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COSMIC CROSSING REDUX: THE BEST OPPORTUNITY OF 1998...1999...

Who would have thunk it. **Global Crossing** (GBLX), our "best opportunity of 1998," has become also the best opportunity of 1999. You might call it cosmic slippage for the Bermuda based Telecosm star that every month or so announces new records for fast deployment of undersea bandwidth and then, lately anyway, surfaces only to see its share price heading for the same depths as its cable.

Since we first touted GBLX last November, the company has moved to buy **Frontier**'s (FRO) 20 thousand route-mile fiber network and 160 Global (Internet hosting) Centers. It has acquired the Global Marine armada of fiber trawlers and submersibles that builds and backs some 35 percent of the world's undersea cable miles. It doubled the capacity of its Atlantic Crossing 1 cable for less than 10 percent of the original construction price, fully funded construction of its global network, and sold bandwidth more than twice as fast as contemplated in the original business plan. It is ahead of schedule with its Pacific Crossing, MidAtlantic Crossing and Phase 1 of its European Crossing, projects all scheduled to open for business this year and all with substantial pre-booked sales. All of the originally planned 88,000 kilometer network is funded, 14,000 km is in service and most of the rest is under contract for construction. So naturally some $16 billion in market cap is missing in the Bermuda Triangle.

The bandwidth glut is not a threat to the Telecosm, it is the basis for it. It's not the glitch in the business plan, it is the business plan.

Special Telecosm Update
the latest on

Global Crossing, Metromedia Fiber, Sprint PCS, Java, Sun Microsystems, P-Com, @Home, Terayon, AMCC, Atmel, SiGe, Frontier, AboveNet, Anadigics, Bandwidth Glut, Level 3, Netro, M/A-Com, and more...

As we write the company has announced a new joint venture with **Microsoft** (MSFT) and Japanese Internet giant **Softbank** to form East Asia Crossing. Under GBLX direction and majority ownership, the new venture will construct a 17,700 km East Asia network linking Japan, China, Singapore, Hong Kong, Taiwan, South Korea, Malaysia and the Phillipines, and hook into the GBLX global network via its Pacific Crossing landings in Japan.

This latest news may ease the gloom somewhat, though over at the Telecosm Lounge the mood has been pretty cheerful all along (as it tends to be). Paradigms open eyes for buying opportunities. Yours truly hasn't been purchasing anything much else, except physics books (and the lattes needed to read them). I can report that buying GBLX is easier than figuring out the intricacies of wave theory, or fathoming how many angels the optics dot coms can lase on lambdas, or lure to their boards of directors, before selling out secretly to **Cisco** (CSCO).

Still, to play the paradigm, you do not have to throw all your cash into the ocean and wait forlornly on a widows walk, or even dance until dawn on a Bermuda beach during hurricane season. The paradigm is also bursting out all over terrestrially. **Metromedia Fiber Networks** (MFNX) was already flying high when we cited it alongside **NorthEast Optic Network** (NOPT). A dark fiber pioneer, Metromedia was the first customer for Lucent's 864 fiber cable. A leading proponent of selling bandwidth by the wavelength, Metromedia and its shares have tumbled back into investment reach. Meanwhile the company has added to its portfolio AboveNet, the Internet hosting accelerator that recently hired the already accelerated Avi Freedman to manage its network as an open market system of hubs for bandwidth among ISPs

Now part of MFNX, AboveNet gives a new edge to the world's most innovative dark fiber strategy.

(Internet service providers) and ASPs (application service providers). Like **Akamai** and **Sandpiper**, two rivals in network acceleration, AboveNet offers a special algorithm that channels all packets to the fastest network paths in real time. But unlike its rivals, AboveNet is part of the world's most innovative dark fiber strategy. All these netcelerator companies are surging into the role of optimized Internet provider previously dominated by **@Home** (ATHM) in the cable space.

One of the shrewdest engineers on the net, Freedman was the star of several *ForbesASAP* Telecosm articles. Now he will be a star of Metromedia Fiber. With 267 peering agreements (compared to 72 for UUNet, for example), with command of the Palo Alto network access point (NAP), with such customers as Microsoft MSN Hotmail and Netscape, and with dark fiber from Palo Alto to Pennsauken (the East Coast NAP), AboveNet finally will provide an arena rich enough to keep Avi levitated.

Sprint PCS does data

From the beginning, we have declared that CDMA (code division multiple access) would prevail in wireless because of the superiority of CDMA's shared spectrum channels in dealing with bursty data transmissions. Now **Sprint PCS** (PCS), long the spearhead of CDMA services, has bolted to the head of the wireless crowd with a devastating data play. Rolling out across the nation this month is wireless access to the Internet for anyone with a smart phone bearing a **Phone.com** (PHCM) browser (previously known as Unwired Planet), a Palm VII organizer, or a new **NeoPoint** phone with a Palm on board. All bear Java virtual machines that give these diverse devices the capability of swapping programs and wapping (wireless application protocol) web pages back and forth, as was riotously demonstrated at the Java One Woodstock at Moscone Center last month.

