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LMDS: Trick or Treat?

It's Halloween, the wind is up, and the house is creaking in the night. The earth is revolving around the moon. Paradigm bashers are on the prowl. Paradigm stars are turning into pumpkins and skulking home in rags before our wondering eyes. In the face of my contention that technology stocks were undervalued, the market pre-sumes to crash.

Among the smithereens, the copper cage behemoth **GTE** (GTE) lumbers in and effectively outbids our paradigmatic **WorldCom** (WCOM) for **MCI** (MCIC). *Telephony* magazine in September blares a gold cover: "Blind Faith." That's CDMA, code division multiple access, our humble paradigm for digital wireless. Fifteen pages follow on, "How the facts about CDMA were lost in a holy war over wireless standards."

Seems CDMA is mostly hype, too complex to play, particularly in Hong Kong, just as **Qualcomm** (QCOM) short Charles Biderman always said. Seven million CDMA customers around the globe—two million more than projected—are secretly using analog, or else are smoking something. So are the Japanese with their new national CDMA network under way and **Ericsson** (ERICY) with its acknowledgment that the next generation of GSM will be...CDMA.

Business Communications Review, a sleek and well edited monthly featuring network guru John McQuillan, says I wrote that "bandwidth would be free." It boldly refutes this straw thesis in an October article called "Fire Sale in the Fibersphere." "Most network managers," writes managing editor Eric Krapf summing it up, "would scoff at Gilder's notion." Technology Editor Sandra Borthick reports that tariffed prices for T-1 lines and VPNs (virtual private networks) go up 5 to 7 percent every year" and dark fiber now mostly bulges with luminous floods of bits. Even in the fibersphere, spectrum is scarce.

Andy Grove says that "bandwidth rises a hundred times more slowly than our ability to use it."

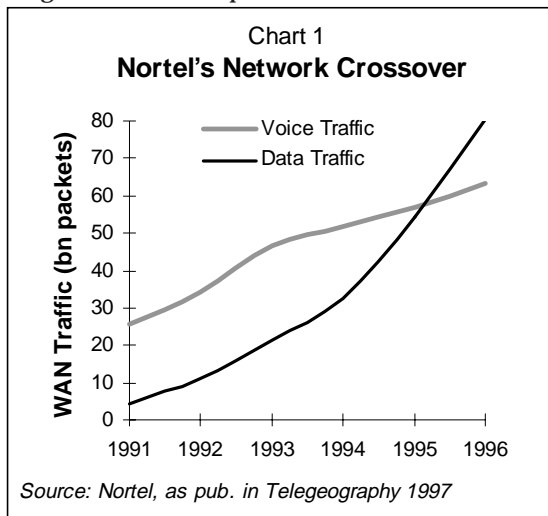
He also claims, in *the New Yorker* no less, that I said the Japanese would blow away Intel in microprocessors. (Huh?) Nor does the paradigm cut it even at the FCC. Flouting my warnings against auctions as a telecom tax, they are putting up for bid under the rubric LMDS (local multipoint distribution service) some 1.3 giga-

hertz in the 28 GHz band. As our correspondent Ira Brodsky reports, this is a span larger than PCS, cellular, and TV put together. Soon the FCC will be auctioning off exclusive rights to use of the color purple.

What's still worse for the paradigm, *Remnant Review*, by our estimable rival Gary North, reports that the world will end in the year 2000. Forget the FCC and the

telcos. What we should be worrying about is the FRB (Federal Reserve Board) and the banks. "The U.S. Banking System is totally vulnerable," says North, and "Sayonara, Japanese banks." No one is really ready, he declares, except the insufferable Warren Buffett with his bonds and Coke shares. Hey, Bill, please save us! Peter Lynch, no less, says buy gold. From Grove to columnist Frank Hayes in *Computerworld*, everyone agrees that it's great to be a futurist. You can say what-

Soon the FCC will be auctioning off exclusive rights to use of the color purple.



In the war over MCI, the two players show inverse powers.

ever you want, come a cropper, and no one notices. Let us hope this fate befalls the year 2000 catastrophists.

Before you all cancel your subscriptions, though, I would like to point out, in all humility, *eppure si muove*. That's Galileo's response to the establishment priests of his day who said the earth revolves around the sun. "Still it moves." Einstein showed essentially that the priests were right; it's all relative. But let that pass. The fact is that from CDMA and bandwidth abundance to Wavelength Division Multiplexing and new computer architectures, from Java to cable modems galore, the paradigm is taking off. And selling for less! What could be better.

The data tornado sweeps on. In accordance with the paradigm, more cable modems are sold every week than the total number of ADSL links deployed by all the phone companies put together. Peter Cochrane of **BT** (BTY) Labs says, "Goodbye to Mr. Erlang." Erlang is the Danish inventor of the prevailing algorithm for telephony traffic, which assumes lots of short narrowband voice connections, statistically trunked and aggregated into smooth oceanic tides of usage. Embroiled by the Internet, the new world teeters and tosses on data spikes and tsunamis: a huge dynamic range of traffic levels, defined by bursty broadband peaks and valleys of demand that bust the old TDM (time division muxed) Erlangs wide open.

In the war over MCI, the two players show inverse powers. WorldCom has revenues of some \$8 billion and a market cap of \$30 billion. GTE has revenues of \$26 billion, four times its rival, and a market cap just a third higher. MCI, meanwhile, has revenues three times WorldCom's and a market cap more than one third lower. Measured by their "Q" factors (market cap over replacement cost), which indicates strategic dynamism, GTE has a Q of 1.34, compared to MCI's roughly 1.5 and WorldCom's five. While MCI and GTE have floundered for the last five years, WorldCom has built a national fiber network from Wiltel pipes, MFS rings and metropolitan access exchanges, Brooks bypass, and UUNet business links. It has multiplied its capability some thousand fold through **Ciena** (CIEN) and **Nortel** (NT) Wavelength Division muxing and OC-192 Sonet (10 gigabit per wavelength).

