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BANDWIDTH DEBATE: WORLDCOM AND QWEST

WorldCom's Ebbers is facile in dismissing the promise of Qwest, Level 3, IXC, and Williams.

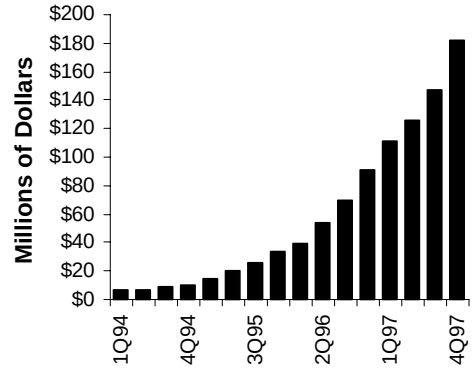
Bernie Ebbers is clearly the world's greatest entrepreneur. In a little over ten years, he has transformed a small near bankrupt phone company linked to nine precarious motels deep in rural Mississippi into the spearhead of the world's most rapidly changing and cosmopolitan industry. Surely this ascent was prepared at Stanford Business School or Tuck or Harvard or Sloan at MIT, where he learned crucial strategic skills and made elite Ivied connections that later fueled his success. Surely he hired visionary consultants from around the globe and from the Gilder Technology Group to guide his technological course. Surely he commands a steel trap mind with a riveting grasp of the seven layers of the OSI networking model.

Aw, shucks. We're talking dumb networks here. Ebbers gained his bachelors degree in physical education. This would put Ebbers in the entrepreneurial hall of fame even if he only started a successful chain of motels in rural Mississippi. This is a case to make the students at Harvard Business School contemplate with special chagrin their hundreds of thousands of dollars of tuition debt and to make the faculty reconsider their continued infatuation with the magic of industrial policy.

Son of a poor family from Edmonton, Alberta, Ebbers could always "sleep well with debt." Contemplating the business plan of a failing long distance reseller, he fixed on the promise of telephony cash flow. Buying bandwidth and selling minutes in a business with regulated prices seemed a powerful idea. He decided to invest. He owned motels bought with money borrowed on the homes of two employees. The motels he saw as equity investments. He could borrow against the equity in the motels to acquire cash flow from the phone company. With the cash flow from the telephone venture, he could expand his motel chain. By the time the telephone company neared bankruptcy, however, he had exhausted all the borrowing power from the motels. He took over the phone company as a matter of financial survival.

Chart 1

WorldCom Internet Revenues



Source: WorldCom Reports

In the Ebbers canon, telephony entails three key competencies: engineering, accounting, and sales and marketing. With his PE degree, he was no engineer or accountant. But he could buy these skills. In the motel business, he had learned how to sell rooms. So he brought this skill to bear on the failing telco. He quickly saw that scale was crucial in the business. The prices you could charge were set by the market and the Public Utilities Commissions. The costs were determined by the volume of bandwidth; a T-1 line cost twice as much per minute as a T-3. As you rented or purchased larger pipes, your costs per unit dropped and you made money. The secret of success in the business was expansion: buying up contiguous regional long distance resellers and channeling them onto your own leased lines.

By buying more regional long distance properties

With MCI, WorldCom will command some 60 percent of total Internet backbone traffic.

to increase economies of scale, Ebbers again exhausted the borrowing power in his motels and other properties. He was saved by an accidental meeting. He ran into an old pal on the street who connected him with Heller Financial in Chicago. Heller came down on December 3, 1986 and despite Ebbers' outstanding loans to 11 other banks, did due diligence and on December 27 decided to invest. It bought 20 percent of the company, then called LDDS (Long Distance Discount Service), consolidated all the loans, and extended an additional $10 million to allow purchase of a key contiguous company. Over the subsequent decade, he would buy and assimilate a new property nearly every year.

In 1989, LDDS took a key further step. It merged with a public company called Advantage, which was a chain of waffle houses with a small long distance arbitrage business. Ebbers kept the public shell and the telco business and sold off the waffles. This made LDDS a public company, which could expand relatively tax free by swapping equity. An early target was the telephone business of Metromedia Communications, which brought LDDS a large and competent sales force. But negotiating with long distance carriers such as **MCI** (MCIC) for network capacity, Ebbers became increasingly aware of a flaw in his strategy: the carriers saved all the best deals for their own customers. LDDS faced a margin crunch. Analyzing the problem, Ebbers reached the startling conclusion that he could purchase his key supplier, WilTel, and pay for it by savings in operating costs. Buying WilTel, he inherited the name **WorldCom** (WCOM) from their European operations and became a facilities based carrier, rich with engineering talent. To his surprise, the savings were far larger than he anticipated. The company's annual growth rate rose from 18 percent to the low 20s. He could link his by then superb marketing resources to an ever expanding array of fiber infrastructure.

By then chairman of the industry organization, Comtel, Ebbers interpreted the 1996 Telecom Act as a boon for companies with local access. This insight drove him to purchase MFS and climaxed with the run on MCI. "I'm sorry to disappoint you," Ebbers said, "but in all this process, there was no hint of a broad Internet strategy." With the arrival at WorldCom of John Sidgemore of MFS's UUnet, that defect would soon be corrected. Now Ebbers growls that the Internet is "a Gorilla, which is going to take over the entire industry." With MCI, WorldCom will command some 60 percent of total Internet backbone traffic. We'll be back to Ebbers later.

The keys to the kingdom reside in the seven layers of the Open Systems' Interconnect (OSI) model of the International Standards Organization (ISO). Although Ebbers does not have to grasp the OSI model, it would be useful if you did. For one thing, it will help you make your way through this report and onto the floor of InterOp and other crucial networking conferences where new companies and technologies are presented. The OSI mumbo jumbo runs from the physical layer–the wire or fiber on the bottom–through five elusive layers above, to the application layer at the top, which is your computer networking program where all messages are either sent or received.

