DISCOVERY INSTITUTE

Inquiry

October 2001
Vol. X No. III

Broadband or Bust!

Networking Society to Accelerate Economic Growth

By: George F. Gilder and John Wohlstetter
Senior Fellows
Discovery Institute

Discovery Institute
1402 Third Ave., Ste. 400
Seattle, WA 98101
www.discovery.org

Introduction

A front page article in the New York Times succinctly summed up the longer-term implications of the technology sector implosion that began in March 2000: The number of applicants taking the Law School Admissions Test rose 18.6 percent over June 2000, with an even greater increase forecast for the October 2001 sitting; law school applications also rose 5.6 percent, the highest jump since 1995. The "dot-com" kids are switching to study law, in pursuit of job stability.[1] Just what America needs as its tech sector, prime driver of domestic economic growth since 1995, faces negative financial leverage, broadband (*i.e.,* high-speed Internet) connections limited by legacy networks, ham-fisted regulation and now a homeland under attack: *more lawyers*. Does anyone believe we are better off if "dot.sue" supplants dot.com?

The jump in economic growth in the late 1990s was in significant measure driven by growth in the information technology (IT) sector, which includes the computer hardware, software and telecommunications industries. Since the March 2000 bursting of the dot.com stock market bubble, share prices and earnings of IT companies have plunged. Sagging economic growth is hampering efforts of surviving firms to resume earnings growth and thus continue to play their indispensable role in powering American economic expansion. Moreover, this bad news was pre-September 11. The advent of a shooting war with further terror attacks on American soil considered certain to come creates investment uncertainty. A recession is probably underway, and the technology sector, already hit hard, is under particular pressure.

A factor of growing importance in IT sector growth is "broadband," a term used in this paper to encompass high-speed Internet access and streaming full-motion high-resolution video, including two-way capability for all services. Today's broadband services are more limited, due to legacy wireline networks: telephone companies provide broadband via Digital Subscriber Line (DSL), which transmits data and video over the copper wire high-frequency spectrum; cable modems connect over networks historically limited as to two-way capability. Wireless broadband is just beginning to reach the marketplace; existing satellite offerings are limited to non-real-time services due to geostationary orbit constraints.

There are many who feel that broadband is rolling out at a commendable pace already, even faster than other consumer technologies. Further, they argue that there is a glut of optical fiber capacity, and therefore no action is necessary to accelerate broadband roll-out. They are wrong. The fiber glut is temporary and confined to long distance service. Lack of fiber in the loop limits residential braodband speeds to well below advertised rates, both for cable and telephone company offerings. And while broadband penetration has been faster than earlier consumer technologies, those earlier technologies made their debut under far less favorable economic conditions, and faced other special retarding factors as well. But even if the "glut" argument were correct it misses the point: Accelerated broadband deployment is increasingly important to re-ignite computer growth, and thus the IT sector, prime driver of the new economy. On this, listen to Hewlett-Packard's CEO, Carleton Fiorina, and Microsoft's Bill Gates.

Speaking at Progress and Freedom Foundation's 2001 Aspen Summit, Fiorina called for broadband deregulation to unlock the potential of networked computing and drive the next round of economic growth. Specifically, she termed broadband "essential," stating:

> The telecom industry finds itself in worse shape today than it was before the Telecommunications Act of 1996…only nine percent of Americans who use the 'Net at home have access via broadband.

> [Broadband is] one thread of continuity that will be woven through education, in the reinvention of business, on the global stage as the platform over which information flows….Today we look through our screens into a broadband future that could disperse health, wealth, and knowledge on a significant scale. We have the technological means to do it. Will we let old habits and old laws keep that screen half-dark?[2]

Fiorina added that existing regulatory policies were outmoded, locking telephone and cable companies into "territorial fiefdoms" that could "eliminate the possibility of robust gain for all."[3] Her remarks were made prior to September 11, and the outlook for the computer sector has since worsened.

Hewlett-Packard's chief is not alone: Microsoft Chairman Bill Gates has called broadband progress "slow," stating: "There is no hardware limitation that will affect what you want to do, but there is one exception and that is the cost of broadband communication, primarily to the home."[4] Gates—also pre-attack—recently urged telephone and cable company representatives to meet with government policymakers regarding how broadband might be supplied at $30 per month.[5] He described real-time communication over today's networks as "a mess."[6]

To understand why Chairman Fiorina called for prompt action to accelerate broadband deployment it is best to begin with how broadband fits into the emerging digital economy, and then explain why it is vital to re-ignite new economic growth. Finally, a vision of the potential realization of full-scale broadband rollout reveals a tantalizing world that lies at our fingertips: the staggering potential of optics to liberate us from the inherent limitations of reliance on legacy networks built for purposes that long antedate the advent of the mass market Internet. Optics will radically transform computer networking.

> ***"It has become widely accepted … that the information technology (IT) sector is now the largest driver of economic growth. What is less widely understood is that broadband communications capability is going to be an increasingly vital component of the IT sector."***

The New Economy Is Real….

It has become widely accepted (by, among others, Federal Reserve Board Chairman Alan Greenspan) that the information technology (IT) sector is now the largest driver of economic growth. What is less widely understood is that broadband communications capability is going to be an increasingly vital component of the IT sector.

A recent study by economists Robert Crandall and Charles Jackson projects that given a 25-year build-out of broadband covering 95 percent of Americans (comparable to the telephone network), *accelerating the peak point of a broadband build-out by just four years would bring $500 billion additional economic benefits to the American people*.[7] The figures that follow present a picture of the new economy, based on pre-war figures. The reader must factor in that the onset of the war on terrorism will very likely depress many projections. Such changes argue even more strongly for action to accelerate economic growth by restarting the IT engine by unleashing its broadband driver.

Maintaining a high rate of growth is essential not just for America's material prosperity, but also to meet the enormous financial commitments made to future retirees; without a robust IT sector such a goal cannot be met.

Progress and Freedom Foundation recently released its latest compilation on the state of the "digital economy," covering through year-end 2000.[8] Internet host and online usage growth remains robust.[9] Nearly all Internet-enabled applications run on narrowband telecommunications; current broadband penetration of U.S. households stands at 9 percent.[10] With the computer sector awaiting broadband network applications to rekindle growth, 2000 saw a 28 percent contraction in the telecommunications sector, a loss in market capitalization of roughly one-third of a trillion dollars.[11] Venture capital spurred technology investment, rising from $5 billion in 1995 to $115 billion in 2000.[12] The peak years 1999 and 2000 saw 69 percent of all venture funding in the past 25 years. From an average of 40 initial public offerings (IPOs) in the US between 1980 and 1994, the average for 1995 – 2000 rose to 191, and in 1999 alone hit 318.[13] Venture capital funding for 2001 has been estimated at $30 to $40 billion.[14] For the 6 years1995 through 2000, IT growth added an average of 1.2 percent to annual real GDP growth.[15]

Internet activity continued to grow in early 2001 despite the downturn: As of June 2001 there were 29.9 million Internet domain names, up 68 percent since July 2000 and 427 percent since July 1999; 22.7 million domain names (78 percent) are "*.com*."[16] In 2001 138 million Americans, nearly 50 percent, will be online; 88 percent of PC households will be online.[17] For 2001, according to eMarketer, 78 percent of small businesses (up from 60 percent in 2000) will have Internet access, compared to 94 percent (up from 68 percent in 2000) of medium/large businesses. In 2001 only 48 percent (up from 34 percent in 2000) of small businesses will have websites, versus 78 percent (up from 57 percent in 2000) of medium/large firms. [18]