None the less, GTE claims to have seen the spotlight and focused it on its venerable Internet subsidiary BBN, that it seized impudently under the stuffed nose of **AT&T** (T), which thought it had a deal with the eminent Cambridge boutique. BBN has an unparalleled Internet history (the ARPANet began there), a Forbes 500 set of customers, a national spread of gigabit POPs, and a super networking laboratory on Alewife Parkway. The lab commands worldbeating crypto technology, terabit router plans with **Cisco** (CSCO), and advanced orthogonal CDMA wireless systems. GTE is the second largest wireless carrier and has gone CDMA for its typically sluggish digital effort. **NextWave** has high hopes for galvanizing the company in PCS if GTE wins.

GTE also is collaborating intimately with the terapopping network of **Qwest** (QWST). But GTE still thinks its 21 million copper loops are an asset and still cherishes its legacy of monopoly rents and tariffs and the plush pinstripes of the DC communications Barr (that's William, esq). Barr is suing for level playing fields rather than looking for mountains to climb. One absolute prohibition of the paradigm is a level playing field.

But changes are afoot. George Conrades, formerly an heir apparent at **IBM**, the MIPS company, is now a bandwidth man. Executive VP at GTE and chief of the Internet unit, GTE Internetworking, ne BBN, he declares that today data rides on voice in the GTE networks. Tomorrow, though, voice will ride on data.

The heart of his company is BBN Planet—the Internet access spearhead—that has increased revenues from \$18 million to \$185 million during the last two years. That's a tenfold rise. Overall BBN is now a \$500 million company enmeshed in GTE, a firm with \$20 billion in U.S. local exchange revenues and \$6 billion overseas. Although GTE currently postures as an aggressive and creative force in telephony, in actuality, it functions essentially as another RBOC with some 21 million local loops. Although officially it was not part of the AT&T breakup and thus is exempt from those legacy regulations, it enlists eagerly in Washington litigation and lobbying to preserve the empires of voice oriented circuitry.

Conrades implies that this GTE is history. BBN is the data tail that will wag this telco dog. He may well be right. He calmly asserts that an 800 number call through the circuit switches of GTE costs some \$2, while a similar Internet call would cost five cents. The future GTE will go for the Internet elasticities rather than the official tariff gouges.

As evidence for a new GTE, Conrades presented Stephen Blumenthal, network chief at GTE Internetworking. Blumenthal pointed out that the parent company had invested some \$700 million in the purchase of BBN and was investing a similar amount in Qwest. GTE purchased an infeasible right to use 25 percent of the capacity of the Qwest network which is being installed five feet below the ground along **Southern Pacific's** railroad rights of way. In addition to the Qwest capacity—some 16,000 route miles of fiber by 1998—GTE's network, which uses **Amtrak** corridors, will comprise 15,000 route miles, linking 100 cities and four key internet National Access Points, together with private exchange operations with several major carriers, including MCI.

Meanwhile, GTE is upgrading its own network to Qwest's specifications, deploying Nortel WDM equipment to put as many as 16 OC-192 (10 gigabit per second) bitstreams on each fiber, each devoted to a single wavelength. This means as much as 160 Gbps per fiber. With 24 **Lucent** (LU) True Wave dispersion shifted fibers in each sheath, the total capacity will rise to nearly half a terabyte per second. With half the capacity left

unlit for emergencies, such a highway will be needed. BBN-GTE has contracted to provide as much as one third of AOL's (AOL) dialup capacity in a five year contract. It began at \$11 million per year and quickly ran up a \$55 million backlog in 1995. Today the AOL backlog at BBN is \$1.2 billion, deploying **Ascend** (ASND) MAX remote access gear, Cisco Routers, and WorldCom's frame relay backbone.

Ah, WorldCom. The subtext of my meeting with GTE was a claim that with BBN—the creator of the original internet technology as a spearhead—GTE was altogether a more worthy bidder for MCI than WorldCom is. For example, BBN is the key testing site for Cisco's new multigigabit router. Today no router runs faster than OC-12 (622 Mbps) interfaces, though OC-48 (2.4 Gbps) is on the way. In order for Qwest to deploy OC-192, it must use OC-48 chunks. Qwest and GTE will have the best backbones in the industry and GTE projects that by 2002, it will handle 100 thousand dedicated IP, Frame Relay, and ATM connections, 2 million XDSL customers, ten million dialups, and 10 million plus IP telephony customers.

Even at GTE, bandwidth is breaking out all over. In America, the FCC regulates telecom bandwidth. Advanced technology is opening new communications spectrum at ever higher frequencies. The FCC wants it all, from AM radio frequencies up through microwaves, allocated exclusively to the highest bidder. Now the FCC is auctioning 1.5 gigahertz at around 28 gigahertz. Sometime in the next five years, dissatisfied with revenues from purple, it will try to auction off the colors red and green.

With LMDS spectrum, the clear choice of the government bureaucrats is to create a new monopoly, in the hopes that that would assure higher auction prices. The FCC is announcing new gardens and sowing a desert.

The FCC these days, Ira Brodsky reports, seems increasingly desperate as the auction date approaches. Though the auction is scheduled for December 10, the commission may use the excuse of a RBOC suit to halt the process before it blows up. At an LMDS conference at the end of October at the Ana in San Francisco, no fewer than eight high level FCC officials showed up to tout the value of their new offering and to offer guidance on bidding rules and technical requirements. But, they warned the some 400 attendees, "This time we're not giving any spectrum away." Kathleen O'Brien-Harn, the chief of the auctions and industry analysis division, introduced the "product management team." Catherine Sandoval, chief of the office of communications

and business opportunities, also touted the promise of this spectrum. The luncheon speaker Rosalyn Allen, deputy chief of the wireless telecom office, continued the pitch. "When she leaves the FCC, she has to go into sales," Brodsky remarked. It all evoked the early days when "wireless cable" vendors were selling MMDS (Multichannel Multipoint Distribution Service) spectrum at 2.4 gigahertz to insomniac couch potatoes as a get-rich-quick scheme in competition with advertisements for 900 number porn and astrology.