The new phones will also double as wireless modems for notebook computers. Beginning at 14.4 kilobits per second for compressed pages, these links will soon be raised into possible megabit rates by **Qualcomm**'s (QCOM) heralded but heavyset pdQ (Sprint will buy some $400 million worth of Qualcomm phones). Sprint is the leader in this CDMA data race. In close pursuit is Airtouch, the recent **Vodaphone** (VOD) acquisition that promises to bring the benefits of CDMA data to Europe where until recently it was regarded as a serious breach of continental manners.

Meanwhile, silicon germanium (SiGe), our paradigmatic up spectrum semiconductor material, is emerging as the key element in scores of breakthrough communications chips from **IBM**, **AMCC** (AMCC), and **Atmel** (ATML). **Anadigics** (ANAD), a gallium arsenide (GaAs) leader and the smaller **M/A-Com**, have finally given up on their previous assumption that Germanium is merely a technologically backward European country. Now partnering with Atmel for an array of new SiGe telecom devices, they are the first gas guzzlers to go germanium. According to our Jeff Dahlberg, SiGe's triumphs have just begun as SiGe chips are clearing speeds of 100 GHz in the lab, obliterating much of GaAs' former speed advantage. At the same time, our analog model is gaining ground. **Analog Devices** (ADI) and **National Semiconductor** (NSM) are offering upside surprises, with Analog Devices announcing a tsunami of orders from communications vendors, and National announcing earlier than expected profits. Combining analog and digital capabilities, these companies are well positioned for the onrushing future of single chip systems.

German Sun?

Most of these technologies call upon Java, which brings us to the rise of the German Sun. For the last two years, under prompting from Star Division founder Andreas Bectolsheim, **Sun** (SUNW) has been using the company's Star Office productivity suite. As Scott McNealy jibes at Microsoft, Sun's share price has been soaring ever since he banned Powerpoint and adopted Star Office. He liked it so much he bought the company.

After a Brobdingnagian bash at Moscone Center, with 20 thousand Java celebrants and 800 speakers, Sun barged out of the closet last month with their Deutsche prize and targeted the Java oriented Star suite at Microsoft. Sun announced that it would offer the programs for free. Perhaps, some observers remarked, **Dell** (DELL), IBM, and **Gateway** (GTW) will find the price is right for bundling in low-end machines. But this is merely an inkling of the story.

A robust suite that commands 20 percent of the German market, nearly all the expanding Linux market, and has been ported to various brands of Windows, Unix, and Solaris, Star Office is fully compatible with MSOffice document file formats and user interfaces. Steven Ballmer of Microsoft has blustered about offering Office on similar terms, but surely he realized the emptiness of his threat. Microsoft makes some 40 percent or more of its profits from Microsoft Office programs.

Planning to make Star CDs as astronomically available as **AOL** (AOL) disks of yore, Sun will also offer the Star suite over the net, using a Star Portal system based on Java. Following the pattern of free email, fax, and instant messaging schemes offered by Microsoft over the net, Sun will extend the freeware scheme to the very heart of the Microsoft empire: productivity software. A set of icons on your AOL or other browser will allow you to call up always updated word processing, spreadsheet, graphics, and presentation programs as you wish, cutting substantial chunks out of IT desktop annual maintenance budgets that typically exceed the cost of replacing every PC in the company. Meanwhile, Microsoft was planning to harvest up to $700 per computer for the move to a new Office suite, afflicted with baroque filigrees of over-rich features and rain-forest green

with plentiful new species of bugs.

As I wrote several times over the last three years, checkmate Java. This is it, folks, the Java consummation that many of us have been waiting for. Microsoft will never be the same again.

Fiber Glut?

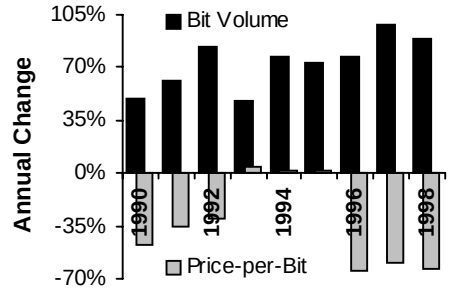
Summer is over. Some stocks are dimming. Some subscribers are down. Gloom spreads everywhere with rampant rumors of the fiber glut, a gluteus maximus sitting on Telecosm stocks.

The Bandwidth Bloat Blues play everywhere, like the big summertime hit at a teenage beach party, mindless but impossible to get out of one's head. Even my own beloved GTR Forum (www.gildertech.com) writhes and wriggles with bandwidth glut anxiety. GBLX! **Level 3**! (LVLT) **WorldCom**! (WCOM) NOPT! **Corning**! (GLW) **Lucent**! (LU). We are drowning in fiber. There is too much bandwidth! Who is ever going to buy the stuff?