In general, routing–the more complex software intensive way of transferring packets across an entire network using a lookup table of best routes–happens at layer three. Simpler and faster but managing only one hop at a time, switching happens at layer two. But these two layers are colliding, **Nortel**'s (NT) Enterprise Data Networks business unit's Passport switch also integrates IP/IPX routing services. Currently in the industry, the most embattled issue is whether to route at layer two or switch at layer three, merging the two functions in a layer three packet forwarding engine or hardware finite state machine resembling a set of traffic lights for data packets. Layer three seems to be subsuming layer two.

Chart 2

OSI Network Layers:

Application	7
Presentation	6
Session	5
Transport	4
Network	3
Datalink	2
Physical	1

Think of the OSI model as an inverted pyramid of increasing network intelligence. WorldCom began at layer five, selling sessions or calls. It has now added layers one, two, three, and four. With Internet fax and telephony software, it moves into the domains above, challenging **AT&T** (T) and the international giants.

InterOp really happens before the show begins, at the physical layer, in a room full of cable and twisted pair and blinking lights and racks on racks of dry humping and heaving routers, switches, stackable hubs and nodes and bridges and network interface cards and disgruntled geeks and nerds and boffins with beards and scopes and sniffers and denim shirts hanging out, Indians, cable guys, paunchy folk with wild hair and pings and rups and interrupts and traceroutes and seven layer brains.

Nearly anyone who is anybody in networking shows up at InterOp and makes his pitch. In previous reports, I told of Alan Taffel. Now one of

Ebbers' valued employees, his views remain highly relevant. Taffel is a rambunctious Vice President of Marketing at WorldCom's Internet subsidiary, UUnet. At the November InterOp, Taffel boldly denounced your current author and my talk of bandwidth abundance.

Sidgemore and Taffel declare, your humble servant is leading ISPs down a road to perdition. Bandwidth is inexorably scarce and expensive, so they say, and WorldCom commands much of it. "Bill Gates says bandwidth will be free," observed Sidgemore, "Well, I say software should be free." Any Internet Service Provider who does not own his own facilities will crash in a coming bandwidth crunch. Someone has made this pitch at every InterOp since the Internet broke out into the web: the independent local ISP is doomed. And every year yet more thousands of ISPs show up. In 1997, the number of these lemmings had swelled by another 25 percent over the previous 12 months, despite a long list of mergers and acquisitions by telcos, from **Intermedia**'s (ICIX) purchase of Digex to **GTE**'s (GTE) absorption of BBN and WorldCom's capture of UUNet itself, together with Compuserve, ANS, and MCI. By InterOp there were more than 5000 ISPs, including **Mindspring** (MSPG) and **Earthlink** (ELNK) on Taffel's panel.

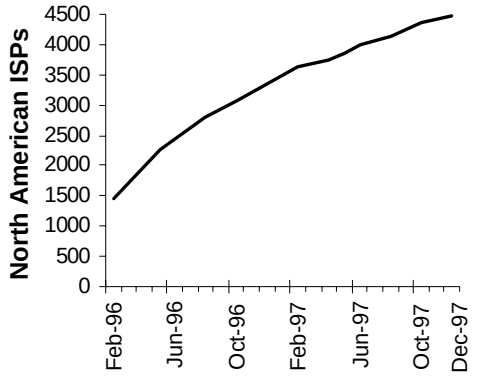
Still, he continues his case. The merry music is about to stop and there will be no chairs for anyone without ownership of bandwidth. Then he makes a truly stunning claim about Internet traffic, confirming my most extreme projections. At WorldCom-UUnet, so he says, traffic is increasing at a rate of some ten times per year. He explains the implications. Every network architect must plan at least three years ahead. Over three years, a tenfold annual rate of advance means an increase of ten to the third power: a thousand fold rise. In order to avoid losing market share in the coming era, networks must scale a kilofold wall; they must increase their capacity by at least 1000 times every three years. This is almost impossible. Hence a world of bandwidth scarcity.

Roughly a factor of eight in the traffic increase will come from the annual doubling in the number of computers and other devices linked to the net. According to the kilofold mandate, on average these machines will increase their flow of bits by about a factor of 130 every three years. The average computer linked to the net is on line an hour or so a day. Let us assume that with more bandwidth at lower prices this span increases to three hours per day. At a minimum, modems will have to improve by a factor of 40. Forty times 28.8 kilobits a second means modems after the turn of the century will have to run faster than a megabit per second. Everyone will have to have T-1 speeds. With cable modems, broadband wireless radios, new satellite systems, and digital subscriber line technologies, this rate is in reach.

Taffel's key problem comes in the backbone, where the bits from all these machines converge. Amdahl's law–system bandwidth is set by the slowest components–dictates that all the servers, routers, edge switches, add-drop multiplexers, national access exchanges, fiber connectors, and other network links that comprise the network fabric must all collectively scale the kilofold wall. Sure that this will not happen, Taffel derides the idea of bandwidth abundance. He scorns the future of the local ISP. Only "facilities based carriers" such as WorldCom-UUnet will be able to compete and even these will face a nearly insuperable challenge of bandwidth scarcity.