In any case, the myth of a spectrum shortage will shatter when the FCC puts LMDS' 1,300 megahertz of wireless bandwidth up for auction and bidders offer peanuts. Winners will gain access to more new spectrum than the total radio spectrum available to consumers just a few years ago.

Technology breakthroughs have opened the spectrum floodgates, but the FCC imagines LMDS' colossal bandwidth is the result of its own largess. Entrusted with the equitable distribution of licenses, but under orders from Congress to help balance the federal budget, the FCC is desperately trying to manufacture spot shortages. Officials vow there will

be no repeat of the "give-away" that permitted an enterprising individual to pick up the St. Louis license in a recent auction for a mere \$1. Were those same FCC officials to listen to the market forces they profess to believe in, however, they would realize we are headed for a spectrum glut.

And so the stage is set for the death of an infant industry—one that could have rivaled fiber for "last mile" delivery of high-speed, two-way services.

With twice the bandwidth of AM/FM radio, VHF/UHF television, and cellular telephone combined, and 43 times the bandwidth of broadband PCS licenses that sold for a total of approximately \$20 billion, LMDS promised bandwidth-on-demand-for-all.

In fact, LMDS could have been the ideal solution for delivering advanced telecom services to an uncertain market. As equipment maker **Hewlett-Packard** (HWP) points out, LMDS gear can be deployed quickly, offers a scalable architecture, and can be the basis of a profitable business even at "low take rates." Throw up an LMDS base station for as little as \$200,000 and it's ready to serve most users within a two kilometer radius. Fiber, in contrast, would have to snake its way across the entire service area before its owner could even begin to market services.

The market is uncertain because LMDS has so many potential applications. Originally, pioneers were split between those who viewed LMDS as the road to interactive television, like New York City-based **CellularVision** (CVUS), and those who hoped to accelerate the introduction of high-

GTE claims to have seen the spotlight and focused it on its venerable Internet subsidiary BBN.

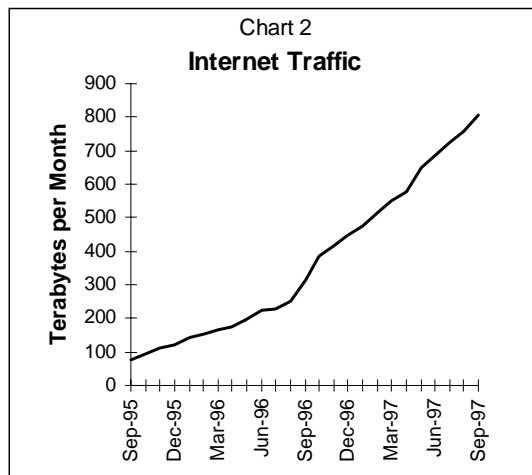


Chart 3
US PC Shipments Dwarf TVs

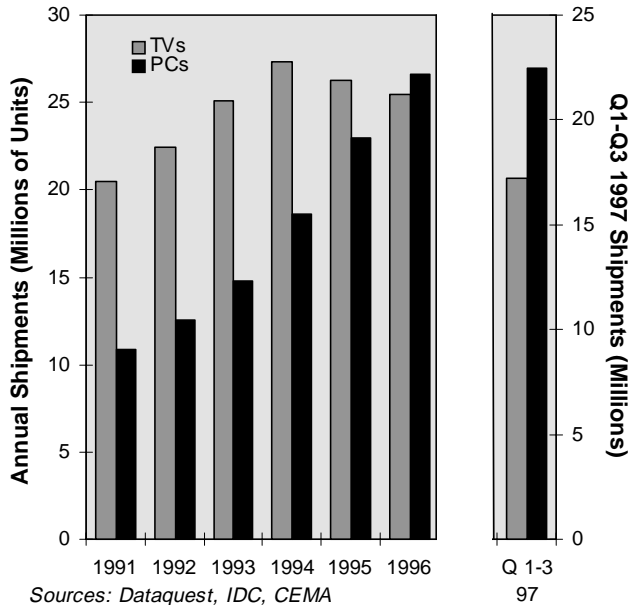
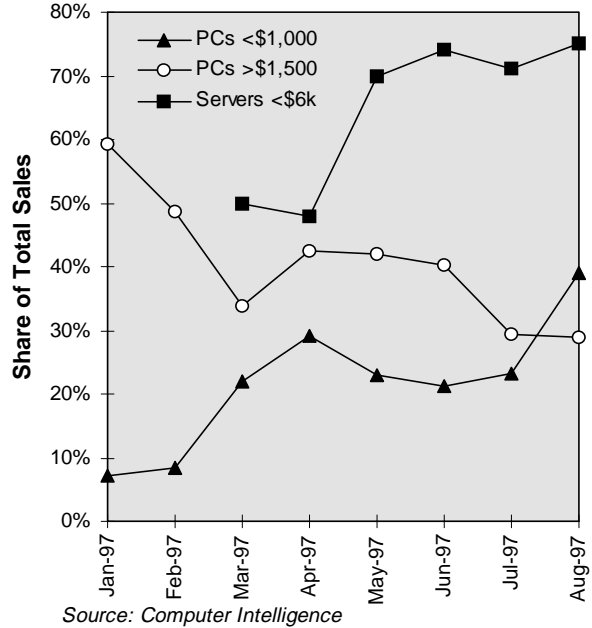