What do you mean, you don't have too much bandwidth? You like the stuff? You want more, cheaper? Think you can use all we can throw at you? Well, you know buddy, if you're not part of the solution you are part of the…

Chart 1

DRAM's 1990s Average Annual Price Drop of 33% Resulted in 73% Bit Growth



Source: IC Insights

The key to economic dominance in any era is to identify the key abundance that defines that era and then fully exploit it to gain market share. How do you identify the defining abundance of the era? It is the crucial resource whose price is falling faster than all others, plummeting so quickly in fact that it is, at the margins, virtually free.

In the industrial age the defining abundance was physical force, motive power. In the course of that era the cost of an effective kilowatt hour dropped from thousands of dollars to about five and one half cents today. The key to success in that era was to "waste" physical force, substituting it whenever possible for more expensive and scarce resources such as manpower.

In the computer era, the critical abundance was transistors, tiny silicon switches. Thirty-five years ago, a chip factory could produce a few score transistors a day for an average of some $7 apiece, with support circuits. Today, a single production line in a microchip wafer fabrication facility can produce some 1.6 trillion transistors in twenty-four hours. This year wafer fabs will produce some 50 thousand trillion transistors, each nearly as cheap as the beach sand of which they are made.

Yet most of us never worry about a transistor glut, any more than in the industrial age men lamented the "power glut." The only occasional wails emanate from less efficient producers who trek to Washington, or Brussels, to spin tales of glut-wrenching foreign rivals who plot to enrich the rest of us by "dumping" their transistors in our markets below cost.

In the era of the Microcosm many of these transistors were used to compensate for a shortage of broadband communications capacity, billions of chips devoted to making our telephone switches, modems, faxes, and "fast" Internet links function over narrowband telephone wires. It was in response to this basic problem that the transistor was invented at **AT&T**'s (T) Bell Labs.

But now the age of the Microcosm gives way to the Telecosm. The practice of substituting cheap computing power for costly communications connections is reversing itself, and upending the entire structure of the information economy, to take advantage of the new canonical abundance, aka the bandwidth glut. The availability of bandwidth is increasing by a factor dwarfing Moore's Law, doubling not every 18 months, but every three or four months.

Next year or next month some optical magician will put a thousand wavelengths on a single fiber, ten billion bits of information per second on each wavelength, and as many as 864 fibers in each fiber cable. This adds up to a total of 8.6 petabits per second in a single fiber sheath.

Eight petabits per second is a thousand times the total average telecommunications traffic across the entire global infrastructure as recently as 1997. Eight petabits represented the total Internet traffic in 1995, per *month*.

Yet demand, as measured by, say, the doubling of Internet traffic every four months, has kept pace with every supply-boosting innovation and price cut. Say's Law–supply creates its own demand–is always most literally true for an era's defining abundance. Demand asymptotically approaches infinity for the critical resource whose collapsing price–asymptotically approaching zero–requires that it be substituted for all other resources when feasible.

Thus demand for the defining abundance always shows extraordinary elasticity–elasticity being that blissful state in which every drop in price so pumps up demand that revenues actually rise. In a paradox of productivity, the greatest rewards go to the producers who push their own prices down the fastest.

In DRAMs the elasticity of demand is usually estimated at about 1.5, meaning for every one percent drop in prices, you get a one and a half percent increase in revenues, an extraordinarily powerful factor. The same number is sometimes cited for bandwidth, but I believe the elasticity for bandwidth will prove

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The declining cost of bandwidth is no more a problem for GBLX than declining transistor prices were a problem for Intel.

much greater than that, since the current number is based on experience in the regulated system with all its access bottlenecks.

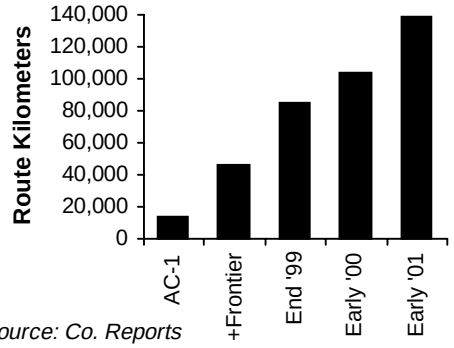
In short, the bandwidth glut is not a threat to the Telecosm, it is the basis for it. It's not the glitch in the business plan, it is the business plan. The declining cost of bandwidth is no more a problem for GBLX, Level 3, and others positioned to profit from the new abundance than declining transistor prices were a problem for Intel.