According to year-end 2000 figures e-commerce is still growing. Of 103 million estimated active Internet users (up 17 percent from 2000), 69 million (67 percent) will have made an online purchase within the previous 12 months, and 41 million (40 percent) will have done so in the immediate preceding quarter.[19] Business-to-consumer (B2C) commerce estimates for 2001 range from $48 to $60 billion (up from $25 to $37 million in 2000)[20]; the business-to-business (B2B) segment is expected to rise from an estimated $489 in 2000 to $864 billion in 2001.[21]

The latest GDP figures released by the Department of Commerce were worrisome even before the terrorist attacks. Preliminary data for second quarter 2001 show real GDP slowing to 0.2 percent, down from 1.3 percent in the first quarter. Positive contributors to second quarter growth were personal consumption, state and local government spending, and residential fixed investment; these were partially offset by decreases in equipment and software, exports, non-residential structures, a deceleration in personal consumption expenditures (partially offset by a smaller decrease in private inventory investment), and a larger decline in imports than experienced in the first quarter.[22] While recovery will come eventually, its pace and breadth can have significant impact on the American economy in terms of growth, employment, inflation/deflation, and private and public investment. And war may well retard it further, even with remedial policy action, as policy changes usually have a "lag" effect.

The magnitude of the technology sector decline extends far beyond the pure dot.com companies, many of which were mere notional businesses. The shakeout of such companies was predictable and widely anticipated. Not to be confused with those companies are numerous high-technology firms that were producing real products and services, and have suffered immense financial damage in the past 18 months.

By August 2001 the telecom implosion had destroyed $1.7 trillion in stock capitalization of local, long distance, wireless, and telecommunications/network equipment firms, a 63 percent decline (from $2.7 trillion market capitalization down to $1 trillion) from the market's March 2000 peak. *This loss represented more than 90 percent of the net loss in stock market capitalization during that period.*[23] Further financial figures show that as of Spring 2001 junk bonds, which financed telecommunications upstarts in the 1980s, represent $120 billion of debt issued by telephone and cable companies; at their peak these bonds were 40 percent of the high-yield bond market, but now half of that debt is trading at or below 50 cents on the dollar and thus carries a high risk of default, according to UBS Warburg.[24] Thompson Financial Securities Data estimates that since 1996 telecom companies have raised $650 billion in debt and equity worldwide.[25] Domestic banks, according to Thompson, have made syndicated loans of more than $320 billion to telecom firms since 1999 alone.[26] Capital Access Management tallies $160 billion of debt held by insurers, mutual and pension funds.[27]

"The peak years 1999 and 2000 saw 69 percent of all venture funding in the past 25 years."

Lehman Brothers estimates that capital spending by major telecom companies will decline 20 percent in 2002, to $82 billion; this follows 2001's 5 percent drop from $107 billion to $102 billion, itself an unprecedented decline for the sector.[28] The telecom sector represented 12 percent of domestic business spending on equipment and software in 2000 and 25 percent of the increase in such spending since 1999. The 175,000 workers laid off by telecom companies were 19 percent of total layoffs for the first eight months of 2001.[29]

High-quality companies producing top-level technology have met serious reversals. Corning, Inc., the world's premier manufacturer of optical fiber, is just one of many companies that laid off workers this year, in Corning's case, 12,000 out of 43,000 peak employment.[30] Corvis, a cutting-edge fiber technology company, has in a corporate lifespan of less than a decade already developed optical equipment that extends from 400 to nearly 2,000 miles the distance signals can be sent without amplification over fiber, which ultimately could cut network costs 90 percent. Its shares have declined steeply, as have many other technology firms making products of real significance.[31] But continued Internet online growth alone has not protected the IT sector from supply-side depression, an asset value implosion and near evaporation of technology investment.

A top cable broadband access provider, Excite AtHome (74 percent owned by AT&T), which serves 3.7 million subscribers—71 percent of cable's broadband subscribers and 41 percent of the country's 9 million total domestic broadband households—has declared bankruptcy, despite its market leadership position and funding from powerhouse companies (besides AT&T, Time Warner).[32]

Personal computer sales have slowed, most buyers having decided that their existing Pentium-powered machines have more than enough computing power for today's suite of stand-alone software applications. Notebook and server sales are rising, but these account for only 20 percent and 3.4 percent of the computer market, respectively. One research firm, NPIntellect, estimates that 2001 PC sales will be 21 percent lower than in 2000. The PC sector awaits a "killer app" to drive a new round of PC growth.[33]

These pre-war figures will not likely be met.

There is a potential driver for future PC growth: broadband-networking applications. Metcalfe's Law, named after Internet pioneer Robert Metcalfe, holds that the value of a network is proportional to the square of the number of devices attached to it. Metcalfe's rule is a rough yardstick that, like all such measures, oversimplifies; not all connections are of equal value, as devices vary enormously in processing power, storage and functionality, and networking communities may place more value on some connections than on others.

Bringing broadband to the PC will require speeding data transfer inside the PC as well. Computer manufacturers have agreed on a new standard that in two years will make data transfer 50 times faster than over today's internal data bus. Today, much of the processing power of chips like the Pentium 4 is simply wasted, because the central processor stands idle while data transfer runs at far slower speeds.[34] New broadband services will be needed to productively employ the power of new generation PCs, or else consumers will not buy them.

"New broadband services will be needed to productively employ the power of new generation PCs, or else consumers will not buy them."

But Broadband Is Stalled

Broadband deployment spurted in 1998-2000, but in 2001 showed signs of slowing. Since 1997, the launching year for broadband deployment, 9 percent of households have adopted broadband. But this obscures the fact that 2001 has seen slackening deployment of telephone company-provided DSL. Gartner Dataquest tallies an 8.4 million increase in domestic Internet households between November 2000 and June 2001, to a 65 million total, but says that DSL is not being deployed "aggressively."[35] Lehman Brothers now projects 15 percent revenue growthfor high-speed data in 2002, half the previously expected gain.[36]

Figures more recent than the FCC's latest numbers, for year-end 2000, show DSL falling further behind cable modem deployment, albeit cable growth—notably, AT&T Broadband—has also slowed. In the second quarter of 2001, DSL growth was 14 percent, compared to 20 percent in the first quarter and 41 percent for the last quarter of 2000.[37]

Cable modem deployment has gained ground in 2001: Morgan Stanley estimates that cable garnered 64 percent of new broadband access customers in the second quarter, up from 59 percent in the first quarter.[38] In terms of homes passed—for which access is available—cable has reached 64 percent, compared to 51 percent for DSL, a 13-point difference that is nearly double the 7 percent lead cable enjoyed in mid-2000.[39] Cable's edge is evident when comparing the relative "take" rates of cable and DSL: cable's 5.2 million high-speed access customers represent 8.5 percent of cable's 65 million homes served[40]; DSL's 2 million subscribers amount to only 2 percent of the nation's 100 million phone subscribers.[41]

Because nearly all growth in 2000 was broadband subscribership—dial-up Internet access grew only 6 percent in 2000—a slowdown in broadband access growth signifies a slowdown in Internet access growth overall.[42] According to Gartner Dataquest, 16 percent of broadband users went directly to broadband, skipping dial-up entirely. Gartner sees almost 20 percent of dial-up users as planning to migrate to broadband by mid-2002; for this to be the case, the recent trend would have to sharply reverse itself.[43] The leveling off in broadband demand comes even though average broadband access monthly prices have fallen from $80 in 1996 to $52.50 in 2000.[44] That dial-up demand has slowed is no surprise: some 70 percent of dial-up connected online transactions fail before completion.

