BROADBAND AMERICA—AN UNREALIZED VISION

An EDUCAUSE Policy Paper

Developed by the EDUCAUSE Broadband Policy Working Group

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A. Executive Summary

Despite enormous progress in deploying Internet technology and services over the past 15 years, many of the goals for use of the public Internet in education and research, particularly for support of e-learning, remain unrealized. The purpose of this paper is to examine the present situation and outline steps that would, if widely embraced, contribute to a revitalization of vision and expectation and lay the basis for creation of an advanced communications infrastructure for Americans that fully supports the needs of the academic community and its educational mission.

At the present time not more than a quarter of U.S. households use broadband Internet access, and in most cases, the so-called broadband access that is available—cable modems or the somewhat slower digital subscriber line (DSL)—is technically inferior to that routinely provided to students residing on campus. Thus, higher education has an important stake in the national effort to widely deploy a state-of-the-art broadband public network which overcomes these deficiencies. Many of its own educational goals cannot be realized without affordable and ubiquitous access to such a network.

But educational reasons for a public broadband network are only part of a larger and more complicated picture involving users, providers, and governments at every level. College and university leaders, working through associations such as EDUCAUSE, foresee that many sectors of our society will benefit from a widely deployed and affordable broadband network and seek to collaborate with the appropriate individuals and organizations in promoting its development and deployment.

Achieving a new sense of national purpose in deploying broadband Internet services to all Americans will require the efforts of many individuals and organizations. To fulfill its intended aims, EDUCAUSE believes this work must be guided by several basic principles, including:

1. Affordable Broadband Access

Affordable access to advanced communications services and capabilities by individuals, households, businesses large and small, nonprofit organizations and public service agencies is a matter of the highest public interest. Planning and deployment of a network that meets these collective needs must be accomplished in a way that engages both the public and the private sectors and builds on the strengths of each.

2. A New Regulatory Structure

Progress in the deployment of public broadband services requires a new and streamlined regulatory structure based on sound economic and social concepts, recognition of the advantages inherent in new network technology and a new network structure, and a willingness to undertake the difficult transition away from current, obsolete telecommunications facilities and the regulations which govern their use.

3. Federal R&D Support

The federal government must renew its leading role in funding and sponsoring network and computational research, now collectively known as cyberinfrastructure. This work—much of it conducted within the university community through basic research, prototyping, and proof-of-concept deployment activities—is an essential part of the

R&D "food chain," which leads to commercial products and services and the substantial economic benefits flowing therefrom.

Working from these principles, a revitalized National Broadband Internet Vision can be articulated whose major objectives include:

- an open, secure, reliable network that continues to be based on freely available, interoperable, international technical standards;
- network access prices that are reasonable, nondiscriminatory, and universally available on a nationwide basis;
- network access bandwidth at a minimum of several megabits per second (in both upstream and downstream directions) that is easily and transparently scalable to hundreds of megabits;
- a national commitment, including industry and all levels of government, to deploy technologies that meet the bandwidth standard above to 80 percent of American homes and businesses by 2007 and to all homes and businesses by 2012;
- network access based on the IP transport layer standard that is open to all providers of higher-layer services and applications on an affordable and nondiscriminatory basis;
- network access that is standardized for the delivery of essential residential and business public services, including police, fire, health, civil defense, and national disaster.

In addition to these basic principles and objectives, EDUCAUSE endorses a number of important broadband policy goals, including new approaches to universal service, local government provision of broadband access, and renewed federal research support for broadband technologies.

Congress must lead the national broadband effort with new and forward-looking telecommunications legislation that builds on the successes of the Internet and avoids the pitfalls experienced as a result of passage of the 1996 Telecommunications Act.

B. Background

In less than two decades, the Internet has grown from a research project within a limited number of universities to a worldwide communications system. American academic scientists conducted much of the research leading to the deployment of Internet technology and their institutions also played an important role in prototyping and building campus and wide area production networks, thus laying the foundation for the rapid creation of the global public Internet in the 1990s.

Today, the combination of accessible communications bandwidth, coupled with powerful computational and information resources, has produced a medium of unprecedented power. The synergy possible from the synthesis of powerful networks, computers, and databases has recently been the subject of a U.S. National Science Foundation blue ribbon panel report on cyberinfrastructure[1] that sets aggressive national goals for fresh investment in these technologies.

Information technology leaders in higher education have long been active in planning and deploying advanced network facilities. Their achievements include the formation of the regional NSFnet links in the late 1980s, the successful effort to generate Congressional support for scientific and academic networks, which culminated in the High Performance Computing Act of 1991, the creation of the Internet2 consortium in 1996, and, most recently, the National LambdaRail effort to build an all-optical, facilities-based network for leading edge science and research.

