make Internet usage more appropriate at some times than at others. That's why average backbone utilization of 10 to 15 percent has carried through from 1997 to 2003 and will continue to do so. Corporate long-haul links average 3 to 5 percent utilization (employees tend to go home at night). At home in his Korean high rise, Charlie might get a 50 Mbps VDSL connection so he can send video clips to family a few times a month. His monthly average utilization as a percentage of capacity would almost certainly decline, but he'd prefer the timeliness and convenience of the Internet to mailing CDs. High, symmetrical bandwidth makes QoS concerns unnecessary and allows for quick downloads and uploads, faster than video streaming. Most of the time the bandwidth will go unused—we will waste it, just as voice bandwidth was mostly wasted on local loops where the phone was used 20 minutes a day. Korea seems to be confirming just this.

In the U.S. meanwhile, over a million DVDs are shipped through the mail every day, which comes to 300 petabytes per month compared to the 185 petabytes that traversed the U.S. Internet backbone last December. What this means is that we need much more bandwidth at the edges of the network, in the access networks and first-mile links. Not surprisingly, then, the complexity, cost, and revenue and profit opportunities continue to migrate towards the edges of the network.

Corvis sharpens its edge

In mid-2003, approximately 730 Gbps of network capacity would have sufficed to carry all U.S. backbone traffic. (We estimate this by taking the average traffic of 148 PB per month multiplying it by 1.6 to obtain a peak traffic value, multiplying that by 8 to get bits and dividing by seconds per month.) Also in mid-2003, according to Odlyzko, it was standard to obtain transit services from large ISPs for about $100 per Mbps per month in large

TELECOSM TECHNOLOGIES

Advanced Fibre Communications	(AFCI)
Advanced Micro Devices	(AMD)
Agilent	(A)
Altera	(ALTR)
Analog Devices	(ADI)
Avanex	(AVNX)
Broadcom	(BRCM)
Cepheid	(CPHD)
Chartered Semiconductor	(CHRT)
Ciena	(CIEN)
Corvis	(CORV)
Energy Conversion Devices	(ENER)
Equinix	(EQIX)
Essex	(KEYW)
EZchip	(LNOP)
Flextronics	(FLEX)
Intel	(INTC)
JDS Uniphase	(JDSU)
Legend Group Limited	(LGHLY.PK)
McDATA	(MCDTA)
Microvision	(MVIS)
National Semiconductor	(NSM)
Proxim	(PROX)
Qualcomm	(QCOM)
Samsung	(SSNLF/SSNHY)
Semiconductor Manufacturing International	(SMI)
Sonic Innovations	(SNCI)
Sprint PCS	(PCS)
Synaptics	(SYNA)
Taiwan Semiconductor	(TSM)
Terayon	(TERN)
Texas Instruments	(TXN)
VIA Technologies	(2388.TW)
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.

Advanced Micro Devices (AMD)

INTERNET COMPATIBLE PROCESSORS

APRIL 23: 16.36, 52-WEEK RANGE: 5.80 – 18.50, MARKET CAP: 5.8B

March quarter earnings of $.12 per share blew past Street estimates of $.03 and marked three consecutive quarters of profitability. Sales of $1.236 billion topped year-ago sales by 73%. Flash memory sales into wireless devices and embedded systems were especially strong, and the memory group, having fully integrated Fujitsu's Flash operations, is now profitable. This contrasts with Intel's memory division, which continues to lose money and lag Intel's other businesses. AMD also has dented Intel's high-end server dominance by luring Sun and HP to join IBM and Fujitsu in building servers and workstations using AMD's 64-bit, x86 Opteron processor. The Opteron is beating Intel's Itanium in many compute-intensive markets like finance, web infrastructure, and graphics. Were AMD to build on these successes and evade Intel's long shadow in several niche markets, its relative valuation could jump into a range more comparable to other technology companies. Today AMD trades at a price-to-sales ratio less than a third of the industry average. Intel has a commanding lead in PCs, laptops, and, importantly, in wafer fab technologies. But a mere return to respectability for AMD could mean profits for investors.