Broadband Intelligence, Inc., a Bethesda consulting firm, notes that the slowdown in broadband means that at the current rate of subscriber growth broadband will take four additional years to reach 50 percent of subscribers. Early adopters have already taken broadband, and absent compelling new applications growth is likely to be slower than in earlier years.[45] The four-year lag forecast by Broadband Intelligence corresponds to the four-year delay in peak deployment pace that the Crandall-Jackson study (cited above) found would cost America $500 billion in lost economic benefits.

Defenders of current policy note that broadband deployment to date tops the pace of key consumer technologies of recent decades. Attaining the 10 percent threshold of consumer adoption took 12 years for color TV, 10 years for the VCR, 8 years for the cell-phone and 5 years for the CD player.[46] Broadband, after 4 years in the market, stands at 9 percent. But there are crucial differences in the cases that explain why broadband was adopted faster: the general level of economic prosperity, product, service and switching costs, and quality issues.

The late 1990s, when broadband entered the residential market, were a time of unprecedented economic prosperity and a networking boom. Color TV also hit the market during a period of strong economic growth, but that growth took place when consumers had less income and assets than they had in the 1990s. The VCR made its debut in the late 1970s when the US was betwixt oil shocks, and suffering from persistent stagflation. As well, dueling standards (Betamax and VHS) retarded VCR growth (true as to DSL and cable, but switching costs are far lower than between VCRs at late-1970s prices).

The CD player and cell phone made their entry under more favorable economic conditions than pertained for color TV and the VCR, but other factors—switching costs and quality—intervened. Users had a huge inventory of LP records that unquestionably slowed CD adoption. Cell-phone adoption was retarded for years due to astronomical prices (thousands of dollars) for handsets, high prices (above $100 per month initially) for service, poor signal quality and limited "roaming" capability (due to the US policy of regionally Balkanized cellular networks).[47] Indeed, cellular handsets were so expensive that service providers began throwing them in as an inducement to sign up new customers.

Thus, the increment of the average household's income required to adopt broadband was smaller than for any of the earlier cases.[48] But existing legacy-network-derived broadband can offer little of premium value to justify upgrading, far less than color TV's vastly richer picture, the VCR's time-emancipation and playback features, the CD's hiss-free play and random access capability, or the cell-phone's mobility. With early adopters already signed up, to penetrate the mass market broadband must offer higher value services than today's mix.

Broadband Regulation: Yesterday's Rules for Tomorrow's Technologies

Besides lack of compelling applications, another critical factor retarding broadband penetration is regulation. The two are inter-related: Bad regulation slows deployment of the very facilities that would invite deployment of newer broadband applications.

The potential value of broadband deployment was recognized by Congress in 1996, when it revamped telecommunications regulation. Congress specifically wrote into the new law that regulators should pursue policies that "encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all

Americans."[49] Congress further directed that if the Federal Communications Commission determined that deployment was not proceeding rapidly enough, the agency "shall take immediate action to accelerate deployment of such capability by removing barriers to infrastructure deployment of such capability by promoting competition in the telecommunications market."[50]

The legislative design fashioned by Congress, however, was hijacked from the outset by the Clinton-era FCC. Then-Chairman Reed Hundt recounted in his own memoirs that he perceived the 1996 law as favoring the local carriers. This was a dubious proposition: competing local carrier entry into local markets was instantaneous, whereas incumbent phone carriers had to unbundle their networks for their competitors and surmount a 14-point detailed checklist as the price of winning long distance entry, which no carrier accomplished until January 2000, nearly 4 years after passage of the 1996 Act. Nevertheless, Hundt decided to use the FCC's rulemaking powers to tilt against the local carriers:

> Indeed, like the modern engineers trying to straighten out the Leaning Tower of Pisa, we could aspire to *provide the new entrants to the local markets a fairer chance to compete than they might find in any explicit provision of the laws*…..
>
> The more my team studied the law, the more we realized *our decision could determine the winners and losers of the new economy*.[51]

Hundt's goal was to be "master builder" of post-1996 competition:

> In other words, [the Bells] thought I would give up the chance to be the master builder of the information sector's competition rules….
>
> To this day, *I cannot imagine that the Bells thought I would abandon voluntarily the chance of a lifetime*.[52]

The ruinous post-1996 Act rules the FCC adopted (described below) were thus designed to aid entrants at the expense of incumbents, In seeking to "determine the winners and losers" in the new marketplace, the FCC flouted the plainly expressed will of Congress for open market competition. Competition is a process, not a preferred outcome; *protecting preferred <u>competitors</u> is the antithesis of true competition*. Yet that is precisely what the FCC did.

Illustrative of the FCC's post-1996 Act approach is that its implementing rules added in just 5 years over 10,000 pages to the Federal Register—*two and a half times the agency's page total for the five years preceding passage of the Act*.[53] Regarding provision of software systems to support competitors, the phone companies faced more than 200 specific requirements and 600 performance measures for *every state* they operate in.[54] Consider what this means for one incumbent, BellSouth, which estimates it processes *35,000 orders daily* for the Competitive Local Exchange Carriers (CLECs).[55]

Telephone company deployments have, it is true, been handicapped by poor implementation. But adverse regulatory rules have added insult to injury. Although phone companies have 25 percent of the high-speed access market, compared to 70 percent for their cable company competitors, phone company provision is regulated as if they are dominant carriers in broadband, as with residential voice service.

The FCC adopted its so-called "TELRIC"[56] cost standard for pricing incumbent network elements to be made available to rivals. TELRIC is priced according to the incremental cost that the FCC's cost model calculates would be incurred by a perfectly-efficient provider that had built a network with latest technology available at the time of pricing. (The sole concession to actual networks in place is that incumbent wire center locations are included in the calculation.) Phone companies are required to share their networks with rivals, and provide facilities at TELRIC prices—roughly 40 percent of their true cost.[57] *Thus, TELRIC is the FCC's own hypothetical measure of cost far lower than the actual incremental cost any real-world network provider would incur in supplying network elements to competitors*.

Indeed, phone companies were even required to share network components with rivals that were available in the marketplace. As one example, the FCC mandated that the $25 electrician's box on customer premises was to be shared with rivals, under the "technically feasible" standard it adopted for network element unbundling. The Supreme Court found that the agency had failed to consider the statutory language requiring access, *i.e.*, that proprietary network elements to be unbundled are those to which access is "necessary," and whose denial would "impair" the ability of entrants to compete with the incumbent.[58] The Supreme Court found that the FCC had thus violated the law Congress passed in 1996.[59]

In his concurring opinion in that case, Justice Breyer put the matter plainly:

Increased sharing by itself does not automatically mean increased competition. It is in the *un*shared, not in the shared, portions of the enterprise that meaningful competition would likely emerge.[60]

"Congress specifically wrote into the new [1996 telecommunications] law that regulators should pursue policies that 'encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans.' ... In seeking to 'determine the winners and losers' in the new marketplace, the FCC flouted the plainly expressed will of Congress for open market competition."

The TELRIC cost standard will be argued in the Supreme Court October 10, 2001, the Eighth Circuit having struck TELRIC down as "violat[ing] the plain meaning of the Act." Congress was, the Court held, "dealing with reality, not fantasizing what might be"; TELRIC was, the Court noted, "the cost some imaginary carrier might incur" and not actual cost as mandated by Congress.[61] (The Fifth Circuit affirmed TELRIC pricing, but in the context of universal service pricing[62]; as universal service is predicated on subsidies this ruling does not seem applicable to interconnection and unbundling. The FCC's pricing rules were recently argued before the Supreme Court; a ruling is expected in 2002.)