While the benefits of advanced cyberinfrastructure are already visible in such "big science" fields as physics, astronomy, seismology, and genomics, the potential of the technology to infuse and transform many academic fields has hardly been touched. Unmet requirements for computer- and network-mediated instruction, collectively known as e-learning, are numerous, its full potential still undiscovered.

Since the 1980s, educators have recognized the need to extend learning to students wherever they are located. Since fewer than half of the students in U.S. colleges and universities are housed on campus, reaching them for purposes of e-learning can only be accomplished via the public Internet.

Several years ago, EDUCAUSE, an association of information technology executives in higher education, formed a special working group on broadband technology. The participating individuals and institutions, now named the Broadband Policy Group,[2] have sponsored this paper with the expectation that it may serve as a catalyst for efforts to accelerate the planning and deployment of a public broadband network with a sound economic base and with advanced technology that enables e-learning as well as meeting many other vital social and personal needs, a network that genuinely deserves the name Broadband America.

C. Guiding Principles for Broadband Deployment

EDUCAUSE has developed a set of principles to guide its broadband policy efforts. These principles are intended to provide a consistent frame of reference from which specific policy and advocacy initiatives can be developed and pursued.

1. Affordable Broadband Access

> **Affordable access to advanced communications services and capabilities by individuals, households, businesses large and small, nonprofit organizations and public service agencies is a matter of the highest public interest. Planning and deployment of a network that meets these collective needs must be accomplished in a way that engages both the public and the private sectors and builds on the strengths of each.**

It has been an established fact of law and public policy in the United States for nearly a hundred years that communications services must be made available in a manner that serves the public interest as well as the private business interests of the companies that provide them. Telegraph, telephone, radio, and television have all fallen under some degree of governmental regulation in order to achieve this goal.

The Internet, whose public access is barely more than a decade old, initially occupied a new and special niche in the panoply of technology-based communications. But its technical architecture (cutting across the vertical orientation of older systems), implementation in semiconductors and

fiber optics (embodying revolutionary cost and performance advantages), and its increasing commercial use (forging an increased reliance by the general public), herald a seminal change from "niche" status to that of core transport protocol.

Even in the early stages of its existence, the Internet has demonstrated a remarkable capacity to empower individuals, groups, and communities to participate more effectively in society. Schools, colleges, and universities are struggling to assimilate this new wave of technological innovation, which will have as revolutionary an impact on the conduct of education on other sectors of the economy.

In the workplace, networked computers have intruded into nearly every job, and computer-related skills are essential to getting and holding a good job. It is already apparent that lack of access to the Internet contributes to the widening economic gap between the most skilled and the least skilled workers in the global economy, thus contributing to what is called the "digital divide."

In short, the Internet is rapidly approaching the status of an essential public service, whether provided publicly or privately, and deserves the same attention to equal access and affordability that has long prevailed in other areas such as telephones, roads, and television.

2. A New Regulatory Structure

> **Progress in the deployment of public broadband services requires a new and streamlined regulatory structure based on sound economic and social concepts, recognition of the advantages inherent in new network technology and a new network architecture, and a willingness to undertake the difficult transition away from current, obsolete telecommunications facilities and the regulations which govern their use.**

The success of free market economies, which now dominate the world, has led to a re-examination of governmental roles in regulating private sector business behavior. Initiatives to liberalize regulatory structures and open business sectors to competition based on product and service innovation are widespread. At the same time, there has been a major shift toward an economic structure based on information technology rather than industrial manufacturing technology.

These twin forces have brought into question much of the telecommunications regulatory structure erected to ensure social benefits of an earlier time. In particular, studies have concluded that the lengthy duration of proceedings in regulatory hearings and decisions is a significant inhibitor of technology-based innovation. Likewise, the rigidity of regulatory accounting rules creates disincentives to the introduction of services based on new technology that may not initially fully recover their costs.

As the economy is remade by new technologies, so must the regulatory structures designed to ensure social benefits be remade. In particular, we must be alert to situations in which the timely elimination of obsolete services is not inhibited by perpetuation of subsidies that no longer serve the purpose for which they were enacted.