Altera (ALTR)

SOFTENING HARDWARE, HARDENING SOFTWARE

APRIL 23: 21.80, 52-WEEK RANGE: 15.43 – 26.82, MARKET CAP: 8.2B

March quarter earnings of $.15 per share comfortably beat analyst estimates, and sales of $242.9 million were up 12% sequentially. The company repurchased 2.3 million shares for $51.6 million during the quarter and said June quarter revenues would be $15-$20 million higher than analyst estimates.

Altera's HardCopy Stratix structured ASIC won EDN's 2003 Innovation of the Year award in the digital IC category. Programming the chip in the metallization layer, HardCopy allows customers experimenting with Stratix FPGA designs to move quickly into high volume production of hard-wired chips, virtually risk free.

Altera also announced that in a new benchmarking test its Stratix II demonstrated 50% better performance than its top competitor, the Xilinx Virtex-II Pro. Altera attributes its performance leap to a new Adaptive Logic Module architecture, which helps optimize power and speed in the 90-nm process. Altera also said the tests showed its 130-nm Cyclone devices outperform Xilinx's 90-nm Spartan-3 devices by more than 70% on average.

Analog Devices (ADI)

ANALOG EVERYWHERE & SOFTENING RADIOS

APRIL 23: 47.62, 52-WEEK RANGE: 31.15 – 52.37, MARKET CAP: 17.8B

In a two-week span Analog Devices took home the EDN 2003 Innovation of the Year Award in the analog IC category, an Intel Preferred Quality Supplier award, and the title of "Company of the Year" from the Massachusetts Telecommunications Council. Analog also introduces its latest flat panel display interface, the industry's first fully integrated analog interface capable of withstanding the extreme industrial temperature standards of –40 degrees C to +80 degrees C, making it well suited for automotive and aerospace industries.

Scheduled to announce earnings on May 11, Analog historically moves closely with Linear (LLTC), who announced higher than expected quarterly profits on April 13, beating expectations for both earnings and revenue.

Chartered Semiconductor (CHRT)

MICROCHIP FOUNDRY SPECIALIST

APRIL 23: 9.95, 52-WEEK RANGE: 3.50 – 11.40, MARKET CAP: 2.5B

Taking share from UMC, Chartered raised 1Q revenue guidance on March 12 by 1.3% to US$227 million. Chartered reports on April 23.

Ciena (CIEN)

OPTICS AND ACCESS TO FIBERSPHERE

APRIL 23: 5.00, 52-WEEK RANGE: 4.19 – 8.14, MARKET CAP: 2.4B

Moving toward its goal of a 20% reduction in operating expenses by year's end, Ciena announced the closure of its San Jose facility and a 25% cut in its workforce, earlier this month, a move that could have serious implications for what remains of former metro optics systems leader ONI. With even more hard-hitting cost cutting measures needed to approach breakeven, Ciena's path to recovery is precarious.

Essex (KEYW)

"TURPIN'S LAW"—ANALOG OPTICS GALORE

APRIL 23: 8.20, 52-WEEK RANGE: 4.00 – 10.45, MARKET CAP: 123M

On March 25 the company announced contracts for six new projects totaling $7.7 million for its U.S. defense and intelligence customers. Also in late March, Essex moved from the AMEX market to the NASDAQ national market and now trades under the symbol KEYW.

Intel (INTC)

MICROPROCESSOR KING MOVES ONTO NETWORK

APRIL 23: 27.53, 52-WEEK RANGE: 18.07 – 34.60, MARKET CAP: 178.5B

March quarter net income of $1.7 billion was up 90% from last year, but sales of $8.1 billion were at the low end of Intel's predicted range and disappointed the market. Sales for the June quarter are expected to be around $8 billion. The Flash memory division continued to lose money, even as competitor AMD's Flash business turned a profit and began selling the most advanced NOR Flash products, built in a 110-nm process. But Intel said it would ship 90 nm NOR Flash chips in the second half of the year, quickly usurping AMD's brief lead.

Intel retains its substantial lead in microprocessors,

shipping the new "Prescott" Pentiums built at its 90-nm geometry, 300-mm wafer fab in Albuquerque. CFO Andy Bryant rejected suggestions of problems with the new process, saying yields are even higher than expected.

Acknowledging a long-held criticism of many in the industry, including the GTR, the company announced it will no longer focus on clock-speed alone when marketing its chips. With memory access a crucial bottleneck in microprocessors, increased clock speed does not necessarily yield proportional performance increases. The company will instead now market based on a number of factors, including cache memory and bus speed.