Many companies of course will not survive the transition to the new era, and those that dominated telecom before the Telecosm will have an especially difficult time. Leaders of the computer era, their legacy networks and legacy leadership will impel them to persist in the old regime of wasting switches and computer power and conserving bandwidth and connections. Constitutionally unable to exploit the new abundance, they will decry it as a "bandwidth glut" and claim their rivals are "dumping" the "commodity" at "predatory prices."

Trying to escape the commodity game, they will tangle their networks in ever more complex quality of service pretzels, knotted with ever more expensive electronics and computing power. Moving toward high margins, they will marginalize themselves, forgoing all the phenomenal elasticities in the business.

Chart 2

Global Crossing Network to Grow Ten-Fold in Three Years



Source: Co. Reports

These same elasticities will keep revenues flowing to the companies, like Global Crossing and Level 3, who can continue to increase supply at seemingly self-defeating rates. Demand for bandwidth will keep pace with even the wondrous advances in optical networking equipment created in the labs of **Ciena** (CIEN), **Nortel** (NT), and Lucent, which Cisco seeks to emulate with its $7.34 billion foray into optical networking. And with increasing movement of passive optical fiber systems to offices and homes, demand for fiber will outstrip even the 50 percent increase in Corning's North American production capacity.

There will be volatility in both supply and demand as technology in long-haul backbones, metro markets, or last mile access variously advances in fits and starts. But fueling demand will be the always unexpected leap that makes the last mile scarcity of today the new defining abundance for **Nextlink** (NXLT), **Teligent** (TGNT), **Netro** (NTRO), or companies and persons as yet unknown.

GBLX, Poster Child

Global Crossing retains all the advantages it held when I first celebrated it as the best investment of 1998, and more besides. Brilliantly choosing the critical missing link in the Telecosm, the undersea connection between the U.S. and the ever more global Net, and focused on speed by $2 billion in junk financing, GBLX then seemed full of paradigmatic promise. Today it could be the Poster Child for Promise Keepers.

It laid Atlantic Crossing 1 faster than any Atlantic cable project in history. Now it has completed the upgrade, doubling capacity to 80 Gbps, 18 months ahead of the original upgrade plan, and will add at least another 60 Gbps by March of next year.

Most crucially AC-1 is vindicating the first phase of the business plan. Surging demand from European Net users, whose growth in activity now outpaces the U.S. (see GTR July '99), is driving sales. To date GBLX's revenues have been derived primarily by selling Indefeasible Rights of Use (IRUs) to bandwidth, typically denominated in 155 Mbps STM-1 units. When AC-1 opened for business in May 1998, at its original capacity of 40 Gbps, 256 such units were available, with the upgrade to 512 scheduled for early 2001. But 80 percent of the units sold out in a little over a year, forcing the first upgrade to be accelerated.

So why has the stock fallen, at this writing, by more than 60 percent from its 12 month high and to below the "collar" price originally required by the terms of the Frontier merger? (The merger will now proceed on a simple two for one swap.)

Some of the gloom surely arises from the Street's M&A equivalent of all sports talk radio, in which not getting **U.S. West** (USW) is scored as a "loss," rather than a gutsy refusal by Chairman Gary Winnick to be suckered into a price war with **Qwest** (QWST).

Other gloomsters have been wailing about Frontier's bad earnings news resulting from the relentless pressure on long-distance voice prices. So what else is new? Any business plan premised on wireline voice revenues is doomed. This is news only to telco types who have spent too much time whistling past graveyards in 3 kilohertz tones. Fortunately GBLX's plans for Frontier have little to do with voice revenues, as Bob Annunziata reaffirmed in a recent paradigm-peppered address relegating voice to the status of an inexpensive "threshhold" service, "quite possibly a loss leader" for data and video.

Frontier's state of the art terrestrial fiber network, much of it running IP (Internet protocol) directly over WDM (wavelength division multiplexing), and its chain of internet server hubs, are a perfect match for a company premised on the explosion in overseas Net traffic. Linking Frontier's huge server

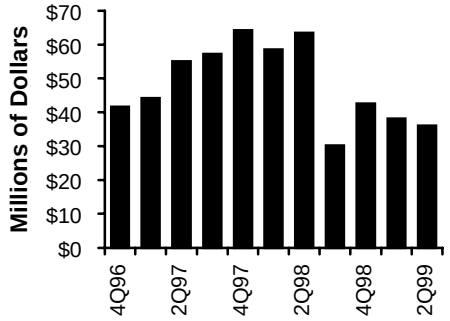
farms, which house some 300 of the top 500 web sites, directly to the GBLX global network can drastically reduce the number of hops on a typical Internet connection from more than 15 to two or three, reducing access time accordingly. For intercontinental Net traffic especially, the Frontier connection makes GBLX even more attractive. Far from a long distance distraction the Frontier acquisition is brilliantly focused.

We are left with fiber glut panic as the only other explanation for the share price slide, though even the dimmest of analysts should have seen that undersea fiber–currently consisting of a pipette less than 5 percent as large as the terrestrial fiber hose–remains a critical scarcity.