Chart 4
PC and Server Pricing



US PC shipments extended their lead over TVs in 3Q97 (Chart 3). As worldwide PC unit shipments rose 16%, Compaq was up between 52% (IDC) and 56% (Dataquest), climbing 63%-67% in the US market, which grew 20%-23%. Compaq had a 14% global share and 19% of the US market, some 70% above IBM's 2nd place worldwide share and 90% higher than Dell's 2nd place US finish. Compaq dominates US retail PC sales with 39% market share, to Packard-Bell's 17% and HP's 12%. After passing IBM and Toshiba in notebook sales within the dealer channel in April, Compaq has now pulled ahead at retail. As PC Data reports year-year retail notebook unit sales and revenue increases of 49% and 44.3% respectively, Computer Intelligence (CI) figures show Compaq's September share of the retail notebook revenue grew to 42.5% ahead of Toshiba's 24.3%, a dramatic change from Sept. 1996 when Toshiba held 57.9% share to Compaq's 5.4%. In the expanding sub-\$1,000 desktop market (Chart 4) Compaq leads with 44% share to Packard Bell's 26%, with all other at 6% or less. While the percentage of first time PC buyers has been trending upward (57% for the week ending Oct. 17), CI reports that sub-\$1,000 PCs are actually attracting a disproportionately high number of repeat purchasers, boding well for the overall market growth. Parallel to the PC market the Intel server market has seen dramatic price drops, with 75% of August sales through the reseller channel less than \$6,000 (Chart 4). With Dell only selling direct, Compaq seems to have a lock on reseller channel based server sales, consistently holding a 56-59% share to HP's 22% and IBM's 18%. CI's corporate PC Purchase Indices, which include direct-sellers, show Compaq's toughest competition is Dell and Gateway. To meet the threat Compaq has begun direct Internet sales.

Semiconductor Equipment Market. Crossed wires in Intel's PR department led to their Friday, Oct. 24, announcement of a one year delay of their Fort Worth, TX fab for next generation processors accompanied by muddled explanations of the cause, followed by the Monday announcement of their settlement of law suits with Digital including the \$700 million purchase of Digital's underutilized semiconductor facility in Hudson, MA and planned collaboration on next generation processors. Intel President and COO Craig Barrett, said the Hudson fab could be quickly retooled and profitable within a year, one year ahead of the originally planned opening of the TX plant. Weekend fears of a semiconductor slowdown were needlessly overblown. The Semiconductor Industry Association announcement of August's 15.3% year-year gain in computer chip sales far outpaced the 7% year to year (2Q97) increase in fab capacity, and semi equipment shipments have been rising to close the gap. The North American semiconductor equipment industry shipments, which bottomed out in 1Q97, grew 24% from 1Q97 to 2Q97, and 18% from 2Q97 to 3Q97 (Chart 5). The worldwide market for equipment, materials and services for the semiconductor and flat panel display (FPD) industries will reach \$65 billion in 1997, according to SEMI. This includes \$25 b. for semiconductor equipment, \$14.2 b. in services and \$22 b. for processing and packaging, along with \$1.5 b. in FPD equipment and \$2.3 b. in materials.

@Home's 3Q97 results revealed that @Home ended the quarter with 26,000 subscribers, far ahead of our estimate last month which was based on other services published numbers. The success of @Home matches their reach, with 50% of North American homes to be accessible through @Home's partners' cable systems, a 45% share of homes passed by cable modem ready systems, and 48% of current subscribers (Chart 6).