Making good on its promises to take on TI, ADI, and Qualcomm, Intel announced a special version of its XScale processor for PDAs and mobile phones. Code-named "Bulverde," the chip renders DVD-quality graphics on color LCD screens and processes images from video cameras. Good news: Intel has finally acknowledged the ascendance of the teleputer, the key device for computing and communicating in the new era. Bad news: Qualcomm and TI OMAP processors will be very difficult to beat.

McData (MCDTA)

STOREWIDTH IN INTERNET PROTOCOL

APRIL 23: 5.88, 52-WEEK RANGE: 5.58 – 15.90, MARKET CAP: 690.7M

Pre-announcing disappointing results on April 15, McData reported that it will miss first-quarter targets with revenue expected to be in the $94-$104 million range versus previous estimates of $108-$115 million. With increased competition from Cisco at the high end and Brocade at the low end, McData was caught between product cycles this quarter. Integration and restructuring challenges associated with its acquisition of Aarohi were also factors. The company is not expected to release new products based on technology acquired from Aarohi or its new 4-gigabit-per-second switches until the second half of this year.

McData has made progress reducing operating expenses and seems to be defending its core director market position despite the deferment of purchases by some existing Intrepid 6000 Series director customers until the release of Intrepid 10000, still on track for 3Q.

Qualcomm (QCOM)

AIR KING—WORLD'S BEST TECHNOLOGY COMPANY

APRIL 23: 66.98, 52-WEEK RANGE: 29.58 – 69.38, MARKET CAP: 54.3B

March quarter earnings of $.58 per share ($.53 excluding Strategic Initiatives) handily beat Street projections. The company expects June quarter earnings of $.48-.50 per share, 10 cents better than analyst estimates, and sequential sales gains of 4%-7%, compared to Street projections of -10%.

Asia continues to fuel CDMA dominance. Japan's KDDI now has 14 million 3G subscribers, leading all competitors in net customer additions for six months in a row, and South Korea boasts 6.4 million EvDO high-speed data subscribers.

Qualcomm demonstrated its new QChat push-to-talk solution featuring call set-up latency of less than one second. QChat is optimized for 1x EvDO data-optimized mobile networks and 1x Revision A networks. Korea's LG Electronics said it would build phones featuring Qualcomm's BREW Chat push-to-talk solution, a lesser but interoperable and upgradeable version of QChat that is optimized for CDMA2000 1x Release 0 networks.

Samsung (SSNLF/SSNHY)

LEADER OF WORLD CHAMPION KOREAN INTERNET

- FOREIGN STOCK EXCHANGE -

March quarter net income was up 178% from last year to US$2.71 billion. Rising DRAM chip prices and record high shipments of high-end mobile handsets led the surge to record revenues of US$12.5 billion. Samsung's strength highlighted the growing dominance of CDMA wireless standards, as CDMA laggard Nokia reported its sales had shrunk by 2% in the same quarter. Samsung's average phone price is $193, compared to Nokia's $154, yet Samsung continues to take market share as it integrates many more features like cameras into its phones and as CDMA takes share in the fast-growing Asian markets. Among the 130 distinct models Samsung plans to release this year, it recently shipped a $512 camera phone that stores up to 120 minutes of video. Meanwhile, the company's profitable liquid crystal display (LCD) business will become more so as it begins producing Sony's flat panel displays, too. With the DRAM price surge expected to continue and Samsung handset market share rising in the U.S., Europe and Asia, all indicators point toward sequential growth in 2Q. Samsung shares had been up 36% for the year until the stellar April 15 announcement, when shares perversely retreated 3.4%.

Sprint PCS (PCS)

NATIONWIDE CDMA WIRELESS NETWORK

APRIL 23: 9.52, 52-WEEK RANGE: 3.40 – 10.70, MARKET CAP: 9.9B

As AT&T Wireless (acquired by but not yet integrated into Cingular) was announcing a loss of 367,000 subscribers in the March quarter, Sprint PCS reported stronger than expected growth with net additions of 414,000 new customers, not to mention 558,000 through wholesale and affiliate channels. PCS revenue of $3.44 billion was up 16.6% from the year-ago quarter. Average revenue per user continues to grow slowly, hitting $61 per user per month. Four million users now subscribe to the $10-per-month Vision data service, up one million for the quarter, and data, headed for $700-million-plus in annual revenue, now accounts for 6% of total ARPU.

