Avoiding the Digital Divide for Smaller Institutions of Higher Education

Recommendations to the President’s Information Technology Advisory Committee

November 2000
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Preface

At the request of the President’s Information Technology Advisory Committee (PITAC), the National Science Foundation and EDUCAUSE convened a meeting on June 5–6, 2000, in Arlington, Virginia, to explore the potential “digital divide” for advanced networks in smaller institutions. The ultimate purpose of the project is to provide recommendations to PITAC on that issue. These recommendations are embodied herein.

Smaller colleges and universities can be empowered to make even greater contributions to research and education if access to advanced networks and services becomes available. Those smaller institutions were the primary focus of this workshop. While we think a logical next step in the evolution of networking for education should be connection of these smaller institutions, the digital divide also refers to the barriers facing minority-serving institutions and geographically remote institutions. While representatives from both communities participated in these discussions, their concerns are also being addressed separately by PITAC (see Appendix I).

Many of the 60 attendees EDUCAUSE invited to participate were from smaller higher education institutions around the country. A number of federal government and association officials also were present. A complete list of participants is available on the meeting Web site (www.educause.edu/netatedu/events/ptc00/) and in Appendix II. The workshop was funded in part by a grant from the National Science Foundation (ANI-9820976).

Presentations and panels of experts in the areas of technology policy and advanced networking opened the meeting. We thank the following people who made special presentations and donated their time and expertise:

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Grant Miller  Technical Staff, LSL Liaison, National Coordinating Office for Computing, Information, and Communications

Following the presentations, meeting participants engaged in a structured dialogue designed to identify problems and isolate realistic solutions. The following report and recommendations were derived from the comments and concepts recorded during the moderated meeting and prioritized by the attendees through conventional strategic planning processes.
INTRODUCTION

Among the competing national priorities for federal investment in information technology, the higher education and research community has consistently worked with federal funding and research agencies to meet the basic IT and disciplinary research needs of the United States. Indeed, the creation and development of the Internet itself emerged from such academic–government partnerships. In the past several years, Congress and the administration have reaffirmed the importance of academic network and information technology development. Examples of this include the Next Generation Internet Act, the IT2, and NITRD legislative initiatives, as well as the President’s Information Technology Advisory Committee (PITAC).

The federal IT funding profile reflects a significant investment in the nation’s largest research universities, and rightfully so. As preeminent centers of fundamental research, such institutions (categorized as “Research Universities” under the Carnegie Classification of Institutions of Higher Education1) are well-suited to deliver the fundamental breakthroughs in IT. These institutions can engage in the long-term, high-risk research that private sector companies more concerned with short-term development cannot perform.

To meet the needs of these basic researchers, high-end, leading-edge, advanced networks have been built among research-oriented campuses (e.g., NSF High Performance Connections program, the Internet2 project). The federal government has played a significant role in enabling the largest 125 or so research universities in the United States to acquire super-fast network connections to their peer institutions and to deploy advanced networks on campus to serve researchers.

A natural, though perhaps unanticipated, outcome of this investment by universities and the government is that the largest universities2 in the United States have a network capability that far outpaces that of the other four-year degree-granting institutions of higher education in the country. These smaller institutions, which educate the great majority of college students in the United States, face severe challenges in meeting the ever-increasing advanced networking requirements necessary to educate a 21st century workforce. In addition, the smaller institutions must provide equal research opportunities for their faculty, and perhaps of greatest importance, enable the rest of the world to take advantage of the vast store of unique offerings they have available.

SPECIAL CONTRIBUTIONS OF SMALLER INSTITUTIONS

By “smaller institutions,” we refer to those U.S. colleges and universities that generally do not fall within the Research or Doctorate Carnegie Classification1, that typically do not receive substantial benefit from various federal high-end networking infrastructure research opportunities (such as NGI), and that generally are not members of national network infrastructure development consortia (such as the Internet2 project). At this writing, almost all Research Universities are members of Internet2 or otherwise participate in the NGI activities, while the majority of Doctoral Universities through Baccalaureate are not.

1 The Carnegie Classification of Institutions of Higher Education is the leading typology of American colleges and universities. It is the framework in which institutional diversity in U.S. higher education is commonly described. The classifications used here are the “1994 Classifications” rather than the newer version, which is scheduled to be finalized this year. See www.carnegiefoundation.org/Classification/index.htm.