Chart 3

Internet Service Providers



Source: Boardwatch Magazine

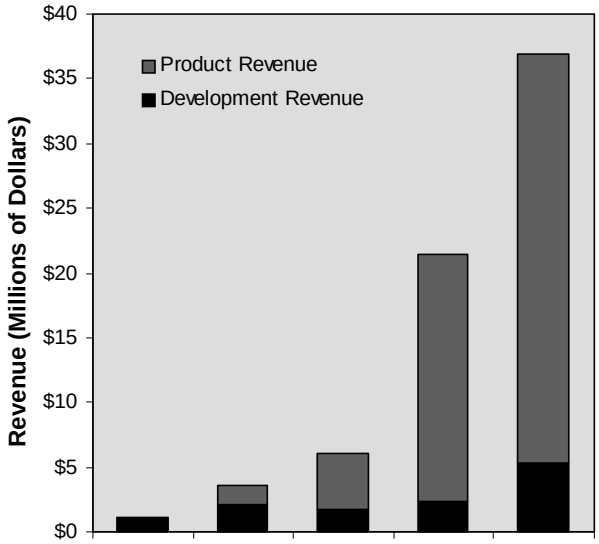
But at the session next door Nayal Shafei, Chief Technical Officer of a new company called **Qwest** (QWST), approached the podium. By the time he sat down, a few minutes later, the world of communications had been transformed. In the world of backbone networks, the kilofold wall loomed as virtually no problem at all. Bandwidth abundance, so he revealed, is at hand.

Shafei lurched forth, in staccato English suffused with rhythms and inflections from a Cairo boyhood: "We have a revolution going here. We are delivering more bandwidth than AT&T, WorldCom, **Sprint** (FON), and MCI put together. These companies are all haggling about when they will offer OC-12 (that's 622 megabits a second); we have OC-192 (10 gigabits a second) available today. Using Nortel WDM (wavelength division multiplexing) systems we can put 16 OC-192 bitstreams on every fiber; that's 160 gigabits per second. And we have two conduits in the ground that can each hold at least 96 fibers. That's 30 terabits for 17 thousand miles. And it's just a start....We are not interested in antiquities and natural history around here. We are exploring OC-384 and above. We are cooperating with **Cisco** (CSCO) and **Juniper** and **Avici** and other router companies to develop terabit routers–routers that can switch at OC-192 wirespeeds and higher…. People talk of launching Internet 2 in the future with the help of the government. We are launching Internet 2 today…."

The merry music is about to stop and there will be no chairs for anyone without ownership of bandwidth.

Chart 4

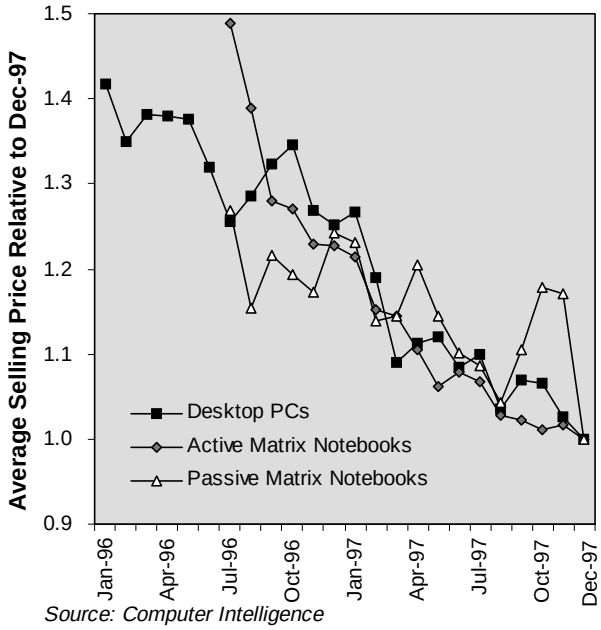
Broadcom Grows With Broadband



Source: Broadcom S-1

Chart 5

PC Price Deflation



Source: Computer Intelligence

Broadcom Corporation *has been added to the Telecosm Technologies Table. Broadcom is a leader in the development of low-cost highly integrated single chip integrated circuits enabling broadband digital data transmission. Developing a range of solutions for use in cable set top boxes, high speed networking, satellite and terrestrial wireless, and xDSL systems, Broadcom has excelled in creating technologies and chips for cable modem systems. Current customers include, 3Com, Bay Networks, Cisco Systems, General Instrument, Motorola and Scientific Atlanta. As broadband expands, the markets for Broadcom's technology will continue to multiply (***Chart 4***).*

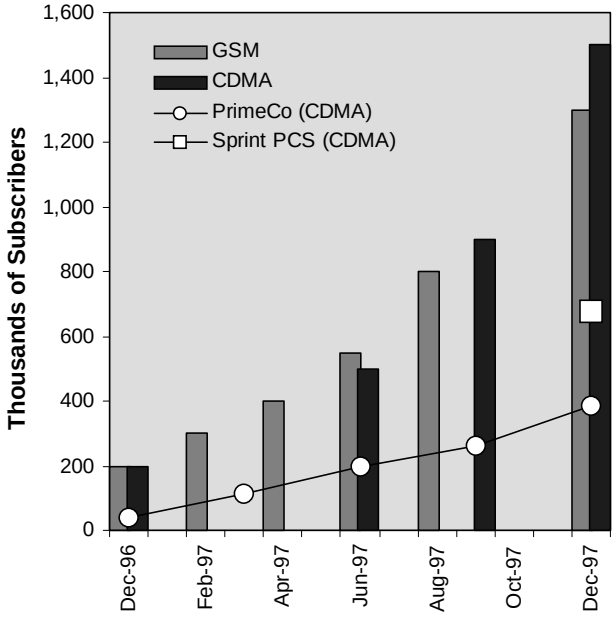
PC Price Deflation *was evident in 1997, as the December average desktop selling price (ASP) at retail dropped to $1,296. Focus has been on the sub-$1,000 market segment, which increased from 9% of sales in January to 36% in December. Lowest priced systems now can be found for as little as $499, but value has increased across the price spectrum, while performance has improved. According to Computer Intelligence, shipments of 17" monitors have increase 30%, as 14" monitors dropped 35%. TrendFocus reports average hard drive storage capacity increased over 60% from 1.4GB to over 2.2GB. Notebook computers declined to December ASPs of $2,887 for active matrix screen systems and $1,741 for passive matrix.* **Chart 5** *shows monthly ASP relative to December 1997 lows. While active matirx screen notebooks saw a steep early drop with the mainstreaming of the technology, all three PC categories have been remarkably consistent in relative price declines.*