Forcing the incumbent to sell network assets below cost damages market competition in three ways. First, to the degree that interconnection issues arise between the incumbent and new entrants, the incumbent has maximum incentive to drive a hard bargain, as every line sold will cost the incumbent money.

If instead the incumbent can obtain the "cost plus a reasonable profit"[63] mandated by the Telecom Act, it would have every incentive to sell network access to maximize profits. Second, below-cost entry undercuts facilities-based entry. Why should a new entrant build its own facilities when it can obtain leased facilities from its prime competitor at half-price? Third, when incumbent networks are devalued, networks dependent upon incumbent services also decline in value, because access services they receive will be lower in quality than if incumbent providers can recover the full cost of providing network services.

Facing losses on every access line used by competing entrants, the incumbent carriers have every reason to raise any plausible issue that might possibly give them marginally less unfavorable terms with the adversaries. They will win some and lose some, with every win reducing the financial hemorrhaging that TELRIC causes. By contrast, the Telecom Act's "cost plus a reasonable profit" standard tilts the balance of incumbent incentives toward resolving issues quickly, because incumbents generally pay a political price when entrants cry "foul."

Entrants, meanwhile, have every incentive to ask for the moon, and they have done so. One entrant requested that the FCC order phone company technicians to put on identifying Velcro patches when doing work for competing firms.[64] While that particular request was not granted, other extraordinary accommodations have been required. Thus, phone companies have been required to provide customer service records in a form requested by entrants, even when the companies do not use such forms themselves.[65]

The micro-managed regulated competition that has ensued is surreal: among the complaints public utility commissions (PUCs) investigate are that Bell companies disparage their rivals in order to win back customers. In late-July 2001 Georgia regulators issued a 90-day order that BellSouth wait 7 days before trying to win back customers from rivals, despite BellSouth having lost 24 percent of the business high-speed market already.[66] Bell rivals have won enough disputes to get the Bells to pay some $90 million in fines in 2001.[67] Just what kind of "competition" is it when certain companies are required to refrain from what normally is considered standard tactics, and fined for not being helpful enough? This is the Alice-in-Wonderland world created by the Clinton-era FCC.

Yet another consequence of distorted pricing and hostile regulation: *rural DSL deployment leads urban, despite the longer loop length of rural networks*. The investment banking house Legg Mason shows DSL penetration at 3 to 4 percent for the nation's 1,300 independent telephone companies, versus 1.5 percent in urban areas.[68] *Not* a misprint: *non-Bell phone companies are installing DSL at twice to nearly three times the rate that the Bells are*. What gives?

Independent companies face fewer competitors than their urban cousins. Therefore, *FCC rules adverse to DSL investment mean less to them, as they face fewer entrants seeking to take advantage of the joys of below-cost access and "rip-apart-the-incumbent's network" unbundling*. Put another way, rural DSL investment is less likely to be poached and socialized for the benefit of others.

Inviting—forcing—below-cost local loop entry has had another cost: equipment manufacturers found hundreds of startups to sell to. They did so, on credit in many cases. Equipment vendor-financed sales of the top 5 North American companies (Cisco, Lucent, Nortel, Qualcomm & Motorola) in 1999 totaled 123 percent of the companies' pre-tax profits.[69] Company managements can be faulted for yielding to such temptation, but the temptation to take the financial plunge was put there by regulations encouraging below-cost entry. The great majority of the competing carriers were creatures of such regulatory largesse, and thus vulnerable to the change of fortune in telecom. Only those with strong business plans and capitalization will survive the shakeout, and the many firms that failed have seriously damaged their creditor-suppliers as well.

The FCC has even allowed continuation of what it acknowledges is a "regulatory arbitrage" that gave entrants a "windfall" and created "market distortions": statutory "reciprocal compensation" payments for exchange of traffic, as mandated per the 1996 Act.[70] Designed for voice traffic, which flows equally both ways between phone companies and competitors, it was extended to data traffic by the FCC. Internet access traffic was still relatively limited when the Telecom Act was signed in early 1996. Users accessing the Internet download far more data from websites they visit than they upload in return. In trade parlance, such data traffic flows between local carriers and Internet Service Providers (ISPs) are highly asymmetric, as are the reciprocal compensation payments between them. The fruit of this policy is a multi-billion dollar annual subsidy flowing from local carriers to their ISP rivals. Despite this manifest inequity the Commission declined to abolish the rule outright, and is allowing the subsidy to be phased out over three years.[71]

Another area of major abuse by the Clinton-era FCC was abuse of agency powers regarding phone company mergers. Under William Kennard, successor chairman to Reed Hundt, SBC and Verizon were forced to agree to pseudo-voluntary conditions that included entry into extra-regional local markets and payment of fines to the US Treasury if they exit those markets before three years pass. The FCC also pressured the companies to renounce rights of judicial appeal—and forgo the benefits of future court rulings on merger-related issues. This kind of extortion corrupts the agency and represents micro-management of market competition to force carriers to make uneconomic entry. This is hardly the kind of entry the Telecom Act envisaged.

"Just what kind of 'competition' is it when certain companies are required to refrain from what normally is considered standard tactics, and fined for not being helpful enough?"

Instead regulators should permit vertical mergers that will lead to four or five end-to-end full-service providers with the scale and scope to economically enter new markets. As long distance voice becomes a commodity sold at ever cheaper rates, vertical restructuring will become necessary for profitable operation of legacy-network carriers—all of AT&T's business units are now up for sale. New entrants, not saddled with legacy networks, can take advantage of fiber-optic economics from the outset, and serve targeted markets. Electrons and photons are blithely indifferent to antiquated, artificial jurisdictional boundaries drawn by America's antitrust trial bar.

Nor do rates show excess pricing. Local phone carrier control of the residential local loop has not enabled monopoly exploitation since 1996. Regarding voice, between 1996 and 2000 local phone rates rose 17percent, from \$29.50 to \$34.50 per month, versus a 13 percent rise in inflation during the same period. Local phone rates thus rose slightly faster than inflation, while cable rates rose nearly *four* times as fast—by 50 percent, from \$26.20 to \$39.30 per month.[72] But cable price increases were accompanied by an increase in channels provided. Combined with cable's far greater broadband market share (70 percent versus 25 percent) there is no support for the proposition that telephone companies can leverage their basic service market position into broadband data.

As it is, early evidence from states where the Bells have been allowed to enter interstate long distance shows that in those states local competition is more robust than in other states. The FCC's own compilation shows local competition levels 135 percent higher in New York and 45 percent higher in Texas, vis-à-vis the national norm. [73] (True, as noted in this paper CLEC entry is subsidized by favorable regulation, but those subsidies also exist in markets where the Bells cannot offer interstate long distance.

Most business customers have access to CLEC fiber. The FCC's oft-cited figure of 8.5 percent as the CLEC share of total access lines is misleading: it lumps together business markets with residential, despite vast differences in demand characteristics and customer density that radically alter the economics of serving each segment. But even the FCC's figures show 93 percent growth for CLEC access lines in 2000, with 60 percent of CLEC lines serving medium/large business (the figure for phone companies is 20 percent).[74]

If further evidence of CLEC market penetration is needed, CLECs and ISPs combined now have a 20.7 percent share of the DSL market, placing them between the two top Bells (SBC, 33.1 percent; Verizon, 25 percent) and the two trailing Bells (BellSouth, 10.7 percent; Qwest/US West, 10.6 percent).[75] If this seems like heavy market concentration, the top *three* long distance providers (AT&T, MCI/WorldCom and Sprint, have a combined market share close to that of DSL held by the *four* Bell companies.[76])

In sum, regulation adverse to incumbent phone carriers hampered broadband growth and fostered regulatory arbitrage, instead of promoting the robust facilities-based competition that the 1996 law was designed to encourage. Pseudo-competition and regulatory micromanagement trumped genuinely economic market entry and entrepreneurial initiative.