On April 23, the PCS wireless tracking stock will cease, and each PCS share will convert to .5 shares of FON stock. Although we wish PCS were not weighed down by FON's shrinking legacy long-distance business, LD does provide cash to fund wireless capex. PCS, moreover, now represents over half of FON sales, and the end of "long-distance telephony" (doesn't it already sound antiquated?) will soon make FON a "wireless company" by default.

In contrast, the other American CDMA star, Verizon, enjoys better possibilities with its own legacy business as it transforms its last-mile copper liabilities into fiber-optic assets. Verizon Wireless also leads PCS in subscribers and services, but VZ owns just 55% of Verizon Wireless, which accounts for about 15% of Verizon sales. VZ is thus less leveraged to wireless growth.

Taiwan Semiconductor (TSMC)

WORLD'S LEADING MICROCHIP FOUNDRY

APRIL 23: 11.25, 52-WEEK RANGE: 6.87 – 12.93, MARKET CAP: 45.5B

The company said it is running at 105% of capacity, a level not reached since 2000, and it may raise its 2004 capital expenditures from the currently planned $2 billion. TSMC and rival UMC are said to be sending overflow business to small foundries, many of which are on mainland China, which is expected to add $4.5 billion worth of new capacity this year.

Terayon (TERN)

MOVING CDMA INTO CABLE

APRIL 23: 3.78, 52-WEEK RANGE: 1.71 – 8.25, MARKET CAP: 285.5M

Number five cable TV operator Adelphia announced it has deployed over 200 of Terayon's DOCSIS 2.0 cable modem termination systems (CMTSs, or "head-ends"). Terayon is the only vendor with an end-to-end DOCSIS 2.0 solution.

Texas Instruments (TXN)

PIONEER OF NEW PROCESSORS FOR TELEPUTERS

APRIL 23: 27.94, 52-WEEK RANGE: 17.21 – 33.98, MARKET CAP: 48.4B

Despite serious weakness at its largest customer, Nokia, TI reported stellar earnings for the March quarter. Sales grew 6% sequentially, and earnings of $.21 per share were triple the year-ago period. While Intel projects June quarter sales to be flat or even down slightly from March, TI expects sequential sales growth of around 9%.

Leading the way in the quarter were high-end analog, used across the communications equipment spectrum, and digital light processors (DLPs), which are the micro-electric mechanical systems (MEMS) used in enterprise projection systems and new flat-screen digital TVs. Analog and digital chip sales into wireless devices outpaced industry handset growth (again, notwithstanding Nokia's problems). Broadband digital subscriber line (DSL) chip sales also continued strength from 2003, when the company shipped 24 million ports, triple the previous year.

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cities, if one leased high-bandwidth links such as T1 lines. Multiply that figure by 730,000 and you get a cost of obtaining 730 Gbps of capacity of $73 million per month. Which means that the 730 Gbps of capacity that would have sufficed to carry all U.S. backbone traffic in mid-2003 could have cost as little as $876 million per year if all bits originated in high-bandwidth links that accessed the optical backbone directly. Yet total dedicated Internet access revenues in the U.S. (the kind of access that businesses, government, and academia buy) were about $15 billion in 2002, showing that most of the money is not in optical transport but in the optoelectronic aggregating (combining) of low-bandwidth links at the edges of the network.

This is confirmed by **Corvis**'s (CORV) Broadwing subsidiary which is in the process of taming its highest cost—local network leasing charges—with a strategy of building or buying its own facilities at the edge of the network. As part of this strategy, Corvis announced last month the acquisition of **Focal Communications**, a CLEC provider of voice and data services to 4,000 enterprise customers with networks in 21 large markets. Corvis estimates that its access cost cutting should eventually yield Broadwing $3 to $6 million per month in savings, enough to reach operating break even this year. Edge economics has not been lost on MCI; the company is reportedly considering building its own infrastructure in metropolitan markets where it currently leases transport and switching gear from the RBOCs. But MCI already owns access equipment in 114 metro markets, and so Corvis is playing catch-up in this vital cost area. But unlike Broadwing, MCI's long-haul network is not yet cutting-edge all-optical.

