WILL AT&T SURVIVE TERAYON?

In 19 months as Chairman, C. Michael Armstrong has donned some $120 billion dollars in uppity acquisitions in order to fit out **AT&T** (T) for the Telecosm. But we're boss around here (particularly in my dreaded second person plural), and we can report that Armstrong has not been consulting us.

When AT&T begins swinging its weight, though, even Telecosm investors have to take notice. Through his merger with TCI, Armstrong took a controlling interest in our broadband cable superstar **@Home** (ATHM). He outmaneuvered both **Comcast** (CMSCA) and Bill Gates to capture **MediaOne** (UMG), a fast growing cable service holding a one third share of Roadrunner, @Home's main US rival.

You already know we like cable. It's the poor man's WDM (wavelength division multiplexing), sending many different frequencies of radiation down the coax, each assigned to a different channel. But Armstrong also is rich in optics, wearing a radiant diadem of some twenty thousand route miles of precious antique fiber and wielding some 1.5 million Internet subscribers, more than any other telco.

Is AT&T becoming a Telecosm company?

Just checking to see if you were awake. Readers who have been following the lively exchanges on this subject on the forum at www.gildertech.com will know that Armstrong still has a long way to go.

For this report, Ken Ehrhart returned with bleary eyes from a party-pooping plunge into AT&T PR confetti, finding the company in headlong retreat from the telecosmic future, but **Terayon** (TERN) breaking out like **Qualcomm** (QCOM).

Admittedly Armstrong does walk

> **AT&T's Armstrong promises "consumers broadband services at equivalent or lower cost than what they're paying for narrowband services today."**

like a duck, and often talks like a duck: "That's our future in communications–end-to-end broadband. … *Technology is driving us there.* …The world of photonics is unfolding at a pace that is one and a half times Moore's Law."

Most dramatically, rather than seeking to shield AT&T's existing T1 line revenues, he promises "consumers broadband services at equivalent or lower cost than what they're paying for narrowband services today." He even stresses that @Home, one of GTR's hottest picks, "is strategic and integral to AT&T's vision."

But this duck won't fly. Unfortunately, while listening to the technology, Armstrong only heard what he wanted to hear. That was hundreds of millions of dulcet voices warbling over an AT&T network, that *mutatis mutandis*, is much like the AT&T networks of old. With its business accounts and some 61 million consumer long-distance customers, long distance voice last year accounted for nearly 90 percent of AT&T revenues.

In Armstrong's vision, the best path to more revenues is more voice, wrested from the RBOCs (regional bell operating companies) that hold 97 percent of the local telephone business. The Internet protocol opens the door for AT&T to go around the RBOCs by allowing telephone calls to share cable lines with television signals and bypass the RBOCs' fees and facilities. The annual difference between the estimated one-half cent per minute cost to the local telcos and the three cents per minute charge to long-distance carriers amounts to what Armstrong terms a $10 billion tax.

Armstrong says he would like to duplicate in the local market the kind of changes seen in long-distance

Voice will be a rivulet on an Amazon of data flow, priced as a loss leader or seamlessly bundled with data services.

markets since the AT&T breakup 15 years ago, which, crows Armstrong, brought about "a 50 percent reduction in long-distance prices."

Sorry, that 50 percent price drop in long distance over 15 years is hardly Telecosmic. The bottom is dropping out of the voice market as the bandwidth blowout accelerates.

To take just one recent example, **Nortel**'s (NT) new 1.6 Terabit per second WDM system carries 160 times more bits per fiber than the maximum just four years ago and could hold 25 million voice calls on a single fiber at once.

Fifty years ago, a forgotten wag famously predicted that every adult woman in America would have to become an AT&T operator to keep up with demand. Now, it appears that every American man, woman, and child will have to spend every waking moment of the day chattering away, preferably on conference calls, to make a dent in available bandwidth, bandwidth so abundant that the marginal bits per second–such as 64 kilobit voice channels–will be virtually costless. That means someone will offer it virtually for free. Voice will be a rivulet on an Amazon of data flow, priced as a loss leader or seamlessly bundled with data services.

There goes AT&T's voice-based business plan. But you'd never know it listening to AT&T's plans for all those cable customers it is acquiring. Cable is the one resource that should be making AT&T more telecosmic, and yet their plan for it is…more voice. AT&T's official forecast for 2004 predicts 36 percent more local cable telephony customers (7.6 million) than cable modem subscribers (5.6 million) and over 3 times more local telephony revenue ($6 billion) than data revenue ($1.9 billion). Translation: despite Armstrong's alleged enthusiasm for broadband, AT&T is going to put more effort into persuading customers to switch from one local phone provider to another (AT&T) than into hooking people into the Telecosm. Not only will AT&T be wasting our time in a near zero sum dynastic rivalry with its offspring, but it will also be wasting the broadband cable resource that it has captured.

AT&T even carried its worthless obsession with competing with RBOCs on voice to the point of jeopardizing its broadband future. It's control of @Home is contingent on meeting quotas for signing up cable modem subscribers. Pushing TCI to emphasize cable telephony trials, it missed the cable modem targets and was forced to renegotiate a weaker position, giving **Cox** (COX) and Comcast, acting together, a veto over AT&T's decisions.

The only profitable voice services will be wireless.

AT&T is very proud of its cellular offerings. But here the company is painting itself into a Time Division Multiple Access (TDMA) corner, while the rest of the world goes Code Division Multiple Access (CDMA). If you are just doing voice, TDMA is okay. But even in mobile applications, data will be crucial. Spreading bits with what is termed a pseudonoise code across the entire band of assigned spectrum, CDMA offers a shared medium for the bursty data that will be the fastest growing market.