The Next Generation of Broadband: The Fiber-Optic Future

Broadband already has had an impact on Internet usage. According to Nielsen//Net Ratings Inc., vis-à-vis their low-speed cousins high-speed users view 130 percent more Web pages and spend 23 percent more time online.[77] But today's broadband access is derived from legacy networks, and thus is severely bandwidth-limited. A typical Internet data call traverses 17 network nodes (hops), adding annoying delays that discourage datanet use and make voice nearly unintelligible. And today's broadband access is at speeds hardly worthy of the name—the FCC's 200 kilobit definition is pitifully inadequate.

Today's legacy broadband services notoriously run well below maximum advertised speed. Sharing of capacity slows both DSL and cable modem speeds to a few hundred kilobits per second, rather than the megabit speeds advertised. DSL offers dedicated access only to the central office-- even here, the loop is shared per FCC rules if a requesting carrier wants it. Network DSL capacity is shared on inter-office plant; cable modem access is shared from the curb.

As fiber moves closer to the home, a high-speed DSL version, VDSL (Very High-Bit Rate DSL) becomes feasible. VDSL is already in service in Arizona. Colorado-based VDSL Systems recently announced the fastest and longest range VDSL version yet: up to 23 megabits per second over 5,000 feet. But this range is usable only over copper loops in "good condition" (many are not).[78]

To unleash the true promise of high-speed networking requires bringing optical fiber closer to the home. At the outset of the fiber-optic era, fiber research star Paul Green estimated that *fiber has a ten-billion-fold edge over copper in terms of both transmission capacity and error rate*.[79] Today's "fiber glut"—Merrill Lynch estimates that only 2.5 percent of fiber capacity is currently used—is temporary; new mass market applications will eventually soak up vast bandwidth.[80] Indeed, estimates are that both globally and domestically, *over the next five years more than twice as much fiber cable will be laid than is already in the ground***.**[81] The Yankee Group predicts that Gigabit Ethernet (10 times faster than the reigning Fast Ethernet packet-switching standard for Local Area Networks) will become the standard of choice for Metropolitan Area Networks over the next four years.[82]

Advances in fiber optic technology over the past decade have radically altered the potential of broadband networks. A decade ago, capacity per single fiber appeared stalled at around 100 gigabits (billions of bits) per second. Today, advances in combining different color wavelengths on a single fiber (a technique called wavelength division multiplexing, or WDM) enable some 2,000 channels to ride a single fiber. If each channel on one fiber carries 10 gigabits per second, total real-time capacity carried by that single fiber would be 20 terabits (trillions of bits) per second. If local loop plant enabled distribution of those 20 terabits among America's 106.5 million homes, each home could soak up 200 kilobits per second. But this FCC-level speed is nowhere near enough for a 500-channel universe plus video-on-demand access to thousands of films.

The Consumer Electronics Association (CEA) has just released a paper stating that cable providers will ultimately upgrade their networks to provide each home with 100 megabit-per-second access.[83] John Sie, Chairman/CEO of Starz Encore Group, a major distributor of cable content, has predicted that the subscription video-on-demand (SVOD) business model will soon spur broadband demand for entertainment video.[84]

"In a recent survey, by a margin of 2 to 1, Internet dial-up users said that lack of compelling applications, rather than price or availability, kept them from upgrading to broadband."

Moreover, current fiber cables carry 864 fibers, and 1,128-fiber cables are coming to market.[85] An 1,128-fiber cable effectively multiples total capacity a thousand-fold. In the example above, fibers in a single cable could deliver 200 megabits per second per home, equivalent to 10 compressed high-definition television (HDTV) channels per household, and twice the per-home capacity called for by the CEA.

To put these figures in perspective, one prominent consulting firm estimates that monthly Internet traffic in 2000 was 1 petabyte (equivalent to 8 petabits—one byte equals 8 bits), nearly exactly the same as the capacity of the 864-fiber cable.[86] Optical bandwidth is exploding even faster than Moore's Law (Intel co-founder Gordon Moore's famous rule that processing power doubles every 18 months per unit of cost, propounded in 1965 and with at least another decade of estimated life). Chip speeds continue to double every 18 months, storage density doubles every 12 months and bandwidth every 6 months.[87]

But the scenario outlined above cannot happen if broadband capacity to the home is restricted to the limits imposed by legacy networks, and in the event applications compatible with today's networks are too limited to spur customer demand for broadband. In a recent survey, by a margin of 2 to 1, Internet dial-up users said that lack of compelling applications, rather than price or availability, kept them from upgrading to broadband.[88] *It will take placing fiber-optic lines nearer the home to enable residential broadband applications requiring tens of megabits per second—high-definition full-motion video* *of the kind described above—to enable delivery of an acceptable level of service***.**

Already, where fiber is close to the home, service packages such as offered by Starpower in Washington, DC combine hundreds of video channels, two megabit per second cable modem access and cost-competitive long distance and local telephony.[89] Some of tomorrow's new broadband applications are already running on Internet2, a private research network serving 180 universities. Violin superstar Pinchas Zuckerman teaches students at Manhattan School of Music remotely, from Ottawa, over a 10 – 15 megabit per second videoconferencing link.[90]

In contrast to a fiber future, consider the limitations of current technology: If a two-hour movie is compressed to 500 megabytes of data this still means that over a 1 megabit per second connection downloading a film would take the user more than an hour.[91] A 20 megabit connection would download the film in 3 minutes, 20 seconds, and the 100-megabit speed sought by video entrepreneurs would scoop up the film in 40 seconds. But even 40 seconds is considered an eternity by Internet users fuming at the "World Wide Wait" delays experienced today o the Web. Cable companies, recognizing the value of fiber and not hampered by the lengthy depreciation schedules that saddle their telephone rivals, have invested $48 billion in network upgrades since 1996.[92]

To achieve the vision of Carleton Fiorina means encouraging extension of fiber-optics into at least part of the local loop, to give homes multi-megabit access. Only then will compelling video and high-speed data applications realize their promise, from entertainment video to real-time high-speed computer networking.

High-end applications will be further aided by high-speed chips combining low-cost silicon and high-speed materials like gallium arsenide, indium phosphide and germanium. These cheaper chips will run up to 40 times faster than current models and will supercharge optical lasers, cell-phones and many other communication devices when they hit the market in 2003.[93]

Fibersphere…and Ethersphere

Yet another frontier for local loop growth is wireless optics. Seattle-based Terabeam, pioneer of free-space laser Fiberless Optics™ communications, now serves three metropolitan markets (Seattle, Denver, Dallas), and plans a fourth roll-out before year-end.[94] Terabeam's Metropolitan Area Network (MAN) service can connect customers at speed ranging from 5 megabits to one gigabit per second (so-called Gigabit Ethernet).[95] Terabeam plans more rollouts later this year. Its system is rugged enough to survive the bad weather conditions that often degrade wireless transmission, given close site tower placing. (Proof of the system's weather resilience is that Seattle's climate resembles that of its Norwegian coastal sister city, Bergen—rain and fog are frequent visitors.)