Built by Corvis, Broadwing's all-optical network now operates with superior latency and hence superior QoS (quality of service) for lower cost and greater reliability than its optoelectronic competitors. Overcapacity in the backbone will chiefly be a problem for other carriers who we predict will be losing business to Corvis. Broadwing will not remain the only true all-optical national network; other carriers will wake up to the technology. But their costs will be higher. Broadwing cost more than $5 billion to acquire and create and Corvis upgraded it to all-optical for about $200 million. Then cash rich Corvis, with no debt, turned around and bought the network $70 million. MCI's cost to build a similar network would be in the hundreds of millions.

Corvis can now reduce costs on the edges not only because it owns the access links but also because it can use wavelength " lambdas" to reduce costly aggregation. Instead of using, say, 165 OC-192 lambdas, Corvis could use 660 OC-48 lambdas or just as easily (and less expensively) thousands of lambdas with even lower TDM (time division multiplex) rates. Connecting end users via circuits using thousands of colors of light was Corvis's original network model and it will now need it to succeed; otherwise access costs might sink the company. Until true broadband hits the U.S. market en masse, gambits like the recent launch of the Broadwing Media Services Network will not succeed unless edge costs are controlled. But for Corvis, communications is not a commodity. It is a vertically itegrated service differentiated by speed, capacity, openness, and latency.

Smart people are the real commodity

So what about the Smart People vision from the Isenberg conference? Will all-optical-networks bankrupt the industry? The usual response to Googin and Isenberg is that telecom will contrive content-conduit plays like the cable industry and reap profits from broadband content. This is exactly the wrong answer. Content and conduit are naturally separate. If you have the best content, you want it on everyone's conduit. If you have the best conduit, you want everyone's content on it. Companies like AOL-Time-Warner and AT&T/TCI that try to combine the two products become schizoid and fail. There are absolutely no synergies between creating attractive and original content and building powerful and available broadband networks. As soon as true broadband conduits are deployed, the cable industry will face devastating content competition from Google, Yahoo, **Movielink.com**, **eBay** (EBAY), Microsoft, and a host of others. IP TV is on the way and it is just as devastating to the TV establishment at IP telephony is to the telecom establishment. Using a combination of storewidth administered by personal video recorders and tapping into real video-ready broadband as it becomes available, customers are going to take over the role of choosing the sources of their entertainment, education and news and deciding what ads they will see and when.

The breakdown of cable's content-conduit strategy, however, is no more destructive to the future of cable than the breakdown of the monopoly voice strategy is ultimately destructive to intelligent telcos. Already the most profitable product in cable, according to a cogent report from analysts at Needham, is not their pathetic TV content with its endless clutter of ads and spam but their dumb pipe: their Internet near-broadband service. The leading product in telephony as of this year is wireless. Despite all the Doomsday Adventists at the Edith Macy Center, communications continues to offer tremendous opportunities for profit in coming years. For all their brilliance, Googin, Isenberg, and their followers, including the gaggle of municipal fiber pushers and WiMax speculators, make a fatal error. They assert that bandwidth is a commodity. But in fact bandwidth is a dynamic technological industry advancing at a tremendous pace but still failing to supply anywhere near the services that people want at prices that they can pay.

A commodity is an undifferentiated product available anywhere at a competitive price. Content is obviously not a commodity. Every film, news show, interactive game, bulletin board, and journal is different. But neither is bandwidth a commodity. Communications is a costly service, differentiated by throughput in bits per second, by peak capacity, by locality or ubiquity, by openness and accessibility, by latency or delay in milliseconds, by jitter or unevenness of transmission, by degrees of mobility or portability, by robustness or reliability, by provisioning speed and quality of service. I could go on. If bandwidth were a commodity, like electricity or water or flour, you

could buy it by the bits per second. You could get one megabit per second for $4.95 and five megabits for $24.95 and fifty megabits for $125. **Cogent** (COI) could have succeeded in delivering 100 megabits for $100. Even backbone bandwidth, though admittedly abundant, is not a commodity, despite all the efforts to make it one. It varies over many dimensions of reliability, latency, and speed.