True, even undersea, bandwidth prices are dropping rapidly. Industry sources estimate the decline at 20 to 30 percent per year, which seems low. But even if the price is dropping twice as fast, here is where elasticities of demand take over. AC-1 cost about $800 million to build, so that at its original capacity of 40 Gbps the first 256 STM-1 (155 Mbps) circuits, cost about $2.8 million apiece. They have been selling on average for close to $3 milllion for a 25 year IRU. At that rate AC-1 is a money loser, after marketing costs and overhead.

Chart 3

P-Com Revenues Continue Decline As Competition Heats Up



Source: Company Reports

But the additional cost of the just completed upgrade to 80 Gbps, doubling the number of STM-1s to 512, was only $50 million, since it was accomplished entirely by upgrading the WDM gear and multiplying wavelengths on the same number of fibers. That makes the marginal cost of the new circuits less than $200,000, less than 10 percent of recent sale prices. And GBLX thinks it can upgrade AC-1 to 1,500 or even 2,000 STM-1s. For AC-2 the math is even more favorable. Since AC-2 will rely on the existing Atlantic loop for redundancy, its construction cost will be only $500 million and it will eventually shuttle some 2.5 Tbps. And as WDM technology progresses the picture simply gets brighter. The cost of provisioning bandwidth becomes progressively less a function of the original construction cost and more of WDM's ability to multiply lightpaths.

Fiber glut analysts are confusing bandwidth sales with dark fiber sales, dropping WDM, the most powerful variable, out of the equation. When a fiber is sold dark, if the price falls below the original construction cost, it's a loser. But GBLX is selling not fiber but proliferating light paths from the constantly expanding magic of WDM.

Selling bandwidth IRUs is currently a very attractive business. The customer pays all the cash up front on a 25 year deal. But because the transaction is more like a condo sale than a long term lease, the buyer assumes "title" to the circuit and bears all the liability in the event Divine forces develop a hostility to undersea installations.

Nevertheless, as the first phase GBLX-Frontier global network falls into place toward the end of this year, the business plan will no longer be premised on IRU sales across an ocean here or there. Rather Global will offer the capabilities of a network with direct connections to every major world city, with the power to connect, say Frankfurt to Tokyo (and both to some of the most capable and capacious Internet server hubs in the world) without the technical muddles or pay toll hassles of having to hand off the traffic to any outside carriers. That end-to-end connection, and especially the undersea links, make GBLX the provider of what Peter Drucker calls "the crucial missing element" that completes a system, to which the largest profits always migrate.

As cable modem providers flirt with regulators and the courts, DSL providers are picking up steam.

GBLX is thus among the most fortunately positioned of Telecosm companies. Like all the other emerging network providers, it is paradoxically powered by the collapsing price of its own product. Over the past three decades it was usually better to be Intel, occupying the relatively high-margin ground of processors around which other components were organized, than to be **Micron** (MU) or **Samsung**, fighting it out below on the windswept, war-torn plains of the DRAM market. But GBLX will benefit both ways, gaining from the relatively resistant margins of companies with "missing link" products and from the fantastic elasticities of demand driving the transition from Microcosm to Telecosm.

The Last Mile

Nothing vanquishes fears of fiber glut more quickly than new progress toward closing the "last mile" broadband gap between the fiber network and the end user.

One of the most promising last mile solutions for the close to 800,000 downtown office buildings is "up-spectrum wireless." With connections to the fiber backbone provided by networks of rooftop or window mounted millimeter wave radios operating roughly in the 24 to 38 GHz range, these systems can run as fast as 200 Mbps, 15 times as much as any coax or DSL (digital subscriber line) link. And the systems can be installed for $5,000 to $20,000 per building (figures that are likely to decline still further) compared to a typical cost of $300,000 for a

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downtown direct fiber connection.

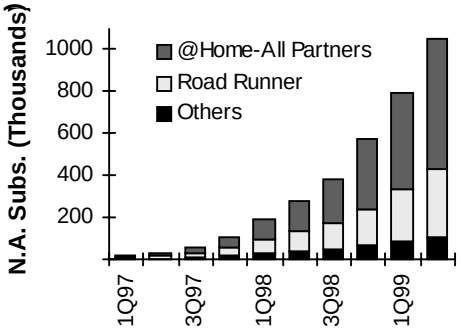
Leading in the use of this still nascent technology are Nextlink, Teligent, **Winstar** (WCII), and Advanced Radio Telecom (ARTT), companies we covered most recently in February '99, and will update soon. But the first Telecosm company in this market was the then ascendant radio maker P-Com (PCMS), launched on the list in November '97. Since then numerous entrants have crowded into the field.