Broadband wireless will complement fiber and provide access in rural areas where fiber cannot economically be laid. President Bush, in response to a question about rural high-speed access at the dedication of the new White House website, said: 'Hopefully, high-speed access will come over the air instead of through fiber optics. Once we get over-the-air high-speed access, then a lot of rural America that hasn't had access will get it."[96] President Bush is right. Wireless is essential to reach many remote areas.

High-bandwidth wireless spectrum comes in several flavors, with multi-megabit data rates for Wireless Ethernet applications. Low-power broadband access already exists for unlicensed spectrum, with Wi-Fi and HomeRF leading the pack, offering access inside and outside the home, including Internet access. [97] With one exception (AT&T), high-bandwidth wireless networks are being deployed with so-called CDMA spectrum technology.

The Fibersphere (wireline) and Ethersphere (wireless) will complement one another, ultimately filling out broadband geographic coverage, as well as opening mobile access for all—inside the home and outside—to high-speed services. Wireless will be an increasingly indispensable part of the whole, as only about 5 percent of buildings in the US are wired for fiber.[98]

But wireless broadband growth is in jeopardy, because the federal government has failed to allocate sufficient spectrum to meet mushrooming demand. Since 1993, wireless minutes-of-use increased by a factor of 13, while spectrum available increased by less than three-fold.[99] Only 189 MHz of spectrum is allocated for domestic wireless use, compared to over 300 in several major European countries and Japan.[100] The US spectrum logjam must be broken—and soon.

> ***"In times of national emergency, as with the horror of the terror assault on New York and Washington, communications capacity is rapidly overloaded. ... The vast potential of broadband optics is the best way to obviate the need for such rationing."***

Networking Society: Broadband or Bust!

The nation has lost nearly six years since passage of the 1996 law, primarily due to the unwillingness of the FCC to accept, and thus implement faithfully, the law as written by Congress—a law that, despite major defects, could have been applied in more workable fashion. Court cases, some still unfinished, had to be brought to make the FCC obey the legislative command of the law. All this was avoidable, but is now correctible. The FCC should take deregulatory steps, as directed in 1996 by Congress, to reverse the hyper-regulation of 1996-2000 and revive carrier incentives to accelerate deployment of broadband services.[101] The results will be renewed rapid economic growth, and a vast expansion of the promise of the Internet for all Americans. Calls to enforce the existing FCC regime must be resisted, else added harm to broadband competition will result.

Congress could further accelerate broadband growth if it passes legislation that allows telephone companies immediate nationwide data market entry, to give them deregulatory parity with satellite and cable and allow for effective market, rather than managed, competition. It is also desirable to ban line-sharing of telephone company local copper loop DSL capacity with their competitors. The FCC's merger authority should be sharply circumscribed. It should have to decide merger applications within 90 days. If the agency rejects an application its ruling must be judicially appealable; if it approves it should be barred from conditioning approval on acceptance of so-called "voluntary" conditions. Reciprocal compensation of data services should be abolished. These measures would complement any economic stimulus legislation enacted this fall.

Even if legislation does not pass, four regulatory changes would encourage investment in new fiber facilities. Potential profits of such investment must not be socialized for benefit of competitors, as is true of much telephone company investment today. Pricing network access at true cost (while revamping telephone subsidies in accordance with the legislative design of the Telecom Act) will enable economic facilities-based competitive entry sooner than will be possible if network access is priced artificially low. Allowing accelerated write-off of legacy copper wire networks will stimulate fiber local loop investment. Finally, more spectrum must be allocated for high-speed use, without delay, if President Bush's vision for rural wireless broadband access is to be realized.

America's broadband future should be one that looks to the vast potential of optics, not one tied for years to legacy networks. Encouraging the building of new optical plant to break out of the "copper cage" should be the lodestar of telecommunications policy. Re-igniting economic growth through revitalizing the technology sector is critical to making this happen. Investors will not put up the risk capital in an inhospitable investment climate. Networking America's more than one hundred million desktop computers (let alone, other devices used at home or on the road) coupled with compelling high-bandwidth applications will be an increasingly indispensable part of reviving the technology sector.

There is now one more compelling reason to promote broadband deployment. In times of national emergency, as with the horror of the terror assault on New York and Washington, communications capacity is rapidly overloaded. Government officials appealed to callers not to tie up public network lines that might be needed for emergency communications. After the terror strike, Internet volume surged 40-fold, causing a virtual traffic jam.[102] The vast potential of broadband optics is the best way to obviate the need for such rationing.

Since 1996 the "dot.sue" crowd has been running the show, and the tech sector is a shambles, with telecommunications investment lagging even other IT categories. The result has been regulatory chaos, and ultimately a market implosion that short-circuited the first broadband revolution, destroyed more than a trillion dollars of invested capital and cost the domestic economy hundreds of billions of dollars. The slowdown in economic growth shrank the federal budget surplus, and imperils the government's prospective ability to meet pension and health care obligations. In sum, there has been enormous economic damage as a result of, among other factors, destructive federal telecommunications policies.

It's time to give the "dot.com" set another chance, with American investment and entrepreneurship leading the way, and the government removing, rather than erecting, regulatory barriers to American IT and overall economic growth.

References

[1] *Law School Calls As Economy Slows*, p. A1, New York Times (Aug. 24, 2001).

[2] Opening Address, Aspen Summit 2001, Progress and Freedom Foundation, Aug. 19, 2001. < http://www.pff.org/pr/pr082001Fiorina.htm >

[3] *Id.*

[4] *Gates Bullish on Tech. But Sees Broadband Weak Link*, Yahoo! News (May 23, 6:37 PM ET). < http://dailynews.yahoo.com/h/nm/20010523/tc/tech_microsoft_gates_dc_2.html >

[5] Gates Calls for a Cut in High-Speed Net Costs, Washington Post, p. E1 (Sept. 6, 2001).

[6] *Id.*, p. E8. Gates spoke at Microsoft's annual Research Conference.

[7] Robert W. Crandall & Charles L. Jackson, *The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access* (July 2001).

[8] Jeffrey Eisenach, Thomas Lenard, Stephen McGonegal, *The Digital Economy Fact Book* (3rd Ed. 20001).

[9] *Id*, p. 1.

[10] *High-Speed Services for Internet Access: Subscribership as of December 31, 2000*, Industry Analysis Division, Common Carrier Bureau, Federal Communications Commission (August 2001).

[11] *The Digital Economy Fact Book*, p. 33.

[12] *Id.*, 79.

[13] Meeker: Tech rebound will take some time, CNet News.Com (July 24 2001, 11:25 Am PT). < http://news.cnet.com/news/0-1007-200-6659239.html?tag=dd.ne.dht.nl.sty.0 >

[14] David Hale, Chief Global Economist, Zurich Financial Services, 2001 Aspen Summit, Progress and Freedom Foundation, Aug. 20, 2001.

[15] *The Digital Economy Fact Book*, p. 83.

[16] *Id.*, p. 4.