For end users, the only significant users, the best combination of bandwidth characteristics is currently offered by **Qualcomm**'s (QCOM) EvDO (evolutionary data only) service chiefly available in the U.S. in Washington, DC, and San Diego. In the U.S., the so-called wireline commodity "broadband" product cannot even compete in features with wireless services going for $85 per month. This does not mean that Qualcomm will dominate the television industry. It means that the current optoelectronic Internet conduits are nowhere near the point where they can be modularized and commoditized by some Federal policy, municipal spec, or government run seven-layer standard.

Internet or layered cake?

Potentially compounding the mistakes of telecom regulation and business analysis is the new "big idea" from the likes of Googin, Isenberg, former FCC authority Kevin Werbach, and Stanford law professor and technology author Lawrence Lessig. The idea is mandated "open access" to the logical layers of the network, and it is embodied in a new legislative proposal by MCI, "A Horizontal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model." Barely recovering from the FCC's TELRIC and UNE-P "open access" mandates that chopped up and assigned ownership rights to the physical infrastructure—the hardware—of the Net, we now face the prospect of rigid reassignment of content, applications, services, and protocols, too. Call it soft open access.

Worried that cable TV companies or the Bells might seek to leverage their broadband networks by wrapping content into their conduits, or that Microsoft might keep "tying" new applications into Windows, or that Google might monopolize information on the Net (yes, there is already an organized effort to turn Google into a public utility), MCI's layering proposal defines rigid boundaries between content (voice, text, video), applications (email, browsers, VoIP), protocols (TCP/IP, HTTP, FTP), and infrastructure (wires, switches, spectrum, PCs, handsets). In a paper entitled "Codifying the Network Layers Model," MCI proposes to "quarantine" major providers of one of the layers within that layer, and to prohibit them from vertically integrating into another layer unless they offer wholesale open access to all competitors. Lessig, MCI, and company worry that the "end-to-end" nature of the Internet—its inherent modularity, in which the core is dumb and any smart device can be attached at the edge—will be threatened if these new layering rules are not adopted.

Layering proponents, however, make a fundamental error. They conflate rough rules of business strategy with top-down laws governing highly dynamic industries. They ignore ever-changing trade-offs between integration and modularization that are among the most profound and strategic decisions any company in any industry makes. They disavow Clayton Christensen's theorems that dictate when modularization, or "layering," is advisable, and when integration is far more likely to yield success.

Metaphors from the Telecosm help explain the fluid nature of these layers that MCI wants to preserve in concrete. Consider Corvis; it blows apart the MCI approach on several fronts. First is CEO David Huber's architecture of an all-optical network, devoid of electronic regenerators and protocol readers, which unites content and conduit by using colors of light both to bear the message and to determine the path of the circuit. It radically collapses the top layers of the OSI (Open Services Interface) stack used in the SONET voice networks of the past, not so much redefining the interfaces as transcending them. In uniting Corvis, a cutting edge equipment provider, with Broadwing, an infrastructure builder and service provider, Huber is also betting that IP networks are not inherently modular, where equipment from a thousand providers can easily be cobbled together to deliver high-bandwidth, low-latency services, but that network are still in fact in an era of undershoot where an integrated provider can deliver a superior product at a much lower cost.

Our favorite digital chip company, **EZchip** (LNOP), also blows away the idea that the layers of the Net can always be defined and "quarantined." Where until now data flowing through the seven layers and numerous sub-layers were parsed and modified by a gaggle of hundreds of chips connected by thousands of wires and glue-logic galore, EZ puts all seven layers of the OSI stack onto one-chip, performing all the essential functions of an Internet router on a single sliver of silicon. The "layers" are once again transcended when EZ's software tools allow programmers to tell the chip what to do without even referring to the rigid layers, channelizations, protocols, and interfaces used in the previous software environment. Is this fair? Should EZchip be allowed to invade someone else's turf, perhaps that of **Cypress**'s (CY) high-end content addressable memories (CAMs) or **Broadcom**'s (BRCM) Silicon Spice communications processors? Or to blow apart someone's whole field, like EZ could one day do to the many providers of comm ASICs, or to Internet router king **Cisco** (CSCO) itself?

It does not take a cynic to see that MCI and company are once again targeting their competitors—the Bells and cable companies—in the political arena instead of the legitimate arena of business. They cannot wait to deploy new teams of FCC horizontalawyers and IPolice.

But if the proposals are meant as anything more than political lobbygagging of rivals, if the proponents really mean their model legislation as a principled, generic set of rules, then we must consider the logical consequences. If applied dispassionately, how would such general rules affect the Internet and technology industries?