An excellent example of this hazard is the current situation regarding analog voice telephony services provided over wireline facilities. Many billions of dollars of telecom investment in such facilities have been subsidized over the years with the laudable goal of achieving universal telephone access at affordable rates. As a result, the United States has more than 200 million wireline access telephones, a majority of which are based on analog technology at the end-user

sites. Although this technology is obsolete—and there are multiple lower-cost and higher-performance replacements available—the subsidy regime and related user taxes associated with the original goals continue. Recently, Reed Hundt, a former chairman of the Federal Communications Commission, published a paper recommending a wholesale diversion of subsidy funds to the support of a widely deployed broadband infrastructure that maintains universality of access while providing Internet-based voice, data and video services.[3]

Regardless of which alternatives for regulatory reform are adopted, the revised goals must embody principles of affordable access to the full range of services that are now enabled by the Internet. The goals must also provide incentives for continued technological innovation and efficiency in the implementation of a new universal service structure.

3. Federal R&D Support

> **The federal government must renew its leading role in funding and sponsoring network and computational research, now collectively known as cyberinfrastructure. This work—much of it conducted within the university community through basic research, prototyping, and proof-of-concept deployment activities—is an essential part of the R&D "food chain," which leads to commercial products and services and the substantial economic benefits flowing therefrom.**

The Internet is perhaps the best single example of public-private partnership in discovering, developing and deploying new technology. Much of the original research was sponsored by the federal government and conducted at U.S. universities. The first large-scale deployment of the technology occurred when the National Science Foundation funded NSFnet in 1987. Web browsers are a product of creative genius at federally sponsored research facilities in Switzerland and Illinois.

But the global Internet of today could not have been constructed without massive private investment and a conscious policy within the federal research agencies of working with industry to commercialize promising new technology. The astonishingly rapid emergence of the centrality of this protocol, with minimal federal support when compared with the aforementioned subsidy regime for the antiquated wireline communication infrastructure, provides perhaps the most compelling hints of what might be accomplished for the good of the nation with appropriately robust R&D support and adaptive regulatory policy.

To achieve its promise as a powerful instrument for economic and social betterment, the Internet must continue to be closely linked to communications and computing research endeavors. Many important architectural and operational issues confronting us in the current network environment require sustained research and proof-of-concept funding.

D. Broadband Policy Goals

Articulating and fulfilling the vision for Broadband America requires many activities, of which those in higher education are only a part. EDUCAUSE places the highest priority on the following five action areas.

1. A Revitalized National Broadband Network Vision

More than 10 years ago, the White House released an "Agenda for Action,"[4] which contained an aggressive vision for the future of the Internet where it would be transformed, through private

investment and entrepreneurship, from a federally sponsored academic enterprise to one which widely served society and the economy. That vision has been achieved beyond the imagination of its creators.

But today we face the reality of an Internet beset by a variety of troubles whose progress has been slowed by lack of a unified view toward the future. Unfettered capitalism has brought us not only a punctured Internet "bubble" but also a network that no longer commands the respect of scholars and the public at large. Not only is the Internet not new anymore, its many warts are all too apparent.

The challenge of a revitalized vision is great; perhaps no technology has held out so much promise while at the same time displaying so prominently its shortcomings. Preserving the freedom of the Internet and its spontaneous creativity, while at the same time maturing it to a system through which essential social and economic goals are achieved, will be difficult. Melding aspiration with realistic expectation will not come easily. Nevertheless, the future of the Internet requires no less commitment from us today in addressing its latter day growing pains than did its original research and implementation efforts 20 years ago.

A revitalized vision for the future of the Internet includes many things, but EDUCAUSE views the following elements as critically needed:

- an open, secure, reliable network that continues to be based on freely available, interoperable, international technical standards;
- network access prices that are reasonable, nondiscriminatory, and universally available on a nationwide basis;
- network access bandwidth at a minimum of several megabits per second (in both upstream and downstream directions) that is easily and transparently scalable to hundreds of megabits;
- a national commitment, including industry and all levels of government, to deploy technologies that meet the bandwidth standard above to 80 percent of American homes and businesses by 2007 and to all homes and businesses by 2012;
- network access based on the IP transport layer standard that is open to all providers of higher-layer services and applications on an affordable and nondiscriminatory basis;
- network access that is standardized for the delivery of essential residential and business public services, including police, fire, health, civil defense, and national disaster.

2. New Telecommunications Legislation

One of the original design goals of the Internet was to ensure that its packets could "ride on top" of the existing telephone network. This meant that millions of users could join Internet services such as AOL for $10 a month or less and experience no increase in their home telephone bills. Likewise, tens of thousands of businesses large and small could provide Web access to customers and suppliers with small increases in existing computer and network budgets. The Internet in the United States could not have grown to its current size and range of services without this implicit subsidy from the traditional telephone network.