AT&T crows about a 23 percent increase in wireless subscribers and a 40 percent rise in wireless revenues in 1998. Compared to the other AT&T businesses, 40 percent growth indeed looked exciting. But globally, wireless customers rose 56 percent in that year, and CDMA customers tripled. AT&T cellular is losing share. Meanwhile, for all the AT&T growth, its wireless earnings actually dropped. And this is before Armstrong has to face a complete overhaul of his network in order to accommodate new Third Generation digital services in CDMA.
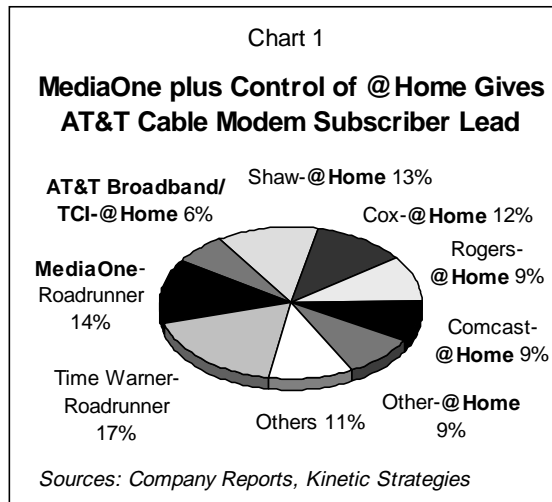
Smart vs. Dumb

AT&T's third cardinal sin, after its voice obsession and its wrong wireless standard, also derives from its legacy as a telephone company. For strategy planners at telephone companies the crowning achievement of the PSTN (public switched telephone network) was the creation of the AIN (advanced intelligent network) which could provision new services using ordinary dumb telephones plugged into a smart network.

Enter Internet protocol and the era of DUMB networking (Digital Ubiquitous Mega Bytes) to every home and office. In dumb networking the network is reduced to light beams and stripped of all extraneous complexity; its main "feature" is that the bits that you shove in one end will come out intact at the other end. The complexity and control of applications is shifted to the network edges where intelligent clients (and servers) interact.

Adding new features such as email, the world wide web, MP3 music distribution, **Foveon** photograph files, or voice telephony does not depend on the network's intelligence, but on the creativity of the users and companies on the network's edge. Simply write and share the client software and an industry is created. Everyone, from engineers designing IP enabled smart phones to new computer users writing simple HTML documents with their word processors, can contribute to the network.

All that intelligence on the edge can be readily hooked onto the same network because the network itself is dumb. Compatibility follows from dumbness.

Chart 1

MediaOne plus Control of @Home Gives AT&T Cable Modem Subscriber Lead

AT&T Broadband/ TCI-@Home 6%

Shaw-**@Home** 13%

Cox-**@Home** 12%

Rogers-**@Home** 9%

Comcast-**@Home** 9%

MediaOne-Roadrunner 14%

Time Warner-Roadrunner 17%

Others 11%

Other-**@Home** 9%

Sources: Company Reports, Kinetic Strategies

A dumb network does not care what is attached to it because its only function is to route bits from one peripheral device to another. The power of the universally compatible Internet, with more than 100 million users, rises as a function of the intelligence added to its periphery at a rate far faster than intelligence could be designed into the network itself.

Yet Armstrong and his engineers already envision a new smart network under AT&T's control to provide "a whole new generation of communications, information and entertainment services." In addition to movies, television, telephones, and other novelties, you will have "a universal mailbox that gathers up your voice mail, email and faxes and gives them to you in whatever form you prefer: a print-out at the office, a voice over your car phone."

These and other features, such as videophones, bundled by AT&T, may be very popular. The problem, according to Armstrong, is that the entire global Internet community has it wrong. "While we all want access to the information, entertainment and communications the 'Net has to offer, we don't want to spend $3,000 on a computer and learn operating systems. We want the access and the useability built in. Built into the network and built into the device." AT&T will improve on the supremely dumb Internet with its own smart network, because, according to Armstrong, "unless we [AT&T] controlled the architecture of what we offered you in terms of the network—I mean the interfaces and the specifications, the protocols, the standards, the platforms—we couldn't control offering you a seamless set of services."

Unfortunately for AT&T, full featured PCs are already selling for one sixth Armstrong's $3000, the majority of us have them in our homes and know how to use them, and over 42 percent of US adults are already regularly accessing the Internet. We are not waiting for Armstrong's smart network. Of course, these PCs will be joined by myriad portable and playable devices, but they are more likely to emerge as smart Java and Jini peripherals, on the edge of the Net than in the "seamless" midst of AT&T.

One of the shrewdest people in the industry, Armstrong is coming a cropper on Joy's Law, the **Sun** (SUNW) magnate's observation that "most of the smartest people are never in your own company." Armstrong and his team are as smart as just about anybody. The problem is they aren't smarter than ev-

erybody, which a centralized smart network would have to be to out-compete thousands of companies, hundreds of thousands of programmers and engineers, and hundreds of millions of customers living and working on the edge.

Conduit vs. Content

For traditional telephone and cable providers, like AT&T, content and conduit are intimately linked. The telephone company provides voice and AIN services (content) through phone lines and a network (conduit) which it controls. A cable company provides cable channels often owned by the company and pay-per-view programs through the cable system, which it controls. The services you receive are those that the telephone and cable companies offer, and through new offerings they derive new revenues.

In an era of bandwidth scarcity the owner of the conduit has no choice but to control and restrict access to it. Content and conduit naturally combine. Thus three TV networks that controlled the limited broadcast conduit to American homes also got to dominate the content of American entertainment.