Chart 5
NA Semiconductor Equipment

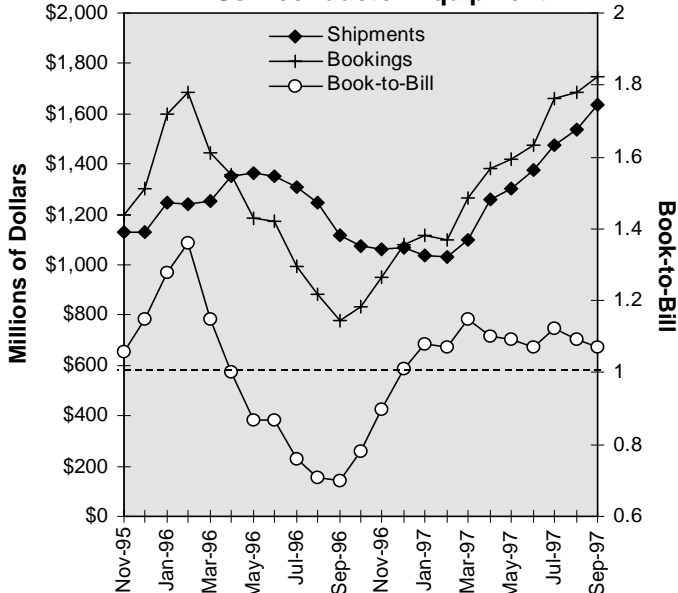


Chart 6
@Home Pulls Ahead

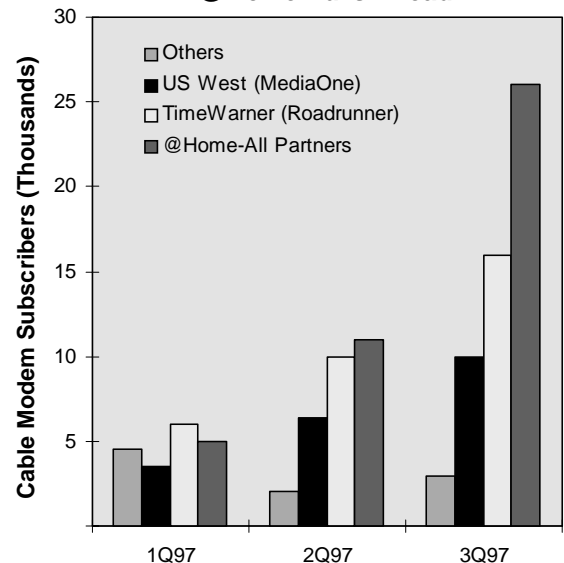


Chart 7

US Internet/Intranet Development Environment Usage

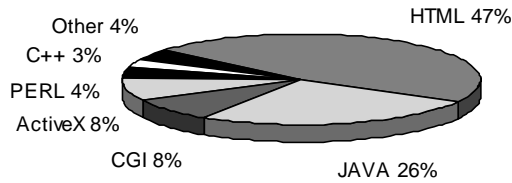


Chart 9

Web Developers Vendor Share

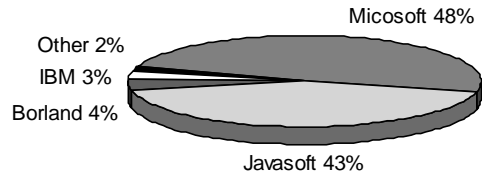
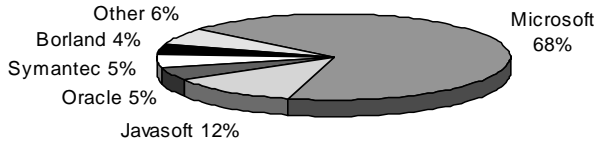


Chart 8

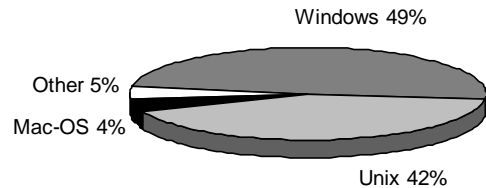
Internet/Intranet Application Development Vendor Share



Source: Computer Intelligence

Chart 10

Web Server Operating Systems



Source: Computer Intelligence

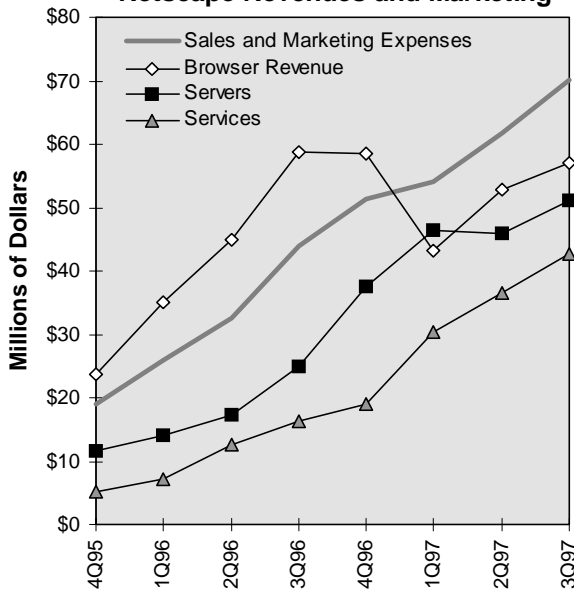
The Internet's explosive growth is mirrored by the rise of corporate intranets—private networks based on Internet protocols and standards. Due to ease of use and administration, relatively low costs and high returns on investment, intranets are already found in 59% of US and 38% of European organizations contacted in a recent IDC survey, with penetration next year growing to 77% in the US and 75% in Europe. Java has become a key tool in intranet strategies. In September, Latin America's largest retail bank, Banco do Brazil, announced it would retrain half of its 900 person IT staff in Java as part of a \$1.8 billion overhaul of its IT infrastructure. The bank plans to write 20 million lines of Java code to supplement or replace some 80 million lines of legacy code, integrating reusable Java components and applications across its banking products. Home Depot now has 70 Java developers and is preparing to roll out Java applications across its network of some 30,000 store-side terminals. A Borland survey of 5,000 software developers found that nearly all (95%) said they plan to utilize Java to build new applications and systems and/or to integrate with existing systems, with 61% of the developers citing the "write once, run anywhere" promise as the number one benefit of Java. Beyond the development of HTML documents which are primarily homepage focused, a Computer Intelligence (CI) survey found Java is the primary environment for the development of intranet applications (Chart 7). Microsoft was the dominant vendor used for Internet/intranet application development, followed by Sun's Javasoft (Chart 8). CI data on vendor share for web development tools, apparently excluding HTML publishing tools, highlights the struggle between Microsoft and Javasoft (Chart 9). This mirrors the underlying web server operating system (OS) battle between Microsoft's Windows and Unix which is about half Sun hardware (Chart 10).

Netscape's browser introduced the possibilities of the Internet by providing a new graphical interface for computing. And, for a time, Navigator users outnumbered Windows users on the net. Microsoft responded with a free browser. Beginning in 3Q96, when Microsoft's browser first matched Netscape's features, Netscape's browser revenues have stagnated. Netscape's server revenues have been affected not only by Microsoft's giveaway of Internet Information Server, but by the incredible ongoing success (45% market share) of the all volunteer Apache group's free web server software. The only growth area for Netscape has become service and consulting revenues—including web site ad revenues. Those revenues maybe at risk as browser share decreases and more sophisticated surfers bypass the default visit to Netscape's site. Netscape sales and marketing expenses are accelerating faster than any category of revenue (Chart 11). Subtracting the dollar increase in sales and marketing from the increase in Netscape product revenues the resulting "real" growth in product revenues has declined each of the last four quarters—except 2Q97 when it rose from a negative figure—with less than \$1 million in "real" product revenue growth during 3Q97. Netscape's "profit margin" (income over revenues) has remained flat at less than 8% for 6 quarters.