2 In addition to nearly all the research universities, Internet2 includes in its membership a number of doctoral and a few master’s institutions.

3 The Research and Doctorate classifications include universities that offer a full range of baccalaureate programs and are also committed to graduate education through the doctorate.
The non-Research, smaller institutions provide the majority of post-secondary education in the United States as the following statistics indicate:

**Fall 1997 Enrollment**

<table>
<thead>
<tr>
<th>Type of Institution</th>
<th>Number of Institutions</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Universities</td>
<td>125</td>
<td>2,667,577</td>
</tr>
<tr>
<td>Other 4-year institutions</td>
<td>1945</td>
<td>5,539,230</td>
</tr>
</tbody>
</table>

Based on numbers alone, the importance of these smaller institutions to U.S. workforce development cannot be overestimated. The United States has a clear and definite interest in furthering the development of these institutions and in enabling them to fulfill their education missions in the 21st century.

Institutional size does not determine quality. Many of these smaller colleges and universities are world leaders in a variety of disciplines, providing preeminent education and research programs in areas of such current importance as software engineering, digital libraries, and genetic research.

Moreover, this group of institutions is on the forefront of the effort to meet the growing need for a competitive information technology workforce in the United States. IT degrees and certifications compose a significant portion of these smaller institutions’ deliverables (particularly the case for Associate of Arts Colleges). Research universities draw significant numbers of domestic graduate students in fields involving IT, science, and engineering from smaller colleges and universities.

In addition, these institutions often have very close ties to their local communities. The economic livelihood and continued development of these communities rely on the health of the institution and the services the institution brings to the community.

In short, U.S. higher education is best characterized not in terms of the largest research universities, but rather by the heterogeneous group of smaller institutions that provide the majority of American post-secondary education. A real danger of a digital divide in U.S. higher education exists because of the non-Research categorization of these smaller institutions and the previous lack of federal funding for network infrastructure development.

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**The Digital Divide in U.S. Higher Education**

The network environment at these smaller institutions—which often lags behind that of their larger counterparts—threatens to inhibit the development of the full potential of higher education in the United States in the 21st century. Although there are notable exceptions (e.g., Stevens Institute of Technology), the current network available to most students and faculty at smaller institutions possesses few, if any, traits that characterize an “advanced network.”

Examples are plentiful of frustrated projects and attempted initiatives at smaller colleges that cannot be achieved due to the lack of a robust network infrastructure. For instance,

- Collaboration with disciplinary colleagues at larger research institutions is impaired. Faculty members at smaller institutions are at a distinct disadvantage. They need the same access to networked resources and collaborative tools as their disciplinary peers.

- Current and future environmental science projects, such as remote sensing and modeling of watersheds, require transmission of detailed and large visualization sets.

- Live access to data from unusual, expensive instruments such as high-end telescopes requires advanced networking. Conversely, smaller institutions with a robust network can make available their own unusual, valuable equipment and resources to others via the network.

- Real-time music transmission to and from conservatories of music is generally not possible without an advanced network.

- International, collaborative research projects such as the Chinese Memory Net are anchored in U.S.-based institutions that do not currently have access to advanced networking.

- Art visualization projects that enable the sharing of images between museums, art faculty, and students, are impeded.

- Conversational foreign language instruction for distance learners is not realistic without an advanced network infrastructure.

- Human anatomy databases and coursework for various distance learning uses and telemedicine is currently impracticable for most institutions. The current network environment generally cannot handle transmission of the dense visual files at the speed necessary for effective anatomy instruction.

- Geographic Information Systems (GIS) labs require robust network infrastructure to enable communication and collaboration.

- A robust network promotes diversity. Through interactive video and other collaborative means, students at smaller institutions would have much greater exposure to diverse populations.
3-D virtual field trips would enable education and research for those unable to visit a particular site of interest (remote archaeological digs, for instance).

With the growing trend of Application Service Providers and the increasing scarcity of IT professionals, smaller institutions are likely to benefit by outsourcing non-core functions to remote ASPs for a variety of administrative purposes. A robust and reliable network is necessary to enable this.

A robust network allows smaller institutions to more effectively recruit and maintain quality faculty and students.