[17] *Id.*, p. 8.
[18] *Id.*, p. 11.
[19] *Id.*, p. 63.
[20] *Id.*, p. 65.
[21] *Id.*, 67.
[22] *Gross Domestic Product: Second Quarter 2001 (preliminary); Corporate Profits: Second Quarter 2001 (preliminary)*, News Release BEA 01-02, Bureau of Economic Affairs, Department of Commerce (Aug. 29, 2001). < http://www.bea.doc.gov/bea/newsrel/gdp201p.htm >
[23] *Telecom Sector's Bust Reverberates Loudly Across the Economy*, Wall Street Journal, p. A1 (July 25, 2001).
[24] *Id.*, p. A4.
[25] *Telecom Meltdown*, Business Week, p. 106 (Apr. 23, 2001).
[26] *Id.*, p. 110.
[27] *Id*.
[28] *Those Wires Sure Are Cold*, Business Week, p. 104 (Sept. 17, 2001). The Lehman Brothers study was released September 4.
[29] *Id.*
[30] *Business Deterioration Continues, Corning Says*, Broadband Week Direct, Oct. 4, 2001.
[31] *The Leading Light of Fiber Optics*, Business Week, p. 152 (Oct. 9, 2000).
[32] *Cable TV Providers May Drop AtHome's Internet Service*, New York Times, p. B4 (Sept. 1, 2001).
[33] *As More Buyers Suffer From Upgrade Fatigue, PC Sales Are Falling*, Wall Street Journal, p. A1 (Aug. 24, 2001.
[34] *It's Still a Plain Gray Box, but the Innards Are Changing*, New York Times, p. E7 (Aug. 30, 2001). The most common current Peripheral Component Interconnect (PCI) Standard enables internal data transfers at a top speed of 133 megabits per second. By switching from parallel to serial data transfer, the successor standard, 3GIO (code-named Arapahoe), slated for late 2003 market debut, will enable over 6 gigabit per second internal PC data transfers.
[35] *Broadband Week Direct* (Aug. 29, 2001). < http://64.4.16.250/cgi-bin/linkrd?_lang=EN&lah=191885cc59f2fff8f06add8304de6bdf&lat=999135539&hm___action=http%3a%2f%2fwww%2ebroadbandweek%2ecom%2fnewsdirect%2f0108%2fdirect010829%2ehtm>
[36] *Those Wires Sure Are Cold*, Business Week, p. 104 (Sept. 17, 2001).
[37] *Beware, Baby Bells*, Business Week Online, Aug. 21, 2001. But cable companies are not immune, either: AT&T Broadband reported 131,000 new subscribers in second quarter 2001, versus 259,000 sign-ups in fourth quarter 2000. *Broadband Growth Market Slows*, The Washington Post, E1 (Aug. 28, 2001).
[38] *BellSouth's Down-Home Strategy*, New York Times, p. C1, at p. C3 (Sept. 3, 2001).
[39] *Broadband Could Pick Up Speed During Q3*, Broadband Internet Daily, vol. 3, issue 159 (Sept. 7, 2001).
[40] Source: National Cable Telecommunications Association (NCTA). In addition to signing up 920,000 cable modem subscribers during the second quarter, NCTA disclosed that cable providers upgraded 1.3 million access lines to digital, making 12.2 million lines converted from analog to digital video capability. Reuters (Aug. 13, 2001). Thus 19 percent of cable's 65 million access lines are now digital.
[41] As of Nov. 2000 there were 100.2 million households served by telephony, 94.1 percent of the nation's 106.5 million homes as of that date. *Trends in Telephone Service*, Federal Communications Commission, Common Carrier Bureau, Industry Analysis Division, p. 6 (March 2001).
[42] *The Digital Economy Fact Book*, p. 19.
[43] *People Still Signing Up for Broadband*, CNet News.Com, 11:05 AM PT (Aug. 29, 2001).
[44] *Id.*, p. 42.
[45] *Broadband Growth Market Slows*, Washington Post, p. E1 (Aug. 28, 2001).
[46] Source: Robert Pepper, Chief, Office of Plans and Policy, Federal Communications Commission. Presented at 2001 Aspen Summit, Progress and Freedom Foundation (Aug. 20, 2001).
[47] There are 305 urban and 428 rural cellular networks; PCS licenses are nationwide.
[48] *Manager's Journal*, Wall Street Journal, p. A18 (June 25, 2001)..
[49] Telecommunications Act of 1996, sec, 706(a).
[50] *Id.*, sec. 706(b).
[51] Hundt, Reed, *You Say You Want a Revolution: A Story of Information Age Politics*, pp. 154-55 (Yale Univ. Press 1999). (Emphases added.)
[52] *Id.*, p. 153. (Emphasis added.)
[53] Thorne, John, *The 1996 Telecom Act: What*

Went Wrong and Protecting the Broadband Rollout (1996). Thorne is Lecturer on Law, Columbia Law School, and Senior vice-President & Deputy General Counsel, Verizon Communications.

54 *Id.*, p. 8.

55 *BellSouth's Down-Home Strategy*, New York Times, p. C1, at p. C3 (Sept. 3, 2001).

56 These rules, the so-called TELRIC (Total Element Long Run Incremental Cost) method of cost allocation, have been vacated by a federal appeals court (on remand from the Supreme Court), on the grounds that the TELRIC standard is based upon a hypothetical best-technology network's costs, rather than the actual costs of the incumbent carrier's network, as Congress intended in sec. 252 of the 1996 Act. *Iowa Utilities Board v. FCC*, 719 F. 3d 744 (8th Cir. 2000). Congress, the Eighth Circuit panel said, "was dealing with reality, not fantasizing about what might be." *Id.*, at 750.

57 Building the telephone company networks today at TELRIC prices would yield a system cost of $885 per line; the true cost of replication is closer to $2,000 per line. *The 1996 Telecom Act: What Went Wrong and Protecting the Broadband Rollout*, p. 14 (1996).

58 Telecommunications Act of 1996, sec. 251(d)(2).

59 *AT&T v. Iowa Public Utilities Board*, 525 US 389 (1999).

60 *Iowa Utilities Board v. FCC*, 525 US 389, at 429 (1999). (Breyer, J., concurring in part and dissenting in part). (Emphasis in original.)

61 *Iowa Utilities Board v. FCC*, 219 F.3d 719, at 750.

62 *Texas Office of Public Utility Counsel v. FCC*, 183 F.3d 393 (5th Cir. 1999).

63 Telecom Act, sec. 252(d)(1) provides a "just and reasonable rate for interconnection of facilities and equipment" and prescribes for competing carrier access to incumbent networks that the incumbent may charge a "just and reasonable rate for network elements" that incumbents may charge, "based on the cost" of such elements, and which "may include a reasonable profit."

64 Huber, Peter, *Stumbling on the Last Mile*, Forbes, p. 74 (June 11, 2001).

65 *The 1996 Telecom Act: What Went Wrong and Protecting the Broadband Rollout*, p. 9 (1996).

66 BellSouth Faces Probes By States on Win-Back, Wall Street Journal Online (Aug. 31, 2001). < http://navigation.helper.realnames.com/framer/1/262/default.asp?realname=Wall+Street+Journal&url=http%3A%2F%2Fpublic%2Ewsj%2Ecom%2Fhome%2Ehtml&frameid=1&providerid=262&uid=417065 >.

67 *Id*.

68 *Heard on the Street: Rural Telecom Shares Are Looking Idyllic*, Wall Street Journal, p. C2 (Aug. 23, 2001). Independent phone companies have 13 million of the nation's 194 million access lines.

69 *Manager's Journal: Vendors Pay the Price*, Wall Street Journal, p. A18 (June 25, 2001). An estimated 35 percent of vendor loans went to telecommunications and Internet startups.

70 Telecommunications Act of 1996, sec. 251(b)(5).

71 The convoluted proceedings between the FCC, state PUCs and the courts are discussed at pp. 19-21 of *The 1996 Telecom Act: What Went Wrong and Protecting the Broadband Rollout*, p. 9 (1996). The quotes in the text are from the FCC's Order on Remand Report and Order, *Implementation of the Local Competition Provisions of the Telecommunications Act of 1996*, FCC 01-131, CC Docket 96-98 & 99-68, para. 2 (released April 27, 2001).