PCS Subscribers *increased in North America as the digital wireless networks were rolled out throughout last year. The Yankee Group reports year end coverage for CDMA PCS systems at 54% of the population, GSM at 39% and TDMA PCS at 35%. Sprint PCS (CDMA) is leading in coverage with operations in markets covering 112,256,000 pops (potential subscribers) according to PCS Week figures. AT&T (TDMA) and PrimeCo (CDMA) follow with 39,426,000 and 35,423,000 pops respectively. Figures from the GSM MoU Association and the CDMA Development Group (CDG) suggest the two protocols tracked each other closely in subscriber numbers (***Chart 6***). Sprint PCS announced in February that they had reached 1 million digital PCS subscribers, including approximately 225,000 GSM users on the Sprint Spectrum network and 775,000 CDMA users. PrimeCo ended the year with 387,000 subscribers.*

SCO (Santa Cruz Operation), *according to data from IDC, holds greater than 40% share of the market for Unix server operating environments/system (OE/OS) software, more than double Sun Microsystems' 16.6% share (***Chart 7***). In last month's discussion of Unix and NT server market share (Feb-98 GTR, Charts 9-11), commentary for chart 9 incorrectly suggested Sun was the leader in Unix server operating environment software market share. Despite their leadership, SCO retains a lower profile because SCO software is shipped on hardware from numerous manufactures. According to figures from Computer Intelligence, Sun leads among Unix hardware vendors with a 35% market share (***Chart 8***), and Sun's 3Q97 share of Fortune 1000 Unix server new installations–again based on hardware vendor–rises to 42%, well above second place IBM's 24% share.* -KE