E-commerce adoption is continuing at a rapid pace. The Computer Intelligence eCommerce index based on 10,000 monthly interviews with participating American businesses shows that 8.5% of all businesses now have installed or plan e-commerce (Chart 12). Dell Computers, is now generating some \$3 million a day in web based sales, up from \$2 m./day 2Q97. Gateway, meanwhile, now claims \$2 million per day. And, Compaq has begun its own web sales in response. -KE

Chart 11

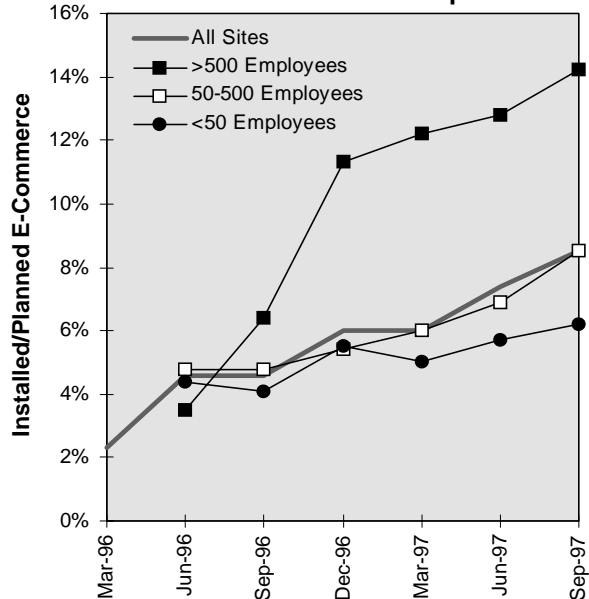
Netscape Revenues and Marketing



Source: Netscape

Chart 12

Web E-Commerce Adoption



Source: Computer Intelligence

Mastering the art of working with, or around, the FCC is P-Com.

speed data services for businesses, like **Broadband Networks, Inc.** of Winnipeg, Canada; **Bosch Telecom** who acquired the LMDS business unit of **Texas Instruments (TXN)**; and Hewlett-Packard who has teamed up with component supplier **Stanford Telecom (STII)**.

With 20 years experience in digital telecommunications, Stanford Telecom is one of the more well established players in LMDS development. It has patents granted or applied for in CDMA, OCDMA, ATM, and TDMA, among other technologies. Stanford Telecom's established business base includes commercial telecom equipment manufacturing and system design and engineering in both terrestrial and satellite-based wireless telecom systems. Stanford Telecom's alliance with Hewlett-Packard is focused on developing a broadband LMDS system for homes and offices. Sitting out the FCC auctions, the two companies will act as equipment vendors for licensed service providers.

CellularVision is currently using LMDS to deliver cable TV service to parts of New York City that resisted deployment of conventional cable. But CellularVision, like the rest of the LMDS industry, also has high-speed Internet access in its sights. Now offering 500 Kbps Internet access, CellularVision plans to deploy modems that will give subscribers downloads at greater than a T-1 speeds. In addition, Hewlett-Packard and Bosch believe LMDS will be used to interconnect LANs, create super-fast campus area networks, and provide gigabit per second asynchronous transfer mode (ATM) and synchronous optical network (SONET) backbone links.

Or will it? As the rules began taking shape, it became clear the FCC viewed LMDS through the distorted lens of the Telecom Act of 1996.

LMDS shares its spectrum with other services, most notably satellite operators such as **Teledesic**. FCC rules offer bidders two separate chunks of spectrum in 493 basic trading areas (BTAs). Block A consists of 1,150 megahertz: 27,500 - 28,350 MHz, 29,000 - 29,250 MHz, and 31,075 - 31,225 MHz. While Block B contains 150 megahertz: 31,000 - 31,075 MHz, 31,225 - 31,300 MHz. In one gigahertz of its spectrum, LMDS owns the "primary" license, which means the burden is on those sharing its frequencies to not cause interference. In the remaining 300 megahertz, LMDS holds a "co-primary" license, which means it must coordinate with other co-primary users to avoid interference.

Ironically, the FCC realized LMDS could share spectrum with unrelated services, and even agreed to permit LMDS operators to divide their spectrum and coverage areas with partners of their own choosing, but refused to assign multiple (non-exclusive) licenses. Instead, there will be just one Block A license per BTA. This is all the more unreasonable given most LMDS systems use short-range, narrow beamwidth, line-of-sight transmission; CellularVision, the only player not relying on line-of-sight, has demonstrated one can isolate disparate users through the selective use of vertical and horizontal antenna polarization. With no one even contemplating use of the entire 1,150

megahertz in a single location, LMDS would have been the perfect incubator for development of intelligent, frequency-agile radios and electronically-steered antennas.

Those who reflexively trust the FCC's wisdom explain that while license winners will enjoy what appears to be a monopoly, LMDS will face competition from a host of wireline and alternative wireless services. But this is like justifying the establishment of a banana monopoly because customers are free to go elsewhere to buy oranges. In the final analysis, the biggest losers are LMDS equipment manufacturers, who must hawk their wares to an artificially confined market, and ultimately LMDS licensees themselves, who will find themselves buying from just one or two surviving manufacturers. We may never know what LMDS would have been—had it not been deprived of internal competition.

The FCC signaled its intentions, as well as its confusion, when on October 17, 1997 it issued a Public Notice (DA 97-2224) proposing the setting of minimum opening bids for upcoming LMDS auctions. Noting that a "reserve price," which dictates a minimum selling price, offers less flexibility than a minimum opening bid, which can be lowered as the auction proceeds, the FCC put the public on notice that it sincerely hopes to maximize the take—but is fearful of scaring away good money.

Predictably, with just one license per basic trading area LMDS was immediately mired in controversy about who should and should not be permitted to participate. Despite vigorous and ongoing protests, the FCC ruled local exchange carriers (LECs) and cable TV companies are not eligible to bid in BTAs where they already serve at least 10% of the population. Thus, we have the spectacle of the FCC barring those who might leverage existing infrastructure to provide more powerful and cost-effective solutions.