P-Com's early promise prompted WinStar to use P-Com radios for its trial point-multipoint system in Washington, DC, last summer. Point-multipoint configurations (in which one rooftop base station can serve many surrounding buildings) are by far the most challenging. In December, the DC WinStar network went commercial, and WinStar subsequently announced that it would begin deployment in other markets. It hasn't yet. Despite securing WinStar as an early customer, and an alliance with **Siemens**, P-Com's sales have been in decline for well over a year.

Other radio manufacturers leaping into the breach include **Triton Networks**, of Orlando, which is proposing consecutive point-to-point radios in either a SONET (at 155 Mbps) or a Fast Ethernet (100Mbps) ring. The company is developing a radio to transmit at OC-12 (622Mbps) early next year, and is also working on Gigabit Ethernet transmission. Triton's radios are being tested by Nextlink and Advanced Radio Telecom which is using Triton gear in a successful San Diego trial that will go commercial later this year.

Chart 4

@Home Leads Among US and Canadian Cable Modems Services



Sources: Company Reports, Kinetic Strategies

Aiming to reduce the price of receivers by 50 percent or more–to some $500–is **Millitech** in Massachusetts, which is working with **Hughes** (GMH), **Newbridge Networks** (NN), **Marconi**, and **Formus Communications**. Pursuing major market opportunities overseas, the company is operating some 60 deployments (most for beta testing) globally.

The most interesting new kid on the block, though, is **Netro** of San Jose. A recent IPO, Netro also is working with Siemens, and their radios have been chosen for Lucent's OnDemand point-multipoint radio network now being used by ART in Oslo, Norway. The Netro radios are running flawlessly according to Ron Olexa, CTO of ART.

One brand new startup, **Internet Wireless**, is proposing to use CDMA in point-multipoint radios.

This still murky picture should clear up abruptly later this month, when Nextlink, the in LMDS spectrum leader which recently piled up a warchest of nearly $3 billion, is expected to announce its technology choices.

@Home Talkin' Trash

Alas, we have a Telecosmic exit scene this month, courtesy of @Home, once the repository of our hopes for consumer broadband access. Founding technologist Milo Medin planned to provide a fast Internet with caching and backbones for express delivery of the most desired content. By most accounts this side of the @Home plan has been an impressive success. But this "parallel Internet" of fiber and caching servers lured the company into the realm of proprietary content. This is treacherous ground for a conduit provider, inevitably tempting it to use its control of the conduit to charge customers for bundles of content they would not otherwise purchase. Now the merger with Excite, and efforts to develop advertising income, have left @Home fatally straddling the content/conduit divide.

Dramatizing the perils of content, the company recently completed an embarrassing road show promoting @Homes' "Talkin' Trash Live With Lola Pandora," an Internet chat-based talk fest aspiring to the heights previously scaled by Jerry Springer.

Even the positive news of an improved Excite@Home search engine architecture for cataloging every byte of the Web, was marred by an itch to manage and molest content. Excite@Home plans "to identify top quality Web content and to boost its visibility in a search results page," for which alas read "Excite@Home produced content."

AT&T CEO Armstrong's bold admonitions at the @Home board meeting to divorce the company's contents from its conduits were met only by additional forays into content, with @Home announcing investments of up to $100 million or more in **tickets.com** and a half dozen other content providers. Medin's telecosmic technology has brought @Home over 20 cable provider agreements giving it access to a majority of North American homes and has brought customer satisfaction ratings to 96 percent. But fresh from triumphs at Silicon Graphics, CEO Tom Jermolak is jeopardizing @Home's future and ATT's as well.

Terayon opens access

One dire consequence of @Home's muddling of content and conduit may be to provoke the regulators into mandating "open access" cable, under which cable companies would be required by law to allow any ISP to use their customer connection. At a time when broadband two way cable is still an

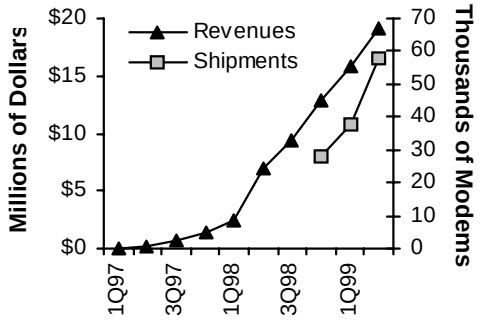
embryonic technology, entrance of mayors, congressional beadles, and other litigious kibitzers would halt progress in its tracks and ironically prohibit the real explosion of open access that would be achieved by a broadband Internet over cable–incidentally making obsolete cable television altogether.

Nonetheless, over time pure conduit companies would inevitably go open access, allowing their customers the broadest possible choice and charging the new generation of ISP's for the privilege. But as a content provider, Excite@Home was bound to resist AOL's bid to use @Home's pipes, boosting the profile of an issue that now has lawyers salivating from one Washington to the other.