By virtue of riding on top of the regulated telephony world, the early Internet also avoided nearly all of the regulatory obstacles that might have slowed or halted its growth.

But as the new digital technology of the Internet inexorably supplants that of analog telephony, the "free" ride is disappearing. The telephone company revenues from telephony which made the early days of the Internet so inexpensive are in terminal decline. Since the beginning of 2000, a trillion dollars of telecommunications industry market capitalization has disappeared, and many observers view the industry as in crisis.[5] The nearly century old structure of telecommunications regulation is also at risk. Formulations that assigned costs and benefits in an analog world are no longer relevant. Vertical industry separations confirmed in legislation have been undermined by the horizontal layering of Internet infrastructure and services. Social subsidy goals can no longer be served when the revenues to support them disappear.

Thus we come to a major crossroads in the legislative history of telecommunications. Industry analyst Kevin Werbach describes the present situation as a "perfect storm," stemming from frustration with failures of the 1996 Telecomm Act, the rapid deployment of Internet technology, and other factors.[6] Congress, state legislatures, the FCC, the Justice Department, and other law enforcement agencies are all being forced into new legislation to deal with the collapse of traditional telecommunications regulation.

Viewed with hindsight, the 1996 revision to the federal Telecommunications Act appears to have done little to prepare industry, consumers, and regulators for the Internet. Many observers are calling for a completely fresh look at the nation's regulatory structure for telecommunications. Recently, Vint Cerf, Richard Whitt, and colleagues at MCI have proposed that the FCC adopt a layered model approach to residual requirements for regulation in an Internet-dominated world.[7] They, and other academic and industry experts cited, note that the Commission implicitly has used elements of layered regulation as far back as its Computer Inquiries two decades ago. Early on, the conflict between "vertical" and "horizontal" regulatory schemes in the same system caused little difficulty because Internet traffic, in both revenue and costs, was trivial compared to that of traditional telecommunications. Today, the conflict is substantial and growing rapidly, particularly as a result of the widespread adoption of Voice over Internet Protocol (VoIP).

But voice is only one of myriad applications that can be supported seamlessly and with greatly enhanced functionality over a robust Internet transport infrastructure. The advantages of converting from the existing vertical regulatory arrangement mandated in the Telecommunications Act to a layered model include: (a) the model matches, rather than conflicts with, the reality of the manner in which services are implemented and delivered over the Internet; (b) competitive abuse by dominant providers in any service layer is more easily identified and remedied; and (c) innovation in future technology and services is promoted by affirming a federal commitment to apply minimal regulatory constraints only to those layers of the Internet where demonstrably anticompetitive market behavior occurs.

EDUCAUSE believes that the fundamentals of the layered model are an essential ingredient of an updated and forward-looking legislative approach to promoting and shaping the future of Internet services, and urges the Congress to adopt them as it considers revision of the Telecommunications Act in 2005.

3. Local Government Provision of Broadband Network Access

Many communities across the United States, sometimes in partnership with their colleges and universities, have undertaken to provide Internet access to their residents and businesses. Originally, one of the reasons for these efforts was the lack of interest in providing such access by incumbent telephone companies. As the Internet and its service opportunities have become

attractive to them, telephone companies have come to view public network facilities as unfair competition with their own services, which have now expanded to include network access offerings such as DSL. In 2004, the Supreme Court ruled, in a case from Missouri, that states have an inherent right to control the activities of their legal subdivisions (for example, counties and cities) and to prevent them from offering Internet access services. Telephone companies have been successful in a number of states in obtaining prohibitions on network access being provided by public or nonprofit entities.

As noted under principle 1 above, EDUCAUSE believes that affordable broadband Internet access is becoming an essential public service, whether provided publicly or privately. This is the case with other utility services such as water, sewer, and electricity. Internet access should be treated in a similar manner. Thus, the test should not be based on provider status within the public sector or the private sector, but on whether a truly affordable, high-quality broadband access is being made available to all residents and businesses.

Successful models of public-private partnership to achieve essential service goals, such as rural electric cooperatives, have existed for many years. A more recent model is community deployment of Wi-Fi "hotspots." These grass roots and community-based efforts should be promoted and supported as one mechanism for achieving the Broadband America vision. Legislation seeking to define a preferred role for one kind of provider or another should be discouraged.