But bandwidth abundance changes everything. Once you are on a broadband Net, content can come from anywhere. No gatekeeper can successfully dominate content by controlling the conduit. Consumers won't stand for it. You will not have to buy your movies or TV shows from the cable company. They can come from video servers in Montana or Bermuda. Music, video, books, web pages, online gaming will all be available from millions of content producers throughout the world.

No single content provider will be able to compete with all content providers. From consolidated voice, email, and fax messaging to video-on-demand there is no service a centralized AT&T can bundle and market that will not be available from dozens to hundreds of competitively priced sources across the world available to anyone through the Net.

If by some miracle people at AT&T should originate exceptional content, its creators will want to put it on everyone's conduit, not just AT&T's. If AT&T tries to stop them, they will be bid away by competitors that don't play those games and the content will go with its creators. If by another miracle, AT&T ends up with the best conduits, it will want everyone's content to run on them (for that will be the definition of
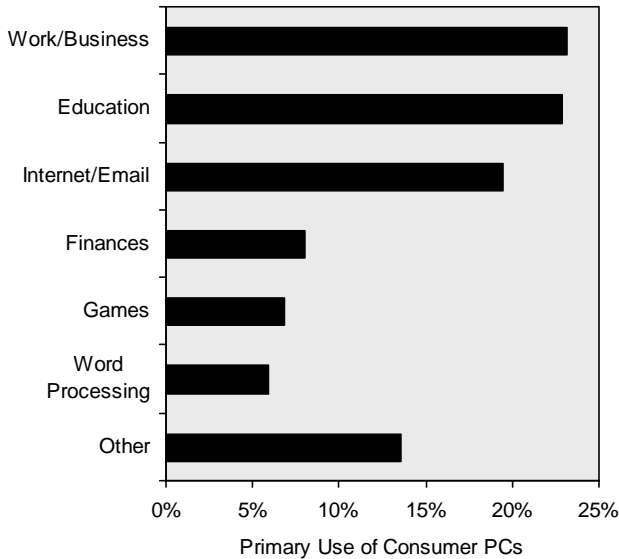
> **The Top Ten Reasons AT&T is Not a Telecosm Company**
>
> 1. They are trying to combine content and conduit, which is a capital crime in the Telecosm.
> 2. Traffic and profits migrate to the least regulated arena and AT&T is a cynosure for lawyers.
> 3. They have lousy rights of way based on microwave lines of sight.
> 4. They have lousy fiber from past generations.
> 5. They want to create a smart network, full of lucrative services.
> 6. Over 90 percent of their revenues come from voice traffic at a time when non-mobile voice will be nearly free.
> 7. Their wireless is TDMA at a time when the rest of the world is shifting to CDMA.
> 8. Their shareholders are still dividend addicts.
> 9. Their best executives left and are now competing with them.
> 10. AT&T took $5 billion to go to bed with Microsoft. Thus it is combining the oldest capital plant with the oldest profession.
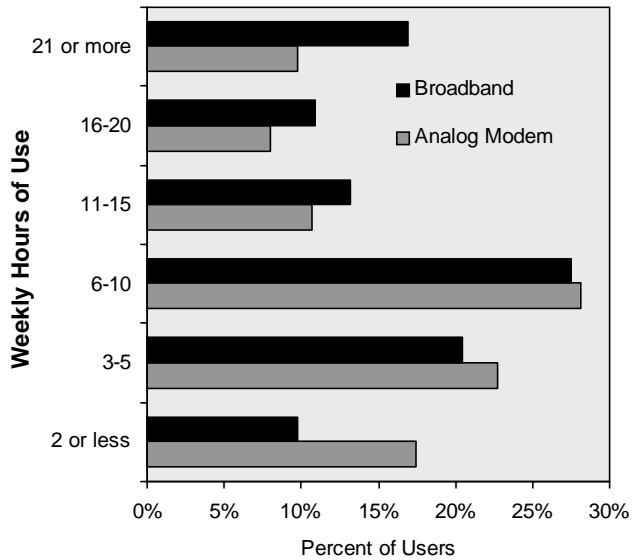
Armstrong and his team are as smart as just about anybody. The problem is they aren't smarter than everybody.

INTERNET GAINS WITH BROADBAND

Chart 2
Internet Joins Education and Work as Primary Use of PCs

Categories (top to bottom): Work/Business, Education, Internet/Email, Finances, Games, Word Processing, Other

X-axis: 0%, 5%, 10%, 15%, 20%, 25%

Primary Use of Consumer PCs

Source: ZD Market Intelligence

Chart 3
Broadband Connections Top Analog Modems in Hours of Use

Weekly Hours of Use (top to bottom): 21 or more, 16-20, 11-15, 6-10, 3-5, 2 or less

Legend: ■ Broadband, ▨ Analog Modem

X-axis: 0%, 5%, 10%, 15%, 20%, 25%, 30%

Percent of Users

Source: ZD Market Intelligence

The Internet has Joined Education and Work as a Top Primary Use of Consumer PCs.

The Internet, including Internet/Web use and research or email, is the primary use of one in five consumer PCs (Chart 2). Though home-based business use (14.4%) and work brought home from the office (8.8%) raise work-related use to first place, and educational/school use by an adult (11.7%) or child (11.2%) put educational use in second place, each of those primary uses includes a large secondary demand for Internet use. Other primary uses, such as finances and game playing, also benefit with Internet connections.

Broadband Net Users Online More, and More Active Across the Range of Online Applications.