Poised to profit from open cable, however, is Telecosm favorite **Terayon** (TERN), which practically owns the Canadian cable modem market, where open cable has now been mandated without the endless briarpatch of cretinous litigation in hundreds of cities and courtrooms familiar over the decades of US cable regulation. Terayon's S-CDMA technology spares it from the complications TDM modem makers face in developing elaborate schemes to allocate separate time slots in each Internet data channel to competing ISPs. Also burnishing TERN's already bright prospects was the September 2 certification of Terayon's new TeraJet cable modem as DOCSIS 1.0 compliant, bringing Terayon fully into the fold of CableLabs certified vendors.

Chart 5

Terayon Shipment Acceleration Powers Revenue Growth



Source: Company Announcements

AMCC delivers on SiGe

We began reporting on Applied Micro Circuits a year ago because of their commitment to develop high speed networking chips in silicon germanium (SiGe). SiGe chips can operate at higher frequencies than pure silicon, but benefiting from the learning curve for silicon–the best understood manufacturing material in the history of the world–are far easier and cheaper to fabricate than the gallium arsenide (GaAs) chips that have dominated the high frequency market. Compared to GaAs, SiGe has lower power requirements, allows higher levels of chip integration, and operates at lower temperatures, making it ideal for handheld devices (which cannot hold fans or liquid nitrogen cryogenics).

The company has delivered on its promise, leveraging its coveted design expertise with SiGe technology licensed from IBM to create the S3060, a high performance transimpedence amplifier (TIA), a critical component in the optical receiver chain. This single-chip solution was the first in a line of planned SiGe products from AMCC which will target the major telecom switch and router companies for use with both WDM and TDM (time division multiplexing). The licensing agreement also includes access to future developments in SiGe processes and libraries giving AMCC's development teams advantages in speed, performance, and price.

Stretching its lead over the field, AMCC has just announced two more SiGe products, a clock rate and data recovery unit (CDR), which is a circuit protection and restoration device, and a high-speed differential crosspoint switch, instrumental in expanding the switch fabric in the network core, enabling larger switches.

SiGe gets up to speed

The SiGe floodgates have opened. **Motorola** (MOT), Lucent, **Infineon**, **AMP**, and even GaAs prodigy Anadigics, all have major SiGe projects. SiGe designers and designs, many of the most coveted reposing at AMCC, have become hot. We were surprised to find silicon germanium dismissed in a recent technology newsletter featuring GaAs. There was a speed difference between the two materials, but the gap is closing rapidly as experimental SiGe circuits have achieved speeds of nearly 100 GHz. AMCC is confident in its plans to use SiGe in the next generation of optical chips running at 40 Gbps, which requires at least 80 GHz of chip speed.

Privately held **SiGe Microsystems** of Ottawa, an early enabler of silicon germanium with much of its own intellectual property, has assumed a larger role after capturing a group of radio frequency (RF) system designers from Nortel. More aware than most of the huge opportunity that SiGe represents, the company has begun fabricating RF components and power amps with some of the lowest phase noise in the industry. With speeds of up to 15 GHz, and targeting Blue Tooth and CDMA applications, the company's components may be soon competing in the millimeterwave range.

Wait a minute! This special update issue isn't over. Ranks of Telecosmic titans, Crowe and Ebbers, McCaw and Kalkoven, and other aspiring paradigmatic prodigies have yet to be heard from. Some bandwidth glut this is! What's that? Paper fibers are not a defining abundance? We're out of ink? But not out of news. See you on the Telecosm Forum–(www.gildertech.com).

George Gilder, September 10, 1999

One dire consequence of @Home's muddling of content and conduit may be to provoke the regulators into mandating "open access."