Chart 6

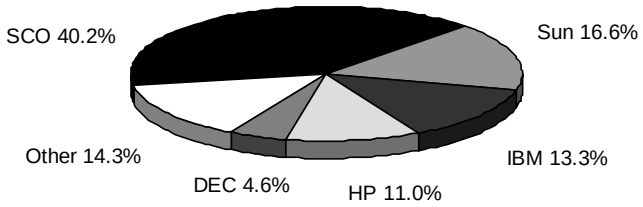
North American PCS Subscribers



Source: GSM MoU Assoc., CDG, Company Reports

Chart 7

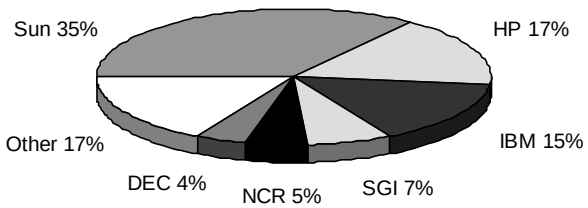
Unix Server OS Market Share



Source: IDC

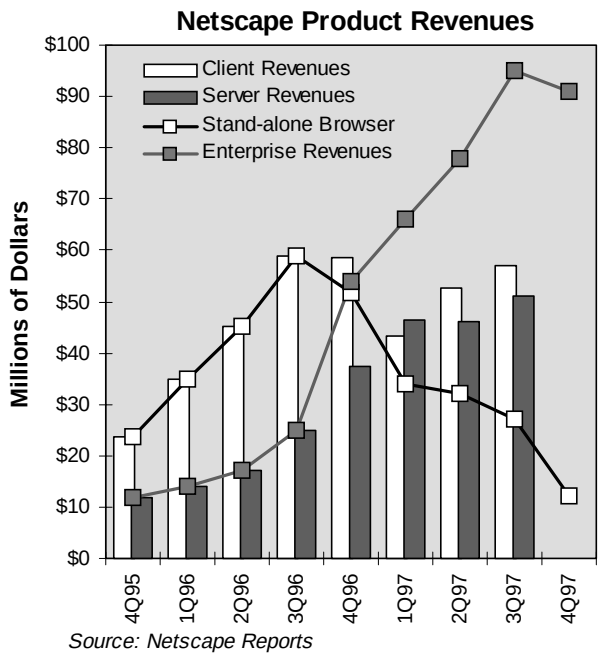
Chart 8

Unix Hardware Vendor Share



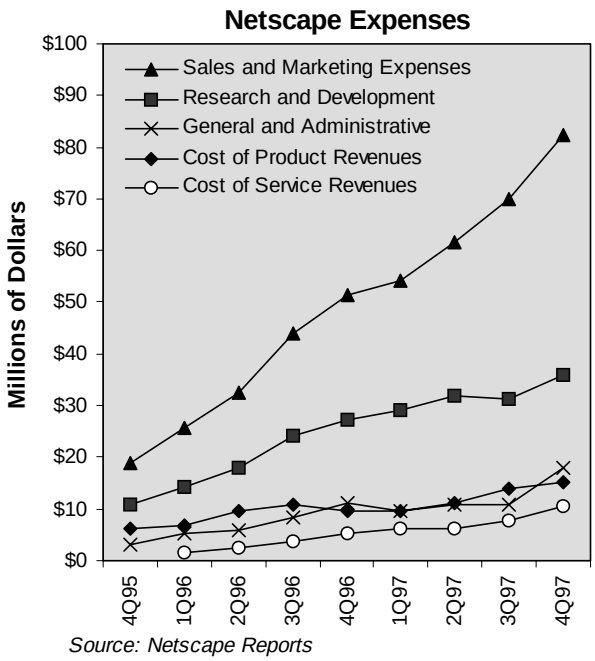
Source: Computer Intelligence

Chart 9



Source: Netscape Reports

Chart 10



Source: Netscape Reports

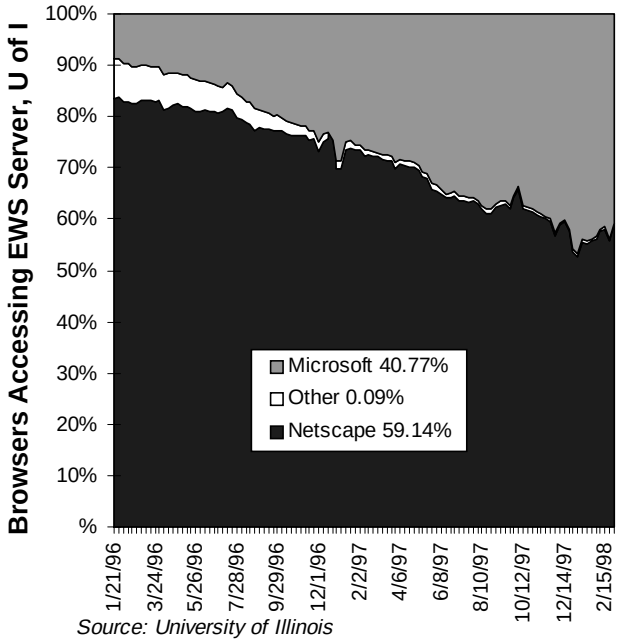
*During 4Q96 Netscape introduced its Enterprise License Program which made Netscape client (browser) and server products available on a combined per seat (user) basis, blurring the line between browser and server revenue. Yet, as recently as their 10Q filing for 3Q97, Netscape apportioned product revenue sources as 53% from client revenue and 47% from server revenue. By January 1998, Marc Andreessen was telling Upside.com that, "It's interesting: you can shift the money around. If you want to call the client $20 a seat and the server $20 a seat, it's actually the same as calling the client $0 a seat and the server $40 a seat. It doesn't matter, right?" As 4Q97 results were being reported, and Netscape announced the giveaway of its browser, the reinterpretation began. The focus on 3Q97 "client revenues" which in the 10Q accounted for 38% of total revenues shifted to "stand alone browser sales" which represented a mere 18% of revenues, and over $25 million was combined with server revenues as they became "enterprise sales." For 4Q97, "stand alone browser" sales were said to decline to only $12 million or less than 10% of sales (***Chart 9***).*

*Attempting to sell products that are available for free from Microsoft and Apache, Netscape's sales and marketing expenses have exploded to dwarf revenues from each traditional category–clients, servers and services–and nearly equal the total from enterprise revenues (**Chart 10**). Netscape would do nearly as well eliminating sales and marketing and buying their own products… or giving them away. The browser giveaway initially seems to be having some effect. Data from the Engineering Workstations Web server (EWS) at the University of Illinois, which reflects a weekly average of some 90 thousand distinct users, is shown in **Chart 11**. Netscape browser share hit a low of 52.6% at the start of the year and, coinciding with their browser giveaway, has rebounded to over 59%. Along with freely distributed browsers, Netscape announced the sharing of the underlying browser source code in an effort to generate public developers' contributions. The Apache Group has been cited as an example. Apache is a loose collection of volunteer programmers who have jointly developed and improved a freeware web server which has captured over 50% market share for pubic Internet web servers. Ironically, the free Apache software and Microsoft's Internet Information server–which is freely available with the purchase of NT server–have dominated Netscape in share of web servers on the public Internet (**Chart 12**).*

With free web browsers and servers dominant, only Netscape's web site revenues provide significant income from the public Internet. And as Internet users gain in sophistication and choose their own default home pages, and discover and bookmark the information, news, entertainment, shopping, and search engine sites which most perfectly fit their needs, the Netscape site is likely to face an increasingly difficult time attracting eyeballs and ad revenues. Clearly, Netscape's focus on the high-end enterprise computing market is a necessary development, not merely a financial reporting strategy. Netscape has evolved to focus on intranets, extranets, and a range of enterprise computing solutions, including high-end application servers, messaging and groupware. The question remaining is whether Netscape can compete against the strength of Lotus, Microsoft and the other more established players in enterprise markets. Netscape's redefinition of revenue sources certainly makes it appear, with the exception of 4Q97, that there is promise in their enterprise strategy. But a free browser will not boost enterprise sales by making Netscape more competitive if per seat costs are adjusted with a doubling of server prices. To answer Andreessen's question, it does matter. Traditionally, Netscape defined over 50% of product revenues as coming from client sales. If in the short term Netscape tries to limit the loss of browser revenue to $12 million, then don't expect an upturn in enterprise sales.