72 *Reform Act Hasn't Delivered Promises to Customers*, Wall Street Journal, p. B1 (May 3, 2001).

73 *Federal Communications Commission Releases Latest Data on Local Telephone Competition* (May 2001).

74 *Local Telephone Competition: Status as of December 31, 2000*, Federal Communications Commission, Common Carrier Bureau, Industry Analysis Division (May 2001).

75 *Digitally Disenfranchised: A Small Field Controlled by Giants*, New York Times, p. C1 (Aug. 6, 2001).

76 The four Bells have 79.4 percent of the DSL market (rounded). The most recent data compiled by the FCC (1999) shows the top three long distance carriers with 74.3 percent of toll revenues for long distance carriers, and 67.7 percent of long distance revenues of all carriers providing toll (includes local carriers). *Statistics of Communications Common Carriers 1999*, Tables 1.5 & 1.6, p. 9, Industry Analysis Division, Common Carrier Bureau, Federal Communications Commission (Aug. 2000).

77 *Digits*, Wall Street Journal, B4 (Aug. 23, 2001). Per person, broadband increases web page access 55%, up to 1,170 pages per month. Total monthly

surfing time is over 15 hours with broadband.

[78] < http://www.vdslsystems.com/media/1stgenerele.html >

[79] *Why Broadband Is Not Yet Free*, 2001 Aspen Summit (Aug. 21, 2001).

[80] *How the Fiber Barons Plunged the Nation Into a Telecom Glut*, Wall Street Journal, p. A1 (June 18, 2001).

[81] *The Fiber-Optic "Glut"—in a New Light, Business Week Online* (Aug. 31, 2001). Consultant firm KMI Corp. estimates that in the US 83 million limes of fiber have been installed, with 186 million miles likely to be installed by 2006; the global figures are 283 million miles to date, and 617 million miles likely to be installed by 2006. (Presumably this reflects circuit-miles rather than cable route miles—*i.e.*, cable miles multiplied by fibers per cable.)

[82] *Bandwidth Glut? Not in Metro Areas*, Forbes.com, 1:17 PM ET (Aug. 1, 2001). A new forum, Metro Ethernet Forum, has been formed by 37 vendors and network providers, to promote Gigabit Ethernet and its upcoming successor standard, 10 Gigabit Ethernet. < http://www.metroethernetforum.org > Fast Ethernet, at 100 megabits per second, is 10 times faster than the original 10-megabit Ethernet standard. Most high-speed connectivity today is far slower: Probe Research estimates that by year-end there will be 298 million T1/E1 (E1 is the European equivalent of the American T1, a 1.5 megabit per second digital network service) connections worldwide, more than 100 times the 2.8 million T3s (45 megabits per second) and nearly 1,000 times the number of OC-3 connections (155 megabits per second, a key building block of optical carrier networks using the SONET (Synchronous Optical Network) standard. *What Bandwidth Boom?*, Internet Week, Sept. 11, 2001.

[83] *100 Mbps and Beyond: Bringing Consumers High-Speed Access*, **CE Frontiers** (Consumer Electronics Assn., August 2001).

[84] Panel Discussion at PFF Aspen Summit 2001 (August 21, 2001).

[85] *Why Broadband is Not Yet Free*, 2001 Aspen Summit (Aug. 21, 2001).

[86] Source: International Data Corp.

[87] *Digital Rules*, Forbes, p. 51 (Oct. 30, 2000).

[88] *The Digital Economy Fact Book*, p. 40. Source: TNS Intersearch,. *Id.*, p. 40, fn. 16.

[89] Starpower is a joint venture between RCN Communications, a CLEC, and Potomac Electric Power, which supplies the necessary right-of-way conduit for RCN's fiber. RCN parents locally with utilities in each market it serves.

[90] *Tech Giants Hold High Hopes for Internet2*, CNet News.Com, 11:15 AM, PT, Oct. 4, 2001.

[91] *The Future will Be Fast But Not Free*, Wired, p. 126 (May 2001). Calculation: 500 megabytes = 4,000 megabits, or 4 gigabits; downloading 4 gigabits over a 1 megabit connection would take 4,000 seconds—one hour, 6 minutes 40 seconds. At 20-megabit and 100-megabit speeds the time shrinks accordingly.

[92] *Cable's Long Reach*, Washington Post, p. H1 (July 15, 2001).

[93] Motorola to Announce Advance in Chips, New York Times, p. C2 (Sept. 4, 2001). *Motorola Unveils "Revolutionary" Superfast Microchip Technology, Independent.co.uk News* ((Sept. 5, 2001). < http://news.independent.co.uk/business/news/story.jsp?story=92371 >.Motorola's own description is at < http://www.corporate-ir.net/ireye/ir_site.zhtml?ticker=MOT&script=410&layout=-6&item_id=203874 >

[94] *Terabeam Revamps to Reach Fully Funded Status*, Broadband Week Direct, Sept. 26, 2001.

[95] *Broadband Week Direct* (Aug. 31, 2001).

[96] *White House*, Internet Daily, p. 5 (Sept. 4, 2001).

[97] Wi-Fi—Wireless Fidelity—is IEEE 802.11b, an 11 megabit-per-second Wireless LAN. HomeRF offers access up to 2 megabit speeds. Both run inside and outside the home. These occupy the 2.4 gigahertz band, reserved by the FCC for unlicensed low-power devices.

[98] *Light From Above*, Red Herring, p. 298 (Oct. 2000).

[99] *A Push for More Frequencies*, Washington Post, p. G12 (Feb. 28, 20001). Source: Cellular Telecommunications Industry Association (CTIA).

[100] Berry, Steven, *Spectrum: The Next Generation of the Information Superhighway*, The ABC's of Getting to Wireless, Progress and Freedom Foundation (July 2001). Source: CTIA.

[101] Section 706 of the Telecom Act specifically calls for steps to remove regulatory barriers to advanced services deployment and infrastructure modernization.

[102] *New Web Sites Clogged in Aftermath*, Los Angeles Times, p. A31 (Sept. 12, 21001).

Help make a positive vision of the future practical

Support Discovery Institute

As a non-profit organization, Discovery Institute is dependent upon your generous support. Discovery is a collaborative association of fellows, staff, interns, volunteers and supporters, all of whom seek to discover policies that will shape the future in the common sense tradition of representative government, the free market and individual liberty. It you are not a supporter, please consider donating to Discovery as we look for tomorrow's solutions today. If you are already a supporter, we urge you to pass this form on to others who might be interested in our work.

When you support Discovery, you receive updates and announcements about the exciting conferences, speakers, reports, research and books that make the Institute a leader in regional, national and international affairs and ideas.

I would like to support Discovery Institute at the following level:

- ☐ E-Supporter (Free)
- ☐ Associate ($100)
- ☐ Introductory ($25)
- ☐ Patron ($500)
- ☐ Subscriber ($50)
- ☐ President's Club ($1,000)
- ☐ Other $________

I am interested in the following area: (please circle)

Defense & Foreign Policy   Environmental Policy   Science & Culture
Cascadia (Regional Cooperation)   Religion & Liberty   Technology

Name	Title	Organization
Address	City	State/Zip
E-mail	Phone	Fax
AMEX, Discover, MC or VISA	Card Number	Exp. Date

For more information call (800) 643-4102, or (206) 292-0401, or visit the Discovery website at www.discovery.org. E-mail can be sent to members@discovery.org.