TELECOSM TECHNOLOGIES

ASCENDANT TECHNOLOGY	COMPANY (SYMBOL)	REFERENCE DATE	REFERENCE PRICE	AUGUST-99: MONTH END	52 WEEK RANGE	MARKET CAP.
CABLE TECHNOLOGIES/SERVICES						
Cable Modem Chipsets	Broadcom Corporation (BRCM)	4/17/98	12 *	128 3/4	23 1/2 - 149 1/2	12.78B
CDMA Cable Modems	Terayon (TERN)	12/3/98	31 5/8	36	7 - 60 1/2	0.699B
MICROCHIP TECHNOLOGIES						
Analog, Digital, and Mixed Signal Processors	Analog Devices (ADI)	7/31/97	22 3/8	51 1/2	12 - 52	9.28B
Silicon Germanium (SiGe) based photonic devices	Applied Micro Circuits (AMCC)	7/31/98	22 11/16	92 1/2	12 1/4 - 99 1/2	2.54B
Programmable Logic, SiGe, Single-Chip Systems	Atmel (ATML)	4/3/98	17 11/16	39 5/16	6 - 42 7/16	3.73B
Digital Video Codecs	C-Cube (CUBE)	4/25/97	23	27 13/16	13 1/4 - 37 7/16	1.14B
Linear CDMA Power Amplifiers, Cable Modems	Conexant (CNXT)	3/31/99	27 11/16	71 7/8	13 - 75	7.45B
Single Chip ASIC Systems, CDMA Chip Sets	LSI Logic (LSI)	7/31/97	31 1/2	56 3/4	10 1/2 - 59 1/4	8.48B
Single-Chip Systems, Silicon Germanium (SiGe) Chips	National Semiconductor (NSM)	7/31/97	31 1/2	28 3/16	7 7/16 - 31 1/8	4.82B
Analog, Digital, and Mixed Signal Processors, Micromirrors	Texas Instruments (TXN)	11/7/96	11 7/8	82 1/16	22 11/16 - 83 9/16	64.22B
Field Programmable Gate Arrays (FPGAs)	Xilinx (XLNX)	10/25/96	16 7/16	69 15/16	14 7/8 - 77 1/4	11.09B
OPTICAL NETWORKING						
Wave Division Multiplexing (WDM) Systems, Components	Ciena (CIEN)	10/9/98	8 9/16	35 1/8	8 1/8 - 37 7/8	4.86B
Optical Fiber, Photonic Components	Corning (GLW)	5/1/98	40 15/16	66 1/2	22 7/8 - 75	16.24B
Submarine Fiber Optic Networks	Global Crossing (GBLX)	10/30/98	14 13/16	25 7/8	8 - 64 1/4	10.43B
Wave Division Multiplexing (WDM) Components	JDS Uniphase (JDSU)	6/27/97	14 1/2	106 1/16	15 5/8 - 120 7/8	9.72B
Broadband Fiber Network	Level 3 (LVLT)	4/3/98	31 1/4	59 3/4	22 3/8 - 100 1/8	20.42B
Carriers Carrier, AllWave Pioneer, Utility Rights of Way Strategy	NorthEast Optic Network (NOPT)	6/30/99	15 1/16	36	4 3/4 - 40 1/2	0.580B
WIRELESS TECHNOLOGIES/SERVICES						
Low Earth Orbit Satellite (LEOS) Wireless Transmission	Globalstar (GSTRF)	8/29/96	11 7/8	25 11/16	8 5/16 - 33	2.09B
Satellite Technology	Loral (LOR)	7/30/99	18 7/8	18 3/8	10 3/4 - 27 15/16	4.49B
Nationwide Fiber and Broadband Wireless Networks	Nextlink (NXLK)	2/11/99	20 7/16	50 3/8	5 1/4 - 57 11/16	3.91B
Point to Multipoint, Spread Spectrum Broadband Radios	P-COM (PCMS)	11/3/97	22 3/8	4 13/16	2 5/16 - 10 3/8	0.217B
Code Division Multiple Access (CDMA) Chips, Phones	Qualcomm (QCOM)	9/24/96	19 3/8	192 3/16	18 7/8 - 198 5/8	27.08B
Nationwide CDMA Wireless Network	Sprint PCS (PCS)	12/3/98	15 3/8	59 3/4	12 3/4 - 66 7/8	28.36B
Broadband Wireless Services,	Teligent (TGNT)	11/21/97	21 1/2 *	63 1/16	18 1/4 - 75 5/8	3.47B
INTERNET TECHNOLOGIES/SERVICES						
Internet Enabled Business Management Software, Java	Intentia (Stockholm Exchange)	4/3/98	29	22 1/16	17 1/2 - 35 1/4	0.530B
Telecommunication Networks, Internet Access	MCI WorldCom (WCOM)	8/29/97	29 15/16	75 3/4	39 - 96 3/4	142.4B
Java Programming Language, Internet Servers	Sun Microsystems (SUNW)	8/13/96	13 3/4	79 1/2	19 3/16 - 80 5/8	61.71B
BROADBAND TELECOM TECHNOLOGIES/SERVICES						
Wireless, Fiber Optic Telecom Chips, Equipment, Systems	Lucent Technologies (LU)	11/7/96	11 25/32	64 1/16	26 11/16 - 79 3/4	196.1B
Wireless, Fiber Optic, Cable Equipment, Systems	Nortel Networks (NT)	11/3/97	23	41 1/16	13 3/8 - 47 1/16	55.03B

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NOTE: This table lists technologies in the Gilder Paradigm, and representative companies that possess the ascendant technologies. But by no means are the technologies exclusive to these companies. In keeping with our objective of providing a technology strategy report, companies appear on this list only for these core competencies, without any judgement of market price or timing. Reference Price is a company's closing stock price on the Reference Date, the date on which the company was added to the Table. Since March 1999, all "current" stock prices and new Reference Prices/Dates are closing prices for the last trading day of the month prior to publication. Mr. Gilder and other GTR staff may

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