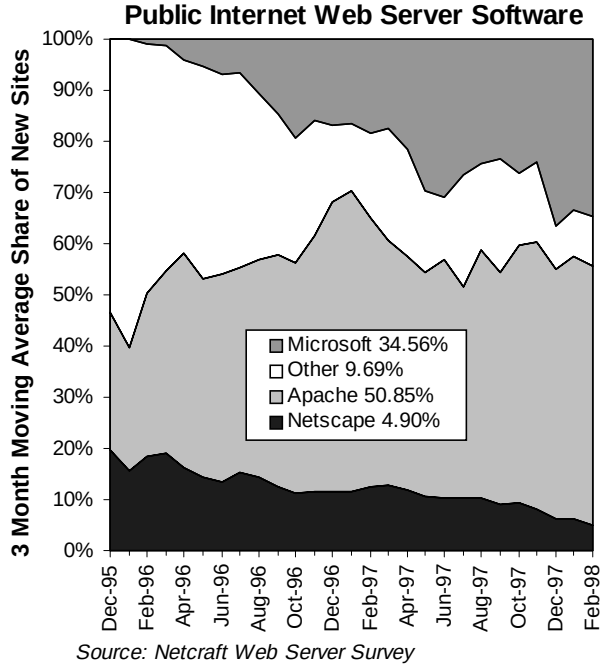
-KE

Chart 11



Source: University of Illinois

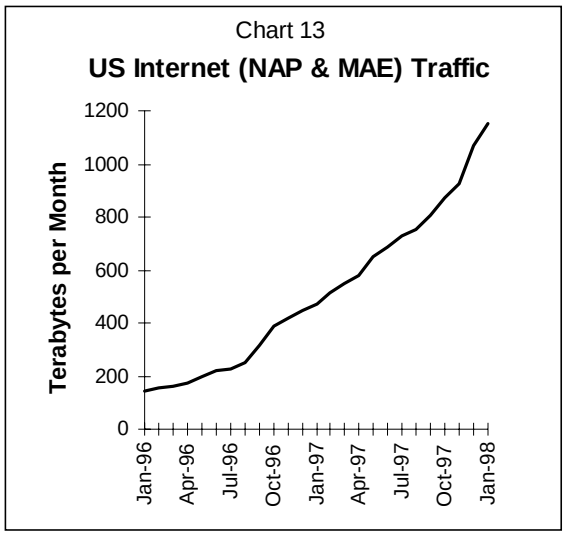
Chart 12



Source: Netcraft Web Server Survey

At WorldCom-UUnet Internet traffic is increasing at a rate of some ten times per year.

By delivering this technology first, Qwest was the spearhead. But it would be followed by several other pursuers of the WDM rainbow. James Crowe of **Level 3**, a company formed by **Peter Kiewit Sons**' (KIWT) construction company after its sale of MFS to WorldCom for $14 billion, announced a new three billion dollar network plan covering some 20 thousand miles. **Williams** (WMB) Communications Group, working with Nortel, declared it would up the ante of WilTel's earlier success running fiber down natural gas pipelines–a network it sold three years ago to WorldCom for $2.5 billion. Williams' new project calls for a 32 thousand mile deployment by 2001. Another Nortel customer, the bypass carrier **IXC** (IIXC) proclaimed grand plans for national broadband fiber networks that exceed the capacity of existing links by a factor of thousands. GTE, in addition to upgrading its own fiber with Nortel WDM, was purchasing 25 percent of Qwest's capacity and extending a new national network to link BBN's "Terapops" (points of presence with a capacity of terabits per second) and supporting GTE-BBN guru Craig Partridge's gigarouter project (Partridge wrote the book, *Gigabit Networks*, in 1993, before there were any).



Preparing for absorption by WorldCom, MCI announced that its 170 mile route linking Los Angeles and Rialto, California, was the first to carry live traffic at OC-192 rates muxed by Nortel equipment onto eight wavelengths for 80 gigabits per second down a single thread. MCI says it is on the way to deploying 1.2 terabits per second on an unspecified schedule. "Using WDM and other technologies over the past 10 years," reports MCI chief engineer Fred Briggs, "we've been able to put 70 times the capacity on our fiber plant at one seventh the cost of adding new fiber."

Even AT&T under Michael Armstrong was deploying some seven billion dollars worth of new fiber technology (together, anomalously announced in a heraldic press release, with scores of new proprietary 4ESS toll switches with millions of lines of antediluvian software).

Following a flood at a Sprint facility in Missouri in 1993, Sprint had begun deploying WDM systems as a stopgap. Discovering that they achieved the same 10 to the minus 11 bit error rates of SONET, the company began moving the technology through its 23 thousand mile fiber network, initially in four channel WDM and in 1998 in 16 channels of OC-48 (2.4 Gbps).

In the wake of the oil and railroad men, and the long distance players, will likely come the power companies. Already deploying fibers with their power lines for remote telemetry, they can even use Nortel equipment putting data directly on power lines for delivery to households.

All in all, the total new bandwidth in view over the next five years mounts into the petabytes per second (compared to total worldwide Internet traffic in 1998 of some four petabytes per month). One way of measuring capacity is to imagine pumping bits as fast as you can into a fiber thread until they begin to spill out the other end. Then count the number of bits in the fiber by multiplying total installed fiber miles by the transmission speed in bits per second and the inverse of lightspeed in fiber. The result is the total capacity in bits at any moment. The US telco fiber installed at the end of 1996, even before the latest building spree, if upgraded using currently available WDM systems, could theoretically hold some 1.8 petabytes at any one instant.

By quietly assembling rights of way and installing fiber and advanced WDM gear while the other carriers tested and talked about it, Qwest was the leader. It used Philip Anshutz' resources of oil and railroad wealth and entrepreneurial vision. Selling off the rail company, Anshutz shrewdly retained the real value–the rights of way. Then he went out and hired a marketing dynamo in Joe Nacchio, who was running AT&T's consumer long distance division, which yields 95 percent of the company's profits. Considered a serious contender for the CEO job and assured a lofty position at AT&T, Nacchio instead chose to split.