All of this has forced most fledgling LMDS players to lower their sights. With **Winstar Communications (WCII)** as a model of success, the industry seems resigned to becoming just another telco bypass solution in the dreary T-1 market. Running 1.544 million bits per second, T-1 circuits are used to multiplex voice channels for transport between large organizations, LECs, and long-distance interexchange carriers (IXCs). Instead of helping to expand cyberspace, LMDS could be relegated to the thankless task of preserving the-world-according-to-MaBell.

Winstar has licenses in the 38 GHz portion of the spectrum to operate its "wireless fiber" networks. Winstar's broadband wireless access systems are linked through a "hub and spoke" array to existing fiber optic networks, providing "last mile" connection to end users. With work underway across the country, WinStar currently has operational systems deployed in sixteen cities.

U.S. WaveLink and **Webcel** are two companies retaining LMDS ambitions which go beyond telco bypass to include multichannel video, high speed data, Internet access and telephony. Each

will be bidding in the upcoming FCC auction.

U.S. WaveLink claims to be the leading operator of LMDS technology and holds a 13% stake in a consortium which is deploying an LMDS (LMCS) system in Canada. The company has recently entered into an agreement with Bosch Telecom to create an advanced broadband showcase for LMDS technology. The showcase will be an operational end-to-end network with service providers and consumers, to provide an opportunity for business in the U.S. and abroad to participate in this demonstration project.

Webcel is a privately-held company, whose primary investor is **Softbank Holdings Inc.** of Japan. Webcel has allied with hardware manufacturer **Newbridge** (NN), of Canada, and is pursuing deals with systems integrators and branded service providers to serve business and consumers. Webcel's President, David Malloff, believes Moore's Law should operate in the telecom, and hopes his plan, which has been described as the "most technologically aggressive" will make it so. Webcel is aiming for 15 to 20 percent of U.S. pops in selected markets in the upcoming LMDS auctions.

Mastering the art of working with, or around, the FCC is **P-Com** (PCMS), of Campbell, California, which develops, manufactures, and markets wireless systems for network access. Along with its Italian subsidiary, Technosystem S.p.A., and alliances in Germany and other European countries, P-Com has been deploying digital millimeter wave radio systems, spread spectrum systems, and broadcast networks in Europe. One of P-Com's key products for U.S. markets (with an excess of \$3.9 million in orders) is their point-to-point full-duplex radio system working at 2.4 and 5.8 GHz. The wireless links can support over 2 Mbits per second at distances up to 45 miles. Perfect for high-speed Internet access, corporate network and PCS/cellular site interconnection, these radios use direct spread spectrum modulation with greater than 10 dB of processing gain to qualify under FCC rules for unlicensed operation. P-Com has also demonstrated a high bandwidth point to multipoint system with scalable capacity. Not to be constrained by the outcome of the LMDS bidding, the system is available through a full range of frequencies from 7 GHz to 50 GHz, including those to be auctioned. This system is scheduled for trial deployments in the 4th quarter of 1997 and for commercial availability in 1998.

What LMDS licensees—and licensees of all new services—really need is not access to abundant spectrum, but abundant access to spectrum. By limiting LMDS to a single license per block per BTA, severely restricting participation of key telecom players, and fixing minimum opening bids, the FCC and U.S. Congress have conspired to create what they hope will be the next monopoly—so they can continue the charade of regulation. Broadband wireless technology will ultimately prevail. But it may not happen before Christmas, or before it explodes first at lower frequencies.

Remember MMDS, notoriously known as "wireless cable." Some 67 companies bid \$216.3 million for spectrum around 2.4 gigahertz covering the entire country. After trying to stick it on insomniac couch potatoes, several of these companies went out and created significant businesses in California, Florida, Texas, Illinois and Nevada. Now they have won the right to go

digital and two way.

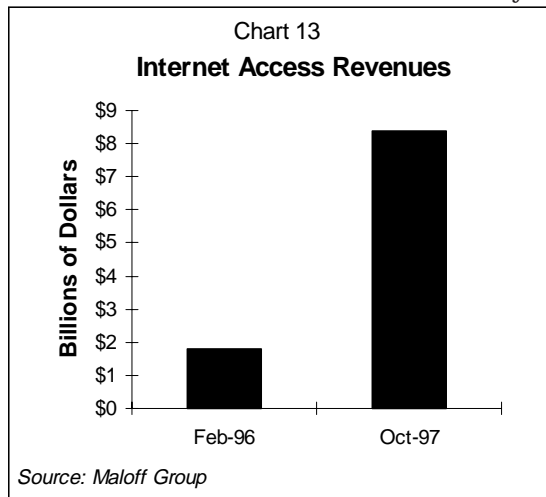
All other things being equal, two-way spectrum at 2.4 gigahertz is preferable to spectrum at 28 gigahertz, which requires far more ambitious gallium arsenide and other exacting heterojunction technology. At 2.4 gigahertz, ordinary CMOS may soon suffice and bipolar silicon is effective. These chips are some ten times cheaper than the monolithic microwave ICs that are needed at KA band (28 gigahertz).

Moreover, the MMDS companies will benefit from the spectacular takeoff of cable modems in the **@Home** (ATHM) and other systems. MMDS can use the same settop boxes and cable modems as terrestrial cable.

CAI Wireless (CAWS) of Albany, N.Y., is testing two way modems in Boston and Pittsburgh and with 28.8 or 56K upstream is already offering powerful T-1 rate service to several thousand homes. User reports from partner **TIAC** in Boston are highly enthusiastic. Among the suppliers to CAI are **Motorola** (MOT) with two way Cybersurfers cable modems and Newbridge with cable modems and equipment that allow sale of wireless leased lines in competition with the telcos. All across the country, MMDS companies are moving aggressively forward to offer two way digital services.

The LMDS conference in San Francisco put up a good front on the first day. But by the last panel, which focused on finances, the bubble of enthusiasm collapsed. Nicole Cawley of **GE Capital Services**, Tim Dibble of **Alta Communications**, and Kevin Maronia of **Spectrum Equity Investors** all denied any enthusiasm for the auction. A poll of the audience showed

CAI Wireless is using MMDS frequencies to deliver two way broadband data service.