Even though they spend less time waiting for downloads of pages and files, Internet users with broadband connections spend more hours online each week than users connecting with much slower analog modems (Chart 3). Granted, more experienced and heavier users are likely to sign up for broadband before more casual users, but the heightened online experience of broadband clearly increases usage. Not only are bandwidth dependent activities such as software downloads more popular, but even relatively narrowband uses such as email also increased among broadband users. Broadband users are nearly twice as likely as analog modem users to participate in a range of activities from online purchases and personal finance to interactive chat and game playing (Chart 4).
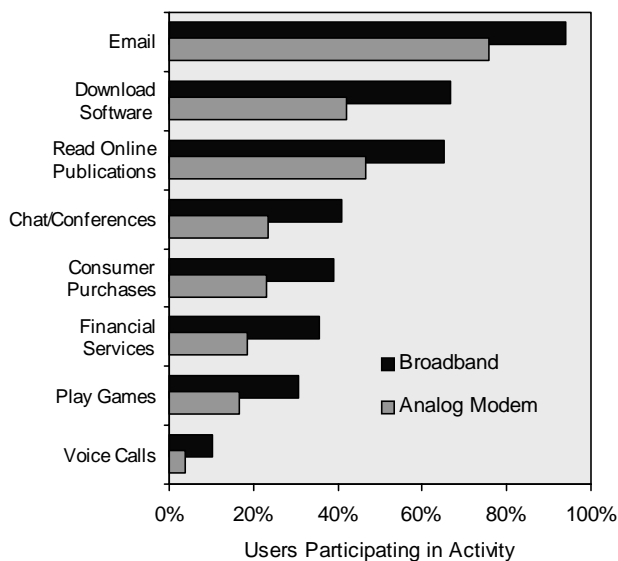
Though Broadband Users Lead in E-commerce Activity, 75% of all Internet Users have Purchased Online.

Internet users are not waiting for broadband to jump on the e-commerce wagon. Of all Internet users 75% have made an online purchase (Chart 5). For most users, their first purchase is the hardest, and confidence, buying activity and frequency rise with online experience.
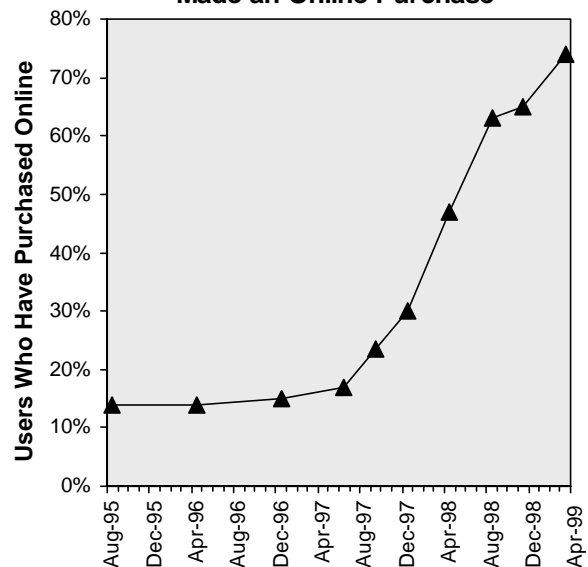
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Chart 4
Broadband Users More Active Across the Board

Categories (top to bottom): Email, Download Software, Read Online Publications, Chat/Conferences, Consumer Purchases, Financial Services, Play Games, Voice Calls

Legend: ■ Broadband, ▨ Analog Modem

X-axis: 0%, 20%, 40%, 60%, 80%, 100%

Users Participating in Activity

Source: ZD Market Intelligence

Chart 5
Nearly Every Online User has Made an Online Purchase

Y-axis: Users Who Have Purchased Online — 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%

X-axis: Aug-95, Dec-95, Apr-96, Aug-96, Dec-96, Apr-97, Aug-97, Dec-97, Apr-98, Aug-98, Dec-98, Apr-99

Sources: Greenfield Online, NetRatings, CommerceNet, Intelliquest

Chart 6
N. American Cable Modem Subscribers Will Pass 1 Million this Quarter

Legend:
- @Home-All Partners
- Road Runner
- Others

Y-axis: US and Canadian Cable Modem Service Subscribers (Thousands) — 100 to 900

X-axis: 1Q97, 2Q97, 3Q97, 4Q97, 1Q98, 2Q98, 3Q98, 4Q98, 1Q99
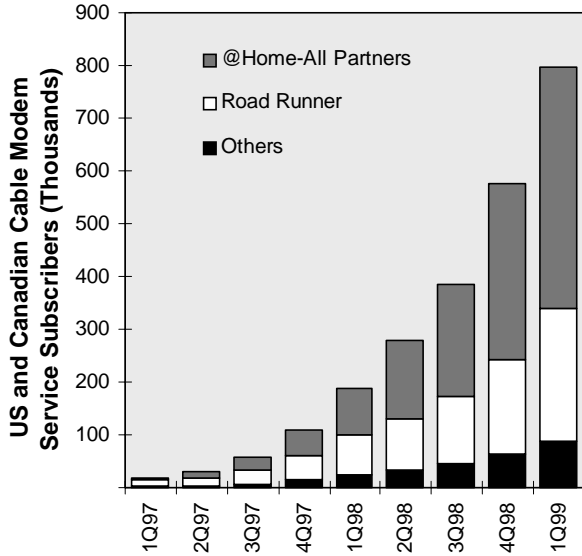
Sources: Company Reports, Kinetic Strategies

Chart 7
MMDS Value Jumps as Worldcom and Sprint Enter Bidding War for Last-Mile Broadband