As well as anyone in America, Nacchio understands AT&T's vulnerabilities. Technically AT&T is sitting on millions of miles of "old glass." Mostly installed in the late 1980s and optimized for 64 kilobit voice, it cannot carry the dense WDM signals that Qwest is deploying. AT&T has less desirable rights of way. For huge fiber bandwidth, you want protected conduits. Much of AT&T's fiber runs across rights of way defined for microwave and coax, through farms and suburbs and around the edges of cities. Perhaps half of it was merely laid in trenches without hard protection.

AT&T has an intelligent network, full of expensive Bell switches, such as the 4 and 5ESS designs that are still being deployed with scores of millions of lines of code. While AT&T is advertising some service at 10 cents a minute and promises IP telephony at between 7.5 and 9 cents, AT&T has some 30 million customers still paying an average of 14 cents per minute for service. A drop to a 10 cent average minute would take $3 billion

out of the company's bottom line. At the same time, AT&T faces a year 2000 problem that will cost perhaps a billion dollars to fix. Its Operation Support Systems are optimized for voice, like everything else at AT&T that is not optimized for law and lobbying. "At the end of the day," he recalls, "Bob Allen loved to hear lawyers refine nuances of anti-trust." What's worse, Nacchio observes, "John Zeglis," the ascendant VP, "still thinks they have the most advanced and intelligent telephone system in the world." By contrast, the Qwest network is mostly dumb and beautiful.

At the same time Qwest is creating an entirely state of the art layer one, it is also integrating a new set of high level systems for network management, billing, and other services from companies such as **MetaSolv**, **OSI** (OSII), and **Kenan**. Founded by a team headed by Mike Waters of **Texas Instruments** (TXN), MetaSolv of Dallas provides an entire system for automated order entry and provisioning, together with a database of network assets. Operating at layers one through three, OSI supplies a network management system that can talk to the switch, collect alarm signals, and manage SONET rings. A spinoff out of MIT, Kenan offers a state of the art billing system.

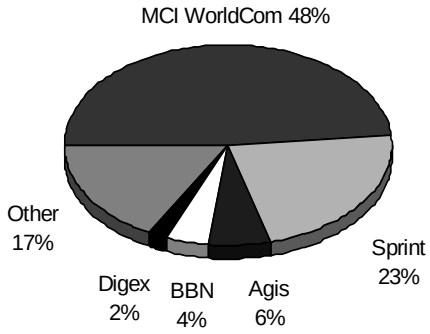
As Qwest network chief, Brij Khandelwal explains, these systems all use a standard set of APIs (application programming interfaces)and interoperate smoothly for totally coherent end to end network management, provisioning, billing and customer care. Companies such as AT&T and WorldCom combine a mindboggling number of incompatible APIs, billing systems, and network management operations. These result in costs at least ten times greater than Qwest projects from its new and fully scalable software, which it has tested thoroughly in concert. "When people talk about Qwest, they stress the state of the art fiber from **Lucent** (LU), the Anshutz railroad rights of way, and the Nortel WDM capacity. But I look at the information systems as an equal asset," Khandelwal says.

Using bandwidth as a substitute for complexity, Qwest's dumb network does not even bother to compress the voice bits for Internet Protocol (IP) telephony. However, it does use some $50 million worth of DMS 250 switches from Nortel to sort the calls and link them to a separate voice intranet backbone on three of the fibers in the network. With 48 thousand ports at less than $100 per port, these Nortel switches have entered an Internet cost performance curve. Although Lucent and others are perfecting WDM add-drop multiplexors, barring a breakthrough, WDM gear will not soon surmount **Tellabs** (TLAB) guru Paul Green's early challenge of switching packets by wavelength.

So what's not to like in this formidable array of state of the art capabilities? Bernie Ebbers believes that many of the Qwest, IXC, and Level 3 claims are mythopoeic. Actually, "asinine" is the word that smoothly sprung to his lips when he heard of the theory of his rivals that advantages accrue to a lack of a vulnerable base of tariffed revenues. "That sounds like the theory of a company without revenues." He scoffed at the idea that these companies would command a fiber infrastructure superior to his own. "Perhaps, half of Qwest's network was swapped from us," he observed. In general, the fiber networks of the leading players are so intertwined that it is very difficult to define where one ends and the other begins. Indeed, he told of Sprint and WilTel providing backup for each other, only to discover that each was supplying the same stretch of fiber.

Chart 14

ISP Backbone Connections Market Share



Source: Boardwatch Magazine

There are two ways to evaluate telecom properties. In the early stages, you discount the cash flow projected in business plans. It's all hokey pokey; you change one assumption and the spreadsheet leaps up, creating huge future value. The second way is earnings. "So far Qwest has done well with dreams of future cash. Soon, like MFS before we bought them, it will reach the point where it has to produce a steady stream of increasing earnings. WorldCom is already there," he said.

At the heart of Ebbers' revenue growth is the Gorilla. The companies that will comprise MCI WorldCom brought in total Internet service revenues of some $1.3 billion in 1997 or more than six times AT&T's WorldNet. With Internet revenues growing at a quarterly rate of nearly 25 percent, WorldCom's Internet revenues will comprise more than half their total by the second half of 2000. Although MCI gives WorldCom a powerful stake in the existing system, WorldCom is perfectly positioned to shift revenues onto the net through their IP fax and voice offerings.

None the less, Ebbers is facile in dismissing the promise of Qwest, Level 3, IXC, and Williams. Telecommunications is in a supremely fertile phase and there is room for a large range of strategies in attacking the old establishment and creating a central nervous system for a new world economy. Qwest is currently charging 7.5 cents a minute. But Andrew Kessler of **Velocity Capital** in San Francisco estimates that when their network is completed late next year, their

By quietly installing fiber and advanced WDM gear while the other carriers talked about it, Qwest became the leader.