TELECOSM TECHNOLOGIES

ASCENDANT TECHNOLOGY	REPORT(S) Volume: No.	COMPANY (SYMBOL)	Reference Price	Price as of 11/3/97
Cable Modem Service	I: 2, 3 II: 7, 8, 9, 11	@Home (ATHM)	19 1/2	24 1/2
Analog to Digital Converters (ADC), Digital Signal Processors (DSP), Silicon Germanium (SiGe)	II: 3, 7	Analog Devices (ADI)	22 3/8	31 15/16
Java Thin Client Office Suite, Rapid Application Development (RAD)	II: 6, 7	Applix (APLX)	4 1/2	7 5/8
Digital Video Codecs	II: 5	C-Cube (CUBE)	23	24 7/8
Erbium Doped Fiber Amplifiers, Wave Division Multiplexing (WDM)	II: 2, 7, 9, 10, 11	Ciena (CIEN)	23 *	57 1/16
Low Earth Orbit Satellites (LEOS)	I: 2 II: 1, 3, 4, 8, 10	Globalstar (GSTRF)	21 3/4	49 3/4
Single Chip ASIC Systems, CDMA Chip Sets	II: 8	LSI Logic (LSI)	31 1/2	23 11/16
Telecommunications Equipment, Wave Division Multiplexing (WDM)	II: 1, 2, 7, 9, 10, 11	Lucent Technologies (LU)	47 1/8	83 1/2
Single Chip Systems	II: 8	National Semiconductor (NSM)	31 1/2	36 1/2
Internet Software	I: 1, 3, 4 II: 1, 4, 6, 7, 8, 10	Netscape Communications (NSCP)	53	33 1/8
Telecommunications Equipment, Wave Division Multiplexing (WDM), Code Division Multiple Access (CDMA), Silicon Germanium (SiGe)	II: 1, 7, 9, 11	Northern Telecom (NT) +	92	92
Wave Division Multiplexing (WDM), Satellite and Wireless Systems, Code Division Multiple Access (CDMA)	II: 10	Ortel (ORTL)	20 3/4	23 1/2
Point to Multipoint System for 7-50 Ghz, Spread Spectrum Broadband Radios	II: 10, 11	P-COM (PCMS) +	22 3/8	22 3/8
Code Division Multiple Access (CDMA)	I: 1, 2 II: 1, 3, 4, 7, 8, 9, 10, 11	Qualcomm (QCOM)	38 3/4	59 1/8
Nationwide Fiber Network	II: 9, 10, 11	Qwest Communications (QWST)	40 3/4	60 3/8
Java Programming Language, Internet Servers	I: 1, 2, 3, 4 II: 1, 5, 6, 7, 8, 10	Sun Microsystems (SUNW)	27 1/2	36 5/8
Optical Equipment, Smart Radios, Telecommunications Infrastructures	I: 1 II: 1, 2, 3, 9	Tellabs (TLAB)	29 1/8	56
Digital Signal Processors (DSP), DRAM	I: 2, 3, 4 II: 5, 8, 11	Texas Instruments (TXN)	47 1/2	115 1/8
Wave Division Multiplexing (WDM) Modulators	II: 7, 9, 10	Uniphase (UNPH)	58 3/4	68 7/8
Code Division Multiple Access (CDMA) Testing Gear	II: 1, 2, 7	Wireless Telecom Group (WTT)	10 3/8	7 7/8
Telecommunications, Fiber, Internet Access	II: 9, 10, 11	WorldCom (WCOM)	29 15/16	34 3/4
Field Programmable Logic Chip	I: 3	Xilinx (XLNX)	32 7/8	38

+ New Addition

* Initial Public Offering

Removed from the Table: Alcatel. While Alcatel still possesses ascendant technologies favored by GTG, it has been replaced on the Table by Nortel, which covers many of the same markets but is felt to encompass a wider range of telecosm technologies.

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.

only one prospective bidder.

Even CellularVision, the inventor of the technology, may sit this one out. The first company to commercially license LMDS spectrum from the FCC, CellularVision recently announced plans limited to the licensing of their technology to other auction winners. And CZ Czerner from Winstar, the successful bypass carrier operating in the 38 gigahertz band, way above LMDS, said she did not know how they would participate. "There is so much spectrum available," she explained.

Already holding 24GHz fixed wireless licenses in 74 of the U.S.'s most populous metropolitan markets (covering 130 million pops and 50% of the nation's business telephone lines), **Teligent** has yet to indicate any interest in the December auctions. Instead the company will be busy with Phase I deployment and testing in Dallas, Los Angeles and Washington, D.C.. Using equipment from Nortel, Lucent, P-Com, Broadband Networks and **Netro Corporation**, Teligent will offer low cost local and long distance telephone service, videoconferencing, Internet access and two way data connectivity up to 20 Mbps to small and medium sized businesses. Teligent Chairman and

CEO Alex Mandl, former AT&T President and COO, heads an all star management team that includes President and COO Kirby Pickle, Jr., previously President and COO of MFS and its subsidiary UUNet, and Senior VP of Engineering and Operations Keith Kaczmarek, who was VP of Engineering and Operations at **AirTouch(ATI)/PCS PrimeCo** and previous to that VP of Technology Development for **Nextel (NXTL)**. These telecommunications, Internet and wireless leaders will soon take Teligent public in an IPO underwritten by Merrill Lynch, Salomon Brothers, Bear Stearns and Goldman Sachs.

George Gilder, November 4, 1997

After much consideration, we have decided to allow ForbesASAP exclusive rights to publish an occasional adapted text from the reports some six to eight weeks following receipt by GTR subscribers. In practice this will mean there is a possibility of a second wave of impact after initial publication.

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