Legend:
- American Telecasting
- People's Choice TV
- CAI Wireless

Y-axis: Millions of Dollars — $0 to $1,500

X-axis: March-99 Market Cap, April-99 Purchase Price
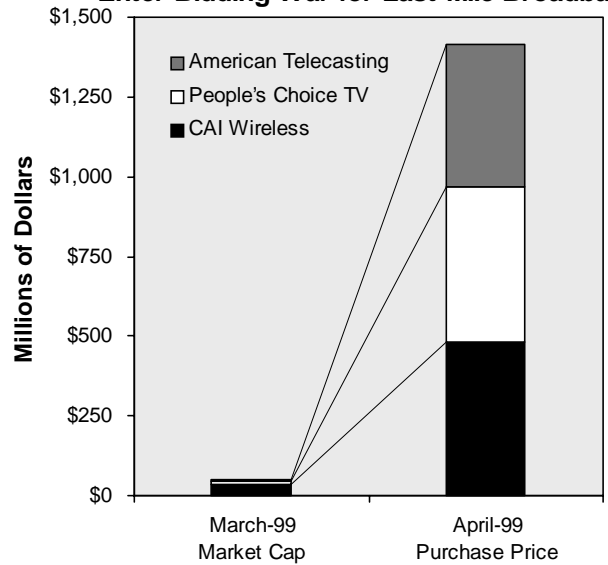
North American Cable Modem Subscribers to Top 1 Million this Quarter.

The number of cable modem subscribers in the US and Canada is nearing 1 million (Chart 6). WebSideStory reports the combined share of Roadrunner and @Home cable modem subscribers, among over 23 million daily visitors to more than 64 thousand web sites, rose from 2.18% in January 1999 to 2.6% in April 1999. Time Warner reports 14.55% market penetration in its flagship Portland, Maine rollout. And MediaOne reports 10% average penetration of homes passed in markets with service for at least 18 months.

MCI Worldcom and Sprint Wage Wireless Bidding War in Effort to Catch AT&T and Bypass Local Telcos.

In response to AT&T's move into cable as a means to offer broadband services and bypass the local telcos, MCI Worldcom and Sprint started a bidding war for wireless cable companies using the MMDS spectrum. The value of three MMDS companies shot up some 27 times in less than a month as MCI purchased CAI Wireless and Sprint bought People's Choice TV and American Telecasting (Chart 7). Sprint then bought wireless holdings from Groupe Videotron and Transworld and MCI bought PrimeOne's LA holdings. Though the MMDS frequency is less desirable and capacious than the higher frequency LMDS and 38GHz licenses owned by Nextlink, Teligent, WinStar and others, the MMDS players have begun rollouts of two-way Internet access.
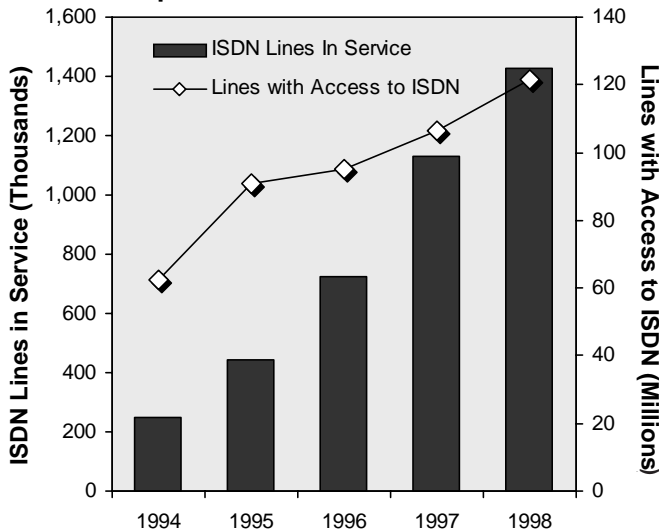
Despite Relative Failure of ISDN, Local Telcos Hope for ADSL Success.

ISDN has had a rocky history, from difficulty in provisioning service to per-minute charges and speeds just over 2 times analog modems. Despite nearly 1.5 million users, ISDN penetration has been slight among the 120 odd million access lines with ISDN availability (Chart 8). Now, the local telcos are hoping to put ISDN horror stories behind them and succeed with much faster ADSL service. After dropping ADSL prices to within the range of cable modem service, the telcos are beginning to count subscribers (Chart 9). DSL low price leader US West (starting at $29/month), has captured 40% of the emerging market.
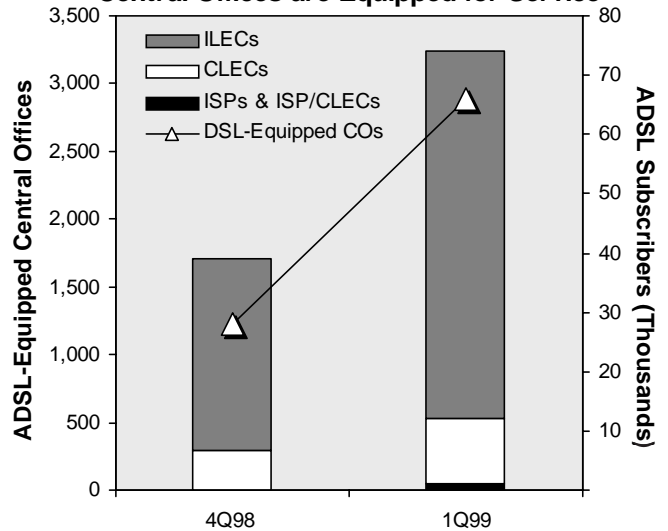
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Chart 8
Despite Availability to 78% of all Access Lines 128Kbps ISDN Penetration Has Been Slow

Legend:
- ISDN Lines In Service
- Lines with Access to ISDN

Left Y-axis: ISDN Lines in Service (Thousands) — 0 to 1,600
Right Y-axis: Lines with Access to ISDN (Millions) — 0 to 140

X-axis: 1994, 1995, 1996, 1997, 1998

Source: FCC

Chart 9
US Subscribers to ADSL Climbing as Telco Central Offices are Equipped for Service

Legend:
- ILECs
- CLECs
- ISPs & ISP/CLECs
- DSL-Equipped COs

Left Y-axis: ADSL-Equipped Central Offices — 0 to 3,500
Right Y-axis: ADSL Subscribers (Thousands) — 0 to 80

X-axis: 4Q98, 1Q99

Source: Telechoice

Using Terayon's system, Shaw plans to become the first operator with 100% cable modem coverage.

the best conduits). The separation of the two domains is the essence of the Telecosm.