ASCENDANT TECHNOLOGY	REPORT(S) Volume: No.	COMPANY (SYMBOL)	Reference Price	Price as of 2/27/98
Cable Modem Service	I: 2, 3; II: 7, 8, 9, 11, 12	*@Home* (ATHM)	19 1/2	34 1/8
Analog to Digital Converters (ADC), Digital Signal Processors (DSP)	II: 3, 7, 12; III: 2	*Analog Devices* (ADI)	22 3/8	32 5/16
Java Thin Client Office Suite, Rapid Application Development (RAD)	II: 6, 7, 12	*Applix* (APLX)	4 1/2	5 5/8
Low-Cost Single-Chip Broadband Data Transmission Chips	II: 10; III: 3	*Broadcom Corporation* (private) +	Anticipated IPO	
Digital Video Codecs	II: 5	*C-Cube* (CUBE)	23	20 3/4
Low Earth Orbit Satellites (LEOS)	I: 2; II: 1, 3, 4, 8, 10	*Globalstar* (GSTRF)	21 3/4	67 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, 12; III: 1, 2, 3	*Lucent Technologies* (LU)	47 1/8	108 1/4
Single-Chip Systems	II: 8, 12	*National Semiconductor* (NSM)	31 1/2	23 7/8
Internet Software	I: 1, 3, 4; II: 1, 4, 6, 7, 8, 10, 12	*Netscape Communications* (NSCP)	53	19 3/8
Telecommunications Equipment, Wave Division Multiplexing (WDM), Code Division Multiple Access (CDMA), Silicon Germanium (SiGe)	II: 1, 7, 9, 11, 12; III: 1, 2, 3	*Northern Telecom* (NT)	46	53 1/4
Wave Division Multiplexing (WDM), Satellite and Wireless Systems, Code Division Multiple Access (CDMA)	II: 10	*Ortel* (ORTL)	20 3/4	12 5/8
Point to Multipoint System for 7-50 Ghz, Spread Spectrum Broadband Radios	II: 10, 11	*P-COM* (PCMS)	22 3/8	20 1/4
Code Division Multiple Access (CDMA)	I: 1, 2; II: 1, 3, 4, 7, 8, 9, 10, 11	*Qualcomm* (QCOM)	38 3/4	51
Nationwide Fiber Network	II: 9, 10, 11; III: 1, 2, 3	*Qwest Communications* (QWST)	20 3/8	35 1/8
Java Programming Language, Internet Servers	I: 1, 2, 3, 4; II: 1, 5, 6, 7, 8, 10, 12	*Sun Microsystems* (SUNW)	27 1/2	47 5/8
Optical Equipment, Smart Radios, Telecommunications Infrastructures	I: 1; II: 1, 2, 3, 9; III: 3	*Tellabs* (TLAB)	29 1/8	60 3/8
Broadband Wireless Services	II: 9, 10, 11, 12	*Teligent* (TGNT)	21 1/2 *	34 15/16
Digital Signal Processors (DSP), DRAM	I: 2, 3, 4; II: 5, 8, 11, 12; III: 3	*Texas Instruments* (TXN)	23 3/4	58
Wave Division Multiplexing (WDM) Modulators	II: 7, 9, 10	*Uniphase (UNPH)*	29 3/8	40 1/16
Code Division Multiple Access (CDMA) Testing Gear	II: 1, 2, 7	*Wireless Telecom Group* (WTT)	10 3/8	8 3/8
Telecommunications, Fiber, Internet Access	II: 9, 10, 11, 12; III: 1, 2, 3	*WorldCom* (WCOM)	29 15/16	38 3/16
Field Programmable Logic Chip	I: 3	*Xilinx* (XLNX)	32 7/8	43 7/8

\+ New Addition * Initial Public Offering

New Addition: Broadcom. To date, we have not listed any privately held companies on our table. However, Broadcom (see Chart 3, page 4), an anticipated IPO in late March, with the symbol BRCM, will be publicly traded prior to the publication of our April issue. For further information on this IPO, contact Morgan Stanley & Co. Inc. or BT Alex. Brown Inc., the underwriters.

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.

real costs will drop to near 1.5 cents. At this rate, they could triple AT&T's current margins and capture much of the business. AT&T by contrast is trying to milk its current market share dominance, actually raising the price of T-3 lines. This stance bespeaks a profound vulnerability.

Nayal Shafei speaks of his company in terms of a diluvian myth. Before I left his office, he gave me a copy of *The Epic of Gilgamesh,* an ancient Mesopotamian saga of the Flood, resembling the Noah story. Reading it, I came to understand better Shafei's visionary passion. With a warrior named Enkidu, Gilgamesh experiences a saga of transfiguration, in which the dimensions of ancient reality emerge from the flood entirely transformed. Shafei grasps that today is an era of transfiguration no less far reaching than the epoch of the flood, that telecommunications is wreaking a diluvian deliverance from time and distance, that he and his rivals in bandwidth abundance are forging a new world of radically different constraints and opportunities.

Shafei comprehends that he and Nacchio–and the other gladiators of glass–are engaged in a truly titanic struggle. When they are through, the old tribal tribulations of nationalism, the afflictions of feral Marxist philosophy and zero sum violence, the sclerotic hierarchies of the corporate state and its parasite businesses, the powers and principalities of the old PTTs, the TV broadcasting establishment, and the degraded culture of mesmerized masses will be swept away.

Neither Shafei nor anyone else fully knows what will emerge in their stead. But they do not fear the future. Beyond the rainbow, Gilgamesh and Enkidu were left on the other shore confronting the residual limits of human life, mortality and light. A richer wisdom and a wider wealth would seem a boon worthy the winning.

George Gilder, March 2, 1998

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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