4. New Approaches to Universal Service

The telecommunications universal service program is funded by a surcharge levied on telephone bills and consequently is threatened by loss of revenue due to migration to currently unregulated and untaxed Internet voice, data, and other services. Additionally, the program has become politically controversial because the use of the funds is no longer tied directly to conventional voice services, and it is no longer a program primarily for underserved and impecunious rural residents. Responding to criticism, the Federal-State Board on Universal Service recently released a report with recommendations for improvement.[8]

Under principle 2 in section C above, EDUCAUSE advocates *"a new and streamlined regulatory structure based on sound economic and social concepts, recognition of the advantages inherent in new network technology, and a willingness to undertake the difficult transition away from current, obsolete telecommunications facilities."* Consistent with this approach, universal service should be revised from a program supporting subsidized legacy services to one promoting an accelerated migration from narrowband legacy voice to broadband Internet transport services. Incentives and subsidies contained in a reformed universal service program should assist all citizens in obtaining quality and affordable broadband access to the Internet at the earliest possible date.

5. Federal Funding of Cyberinfrastructure R&D

The reports of federal advisory committees and other studies outside government have repeatedly underlined the importance of Internet technology, and especially advanced forms of the technology, such as broadband access, which support a wide range of applications as a major component of economic growth and the enhancement of job opportunities.[9,10]

Under principle 3 above, EDUCAUSE notes the essential contributions of federal research sponsors to the design, development, and deployment of the Internet. It also points to the need for

continued research sponsorship, citing the recent NSF report on cyberinfrastructure. The report describes priority areas for research, including improvements in the electro-optical technologies underlying high speed (gigabits and terabits per second) transport; further development of the building blocks of operational infrastructure for very high-capacity databases; creation of middleware tools that enable applications for use in the broadband environment; and specific funding for applications of high national priority, such as in the health sciences.

These research endeavors are the basis for future commercial products and services that will contribute to health, safety, economic security, and other national goals. They are essential to the dynamic process by which innovations in technology find their way into everyday lives.

The NSF Blue-Ribbon Advisory Panel, which studied cyberinfrastructure needs to support national research goals, concluded that an additional annual funding level of $1.02 billion would be required in addition to the current NSF investment in this area.[11] Some of these funds would be diverted from existing efforts, and some would be new appropriations.

Endnotes

[1] NSF Blue-Ribbon Advisory Panel, *Revolutionizing Science and Engineering Through Cyberinfrastructure: Report of the NSF Blue-Ribbon Advisory Panel on Cyberinfrastructure*, the Directorate for Computer and Information Science and Engineering, NSF, January 2003, <http://www.cise.nsf.gov/sci/reports/toc.cfm>.

[2] See Net@EDU Broadband Policy Working Group website, http://www.educause.edu/netatedu/groups/pricing/

[3] Reed Hundt, "Why is Government Subsidizing the Old Networks When 'Big Broadband' Convergence is Inevitable and Optimal?" New American Foundation, 2003, <http://www.newamerica.net/index.cfm?pg=program&progID=23&T1=intro>.

[4] "The National Information Infrastructure: Agenda for Action," U.S. Department of Commerce, 1993, <http://www.ibiblio.org/nii/NII-Agenda-for-Action.html>.

[5] Noam, Eli M., "The Effect of Deregulation on Market Concentration: an Analysis of the Telecom Act of 1996 and the Industry Meltdown," Columbia Business School, Columbia Institute for Tele-Information, December 2002. <http://www.tele.sunyit.edu/ECONOMIC_ANALYSIS.pdf>

[6] Werbach, Kevin. "For My Next Act...", The VoIP Monitor, Pike and Fischer, Inc, April 28, 2004. <http://www.voip-monitor.com/subscribers/index.htm?article_id=4896&PRINTV=Y> (subscription only)

[7] Richard S. Whitt, "A Horizontal Leap Forward: Formulating a New Public Policy Framework Based on the Network Layers Model," an MCI public policy paper, 2003, <http://global.mci.com/about/publicpolicy/presentations/>.

[8] See FCC home page on Universal Service, <http://www.fcc.gov/wcb/universal_service/>.

[9] Committee on Broadband Last Mile Technology, *Broadband: Bringing Home the Bits*, Computer Science and Telecommunications Board (Washington, D.C.: National Academy Press, 2001), <http://www7.nationalacademies.org/cstb/pub_broadband.html>.

[10] "Building Out Broadband," PCAST report, 2002, <http://www.ostp.gov/pcast/pcast2002rpt.html>.

[11] NSF Blue-Ribbon Advisory Panel, *Revolutionizing Science and Engineering Through Cyberinfrastructure: Report of the NSF Blue-Ribbon Advisory Panel on Cyberinfrastructure*, the Directorate for Computer and Information Science and Engineering, NSF, January 2003, <http://www.cise.nsf.gov/sci/reports/toc.cfm>.