AT&T has made a major contribution to the conduit side of this paradigm by affirming our view of the superiority of cable and creating a massive market for cable modems. **Motorola** (MOT) and Nortel / LANCity are the incumbent cable modem leaders. But look north to Canada or east to Asia, and you will find a Telecosm pure play, Terayon, ahead of the field. In the January 1997 GTR, we declared that Terayon's technology "transformed the horizons" of the cable industry, by increasing "the number of homes eligible for fast Internet cable service from 10 million to over 60 million." As a result, we asserted that "wireline winners will include Terayon, TCI, Comcast, and **US West** (USW)" [then the owner of Media One].

The thick coaxial cable used in cable systems is intuitively more capacious than the thin twisted copper pairs used for phone lines. DSL (digital subscriber line) providers must cram enough data through those little wires point-to-point over long distances, all the while limiting noisy interference with neighboring wires twisting through the same bundle. Cable modem providers, however, have their own challenges. They must find a way to make one-way cable plant accommodate two-way data streams twisting through a shared tree and branch structure spread through a neigborhood.

All along the coax path the splits and amplifiers in the lines introduce noise into the system. In the upstream direction–from home to headend–the same noise is compounded and funnelled as the branches rejoin the trunks. Furthermore in the spectrum used for upstream transmission–mostly the "lower forty" megahertz in the pipe–the coax cable itself acts as a large antenna receiving interference from nearly everything that spikes and vibrates in the area, from garage door openers to hairdryers, from CD radios to AM radio and TV harmonics.

The expensive answer to these noise problems is to upgrade the system, laboriously adding fiber and coax, moving nodes closer to homes, severing branches from each trunk, removing old cables, splits, and amplifiers, all in all reducing the number of homes sharing each node.

Terayon Breaks Out

The cheap and effective answer is Terayon's cable modem technology. Based on the same spread spectrum noise defeating principles as **Qualcomm**'s (QCOM) CDMA, Terayon's modems encode the data signals and spread them across the available upstream spectrum. The wide and weak signal escapes the noise and is decoded at the other end. Any components

blocking two-way traffic still must be replaced. But Terayon's system will work on older, noisy, all coax systems without the expense of fiber upgrades and node splits. In addition, the spread spectrum system exploits all the bandwidth all the time, using the codes to differentiate the signals sharing the conduit. Thus, like wireless CDMA, it can gracefully accommodate bursts of data, such as a rapidly downloaded film or webfile.

On May 25th, Terayon announced that its S-CDMA (synchronous-CDMA) technology now enables Terayon modems to operate at a full 14 megabits per second in previously unused *downstream* cable spectrum where signal loss prevents the transmission of video channels. In order to offer broadband Internet service, cable operators with maxed out older systems no longer need either to sacrifice existing video channels or upgrade capacity.

In the early cable modem market Terayon's superiority went unrewarded. Unwilling to adapt to the existing cable regime, Terayon spurned the DOCSIS (data over cable service interface specification) standard. As it is, Terayon's new DOCSIS compliant modem will not be available until early next year. Cable providers with already upgraded cable, or plans for upgrades, signed long term supply agreements for hundreds of thousands of modems with Nortel/ LANCity and Motorola.

But Terayon was not sidelined for long. Making a potent presentation at our 1997 Telecosm Conference, Terayon persuaded the @Home network to test and approve S-CDMA equipment for use by its affiliates. Using Terayon modems and headend equipment, **Shaw Communications** (SJR) in Canada became the first @Home affiliate to pass 100,000 subscribers, and North America's most successful cable modem service as measured in penetration levels (7% of ALL homes passed–not merely served markets and over 17% penetration of some markets). At the time of choosing Terayon's system, Shaw cited its superiority in cost-effective and timely deployment. Now Shaw plans to accelerate the rollout of cable modem availability to its entire system of 2.3 million homes passed within six months, becoming the first operator with 100 percent cable modem coverage.

In a breakthrough resembling Qualcomm's CDMA triumph in Third Generation wireless, Terayon's technology finally prevailed last November, when Terayon was asked by CableLabs to join with **Broadcom** (BRCM) in authoring the next generation DOCSIS 1.2 standard. Terayon will join with other standards participants offering their patents into a shared pool of intellectual property, but Terayon

Chart 10
Terayon Revenues Climb as S-CDMA Gains Acceptance

Source: Company Announcements
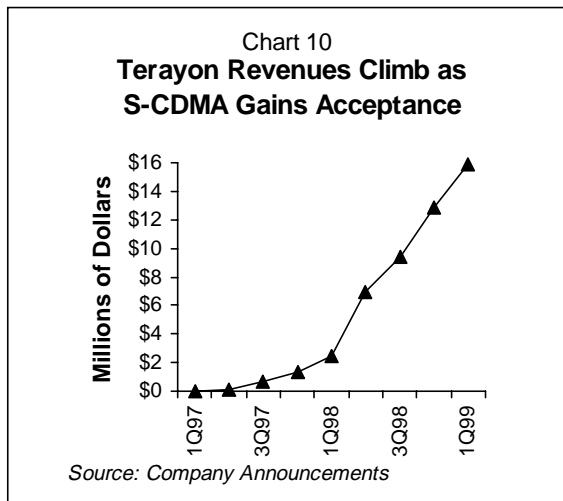
retains the rights to its trade secrets in implementing its technology. We will take process know-how and learning curve leadership over patent hoarding any day. Already developing a highly integrated, low cost chip based on the initial drafts of the DOCSIS 1.2 standard, Terayon should do well following the Qualcomm model, selling not only its own modems but also ICs and technical assistance.