Should Google be able to leverage search into Gmail, or to supply content using its proprietary algorithms and physical network of 100,000 servers? Shouldn't any rival search provider be

able to feed off of Google's advanced infrastructure? After all, wouldn't it be impossible to recreate Google's massive web of global intelligence? Doesn't Google's superior infrastructure exhibit "market power"? Might Google actually evolve into a general provider of web-based information management services, rivaling the PC-based Microsoft, or should Google be "quarantined" as a search provider? Or maybe we should structurally separate Google into three companies: an infrastructure provider (its 100,000 networked servers plus algorithmic IP), a content/advertising company, and an information services company (Gmail plus future knowledge management applications). Surely FCC bureaucrats can make these easy distinctions and explain the resulting penalties to weary entrepreneurs who have just spent 10 years of their life building a new service that people really like.

Should **Sony** (SNE) be able to demand that its PlayStation gamers get access to Microsoft's Xbox Live online video game network? Should **Amazon** (AMZN) be able to aggregate and make searchable the text of hundreds of thousands of books? Should Sprint PCS or Verizon Wireless be allowed to develop specialized content delivery platforms or applications that take advantage of their superior wireless data networks?

What if Equinix succeeds in becoming the overwhelming meeting place (peering point) for the world's network, e-commerce, and content providers? Network economics suggest the concentration of all the largest Internet players in Equinix facilities is possible, or even likely. If Equinix achieves such "market power," are we to assume that other "virtual data centers," like the CLECs before them, could force Equinix to "open up" its hosting facilities so that the new virtual competitors can offer services over infrastructure they did not build?

What about Microsoft integrating easy-to-use voice-over-IP software into its next operating system? Should Microsoft rival Real Networks be barred from aggregating music and video for download with its RealPlayer multimedia suite? All of these are, to one degree or another, inter-layer integrated products and services.

Proponents of "layering," or "Net neutrality," or a free Internet "commons," assume there is one network, that it is sufficient and timeless, that no new networks are possible or needed. They want innovation on the edge, in the form of software apps and WiFi attachments. Innovation in the core is either assumed or ignored. The logical conclusion, however, is that since the "best network"—the free commons—cannot make any money, there will be no network. And just how much innovation at the edge will there be if there is no innovation—no bandwidth—in the core?

MCI's "horizontal leap" asks authorities to pursue vigilantly those who would exploit "network choke points" or take advantage of "network effects." In industries where "entities seek to obtain market power" (i.e., seek to make money in a business enterprise), policymakers need to ensure four things: "open architecture, open access, universal access, and flexible access." When imposed by regulators or courts in a national capital, these four euphemisms boil down to one hard reality: socialization and micromanagement of the "architectures" and "access" networks built by others.

The ability to tie and merge and break apart and outsource products, services, and technologies are the very stuff of business. As is the decision how to price these products and services. Some services will be free, loss leaders to leverage the purchase at another point of sale. But the entire system cannot be free.

The companies that enable an integrated broadband world will be able to charge for it during the years that they provide the optimal service. Their initial margins will be high. When communications becomes a commodity, as it eventually will, the margins will drop. This is not a catastrophe. No one has a right to high margins for a commodity service. But the telecosm is still an arena of innovators, such as Corvis, EZchip, Qualcomm, **KDDI**, Verizon Wireless, **Essex** (KEYW), **Advanced Fibre Communications** (AFCI), **Agilent** (A), and hundreds of others, who will enjoy large monopoly rents until their inventions are standardized and commoditized and the leading edge moves elsewhere.

The telecom industry is nowhere near some mythical paradox of perfection or cul de sac bargain basement of commoditization. It is still engaged in a thrilling adventure of putting together worldwide webs of glass and light that reach from your doorstep or teleputer to every other person and machine on the planet. It is long distance and it is local, it is packetted and circuited, it is multithreaded and aggregated, it is broadband and narrowcast, all at once. These crystal palaces of light and air will be hard to do and the world will reward the pioneers who manage to build them. The real orchestra on the Titanic is not the communications industry and its suppliers, but the premature modularizers and commoditizers, the proponents of the dream of some final government solution for the uncertainties of all life and commerce.

– George Gilder and Charles Burger

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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