The admittance of Terayon to the cable industry's inner circles was reinforced on May 26, when the Society of Cable Telecommunications Engineers announced it had elected as chairman Jim Kuhns, a senior field applications engineer at Terayon.

Expanding on its Canadian success with Shaw, Terayon announced March 1st that **Access Communications**, another of Canada's top ten cable operators, switched to Terayon's system. Benefiting immediately from S-CDMA's RF noise immunity, Access reported a 95 percent decrease in RF related service calls. Later in March, Terayon and Canada's largest cable operator, Rogers Cablesystems, a division of **Rogers Communications** (RG), announced a supply agreement for modems and headend equipment. Rogers found Terayon's modems superior regardless of its highly upgraded cable plant which is already 85 percent two-way activated.

With two thirds of the Canadian market, Terayon's Northern presence dwarfs its US successes at **TCA** (TCAT), **Cablevision Systems** (CVC), and **Frontiervision**. But the company has dazzled its sponsors at TCA in Texas (now being bought by Cox), which reports that an amazing 85 percent of its Terayon customers have been able to install the equipment without any outside help.

Moving South, Terayon has captured the largest operators in Mexico and Venezuela, and a major Brazilian network. In March, Terayon claimed Europe's largest cable modem order, a rollout of 225,000 modems plus headend equipment for **United Pan-Europe Communications** (UPCOY) in the Netherlands, Norway, France, Hungary and Malta. Ramping across Europe like @Home in North America, UPC subsidiary Chello is offering Terayon's Internet service through both UPC's cable systems and through other cable affiliates. Other Terayon deals in Europe include **Brutele's** roll out in Brussels, Belgium, the most cabled European market. As this is written, 12 Swiss cable operators have announced they will deploy Terayon's cable modem systems in their networks passing more than 330 thousand homes. Crucial to

the decision was speed of deployment, with minimal upgrades.

In Asia, where Terayon is the market leader, noisy Japanese systems first showed off Terayon's noise immunity in the field and attracted **Sumitomo** (SMTOY) as a distributor. Last October, Japan's largest cable operator, **Jupiter Telecommunications**, a joint venture between TCI International and Sumitomo, selected Terayon modems and headend equipment. Now, @Home Japan has been formed jointly by @Home (42.9%), Jupiter (35.7%) and Sumitomo (21.4%), initially covering 5.1 million homes passed in 29 markets or some 10 percent of Japanese homes. If Sumitomo's partners TCI International and @Home are impressed, then Terayon's Japanese success may spread to AT&T contracts back home, where AT&T's TCI has lagged its other @Home partners in subscriber numbers in part due to the poor quality of its cable plant.

Terayon is beginning to see the benefits of its growing recognition. First quarter modem shipments of 38 thousand units were up 31 percent over the fourth quarter of 1998, and revenues rose 23 percent quarter-to-quarter and 549 percent over the previous year's first quarter to $15.8 million.

Listening to the technology, one should bet on Terayon's S-CDMA. If you want to hedge your bets, Broadcom has proven success. While Terayon developed their own modems from start to finish–contracting with VLSI to manufacture their chips and **Solectron** (SLR) and **Kinpo** to assemble their modems–Broadcom makes the chips for nearly every other cable modem manufacturer and will be a second source for S-CDMA. Broadcom also makes chips for ADSL (asymmetric DSL), high speed home networking, and gigabit ethernet over standard LAN wiring. Modem chip powerhouse **Conexant** (CNXT) has a commanding position in SDSL (symmetric DSL), with a million units projected in 1999, and will also benefit from the growth of the cable modem market. Though Conexant is new to this market, its ties to PC and modem OEMs (original equipment manufacturers) will give them entrée with sales of cable modem and DSL chips for motherboards.

Chart 11
Terayon Cable Modem Shipments Accelerate

Source: Company Announcements

Can Global Crossing Take-Out AT&T?

About the time US West's sister cable company MediaOne agreed to merge with AT&T, ADSL leader US West proposed a merger with **Global Crossing** (GBLX).

You can't win them all. In an ideal world, the pairings would be reversed. But, as things stand,

Listening to the technology, one should bet on Terayon's S-CDMA.

TELECOSM TECHNOLOGIES
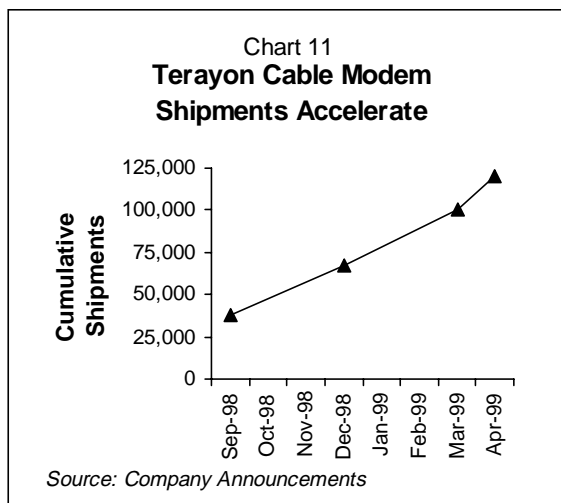
ASCENDANT TECHNOLOGY	COMPANY (SYMBOL)	Reference Date	Reference Price	5/99: Month End
Cable Modem Service	@Home (ATHM)	7/31/97	19 1/2	126 3/4
Silicon Germanium (SiGe)	Applied Micro Circuits (AMCC)	7/31/98	22 11/16	59 1/8
Analog to Digital Converters (ADC), Digital Signal Processors (DSP)	Analog Devices (ADI)	7/31/97	22 3/8	38 7/16
Dynamically Programmable Logic, SiGe, Single-Chip Systems	Atmel (ATML)	4/3/98	17 11/16	19 3/4
Single-Chip Broadband Data Transmission	Broadcom Corporation (BRCM)	4/17/98	12 *	95 3/4
Digital Video Codecs	C-Cube (CUBE)	4/25/97	23	25 1/16
Erbium Doped Fiber Amplifiers, Wave Division Multiplexing (WDM)	Ciena (CIEN)	10/9/98	8 9/16	28 3/4
Linear Power Amplifiers, Cable Modems	Conexant (CNXT)	3/31/99	27 11/16	38 3/4
Fiber Optic Cable, Components, Wave Division Multiplexing (WDM)	Corning (GLW)	5/1/98	40 15/16	54 5/8
Submarine Fiber Optic Networks	Global Crossing (GBLX)	10/30/98	14 13/16	47 7/16
Low Earth Orbit Satellites (LEOS)	Globalstar (GSTRF)	8/29/96	11 7/8	17 11/16
Business Management Software	Intentia (Stockholm Exchange)	4/3/98	29	24 1/2
Wave Division Multiplexing (WDM), Fiber Optic Equipment	JDS Fitel (Toronto Exchange)	5/1/98	19 1/4	67 11/16
Broadband Fiber Network	Level 3 (LVLT)	4/3/98	31 1/4	78 1/2
Single Chip ASIC Systems, CDMA Chip Sets	LSI Logic (LSI)	7/31/97	31 1/2	37 1/16
Telecommunications Equipment, WDM, CDMA, SiGe	Lucent Technologies (LU)	11/7/96	11 25/32	56 7/8
Telecommunications, Fiber, Internet Access	MCI WorldCom (WCOM)	8/29/97	29 15/16	86 3/8
Single-Chip Systems, Silicon Germanium (SiGe)	National Semiconductor (NSM)	7/31/97	31 1/2	19 3/8
Nationwide Fiber and Broadband Wireless Networks	Nextlink (NXLK)	2/11/99	40 7/8	76 1/2
Telecommunications Equipment, WDM, CDMA, SiGe, Cable Modems	Nortel Networks (NT)	11/3/97	46	75
Point to Multipoint (7-50 Ghz), Spread Spectrum Broadband Radios	P-COM (PCMS)	11/3/97	22 3/8	4 13/32
Code Division Multiple Access (CDMA)	Qualcomm (QCOM)	9/24/96	19 3/8	97 1/4
Nationwide CDMA (Code Division Multiple Access) Wireless Network	Sprint PCS (PCS)	12/3/98	15 3/8	45
Java Programming Language, Internet Servers	Sun Microsystems (SUNW)	8/13/96	13 3/4	59 3/4
Broadband Wireless Services	Teligent (TGNT)	11/21/97	21 1/2 *	49 1/8
CDMA Cable Modems	Terayon (TERN)	12/3/98	31 5/8	32 1/8
Digital Signal Processors (DSPs)	Texas Instruments (TXN)	11/7/96	23 3/4	109 3/8
High-Speed Copper Networking	Tut Systems (TUTS)	1/29/99	18 *	41 1/2
Wave Division Multiplexing (WDM) Modulators	Uniphase (UNPH)	6/27/97	29 3/8	134
Field Programmable Gate Arrays (FPGAs)	Xilinx (XLNX)	10/25/96	16 7/16	44 7/16

* Initial Public Offering

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.

the Global Crossing/Frontier/US West tracking stocks G (Global, growth, good) and L (Local, low, litigious) should shield Winnick's Empire from strategic compromise, as @Home's stock separates the good from the bad at AT&T.

Unlike LCI which entangled **Qwest** (QWST)in a quagmire of long distance margins and technology, US West does not create a legacy problem for Global Crossing. US West is prohibited from doing long distance. Nothing in the prospective deal interferes with the global undersea system linking the world's most populous cities in a network that focuses on the weakest links of the Internet. Nothing subverts the creation of a new global system of Web hosting hubs that serve as the central offices of a new global ganglion. US West offers potential broadband customers, good CDMA wireless assets, and some cash flow.

Chiefly a financial deal, the merger equates 200 employees in the paradigm with 55 thousand employees outside it. Legacy systems only paralyze if they shape strategy. I see Global Crossing still focused on global dumb broadband. If Armstrong envisions some conduit/content gotcha around cable services and AT&T

brand names, I see GBLX running circles around AT&T. I see Global using US West rather than the other way around. But I admit it will take a further rachet of management and strategic genius.

Global Crossing's Robert Annuziata previously headed Teleport Communications, leaving after its acquisition by AT&T and a brief tenure as head of AT&T's business services. He has seen the competition and bet with his feet. The Telecosm savvy will follow his path.

George Gilder and Ken Ehrhart, June 4, 1999