As these examples make clear, students and faculty at smaller institutions would benefit from the presence of a robust, advanced networking infrastructure comparable to that enjoyed by the largest research universities. Indeed, such an infrastructure is absolutely essential for these institutions to fulfill their educational and research missions in the 21st century as they comprise the majority of U.S. higher education institutions.

**OBSTACLES TO ADVANCED NETWORKING FOR SMALLER INSTITUTIONS**

**Small**er institutions face many barriers when implementing an effective advanced networking infrastructure to serve education and research. Some of these obstacles can and should be addressed by the higher education community. Others are simply beyond the capacity of individual schools or the community to address, which suggests a role for the federal government as a catalyst for overcoming these problems. The United States has a compelling, competitive interest in providing opportunities for smaller higher education institutions to overcome the significant barriers impeding the deployment of an effective network infrastructure.

From a technological perspective, the primary obstacles to an effective education and research network for higher education (as cited by participants at the PITAC/EDUCAUSE conference) were

- Lack of campus infrastructure. The goal of each institution is to plan for 100Mb capacity to the desktop, dorm room, and classroom.
- Lack of reliable middleware (security, authentication, and network management tools).
- Lack of cooperation from telecommunication companies in providing service.

Some of the most significant obstacles to advanced network deployment, however, are not technological. Examples of these include

- A difficult economic environment for information technology and networking at smaller institutions. (Advanced networking is a significant and often new budgetary item.)
- Lack of high-level support from campus decision-makers.
- A return-on-investment that is difficult to articulate.
- Difficulty recruiting and retaining IT staff.

Recruitment and retention of IT staff on campus is a major problem for these schools. While various campuses are trying some creative solutions, the problem is a fundamental one. It is not unique to higher education, of course, but higher education appears to have a more difficult task as it competes with the lucrative private sector for qualified IT staff. To help alleviate the problem, some campuses are increasingly turning to Application Service Providers for certain non-core IT functions, and the establishment of remote network support centers also may play a key role. Nevertheless, the pace of deployment and maintenance of an advanced network on campus will likely suffer greatly if the network and IT department is short-staffed.

Some of the obstacles noted above that threaten to exacerbate the digital divide in higher education must be addressed by the higher education community through its associations and other channels. EDUCAUSE and its partner higher education associations will continue to work with campuses to articulate the vision of advanced networking, to provide professional development opportunities for more qualified and productive IT staff, and to work with vendors and other technology providers to ensure that the needs of all higher education institutions are known.

Conversely, other obstacles call for the federal government to play a catalytic role by providing network development opportunities to further education and research in U.S. higher education. Our recommendations to the PITAC (below) suggest potential avenues for such a role.

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4 Remote network support centers will be utilized in the NSF/EDUCAUSE Advanced Networking for Minority Serving Institutions.
RECOMMENDATIONS FOR AVOIDING A DIGITAL DIVIDE IN ADVANCED NETWORKING FOR SMALLER INSTITUTIONS

RECOMMENDATIONS FOR THE PITAC

While advanced networking for research and high-end computing has benefited from a number of federal initiatives (generally under the Next Generation Internet umbrella), advanced networking for education has received scant attention. We strongly recommend that advanced networking for education be made a national priority. The federal government has a compelling, competitive interest in helping develop a 21st century workforce and should actively ensure that all U.S. institutions of higher education are able to deploy a network infrastructure that fulfills the promise of the Information Age.

More specifically, we recommend the following:

1. **Support immediate steps to build on existing projects to support research in our smaller institutions.**

   The National Science Foundation Connections and High Performance Connections programs enabled over 170 universities to obtain high-speed connections for research purposes. (Projects under the NGI aegis at research agencies such as the Department of Energy have benefited much the same group of institutions.) While NSF is taking steps to extend the reach of advanced networking, and is to be commended for doing so, we recommend a much broader federal approach that promotes the development of advanced network infrastructure in higher education.

   Specifically, we recommend that the federal government provide resources to leverage current projects such as the Next Generation Internet and Internet2 so that smaller institutions, particularly those with innovative projects and initiatives in research, can connect to advanced networking to prevent any further erosion of their ability to contribute to our nation’s and our world’s store of knowledge. Longer term, a program for smaller institutions modeled after the EPSCoR is recommended.

2. **Encourage the expansion of advanced network access to a broader spectrum of higher education institutions by offering multi-year infrastructure funding opportunities for projects that utilize advanced network technologies for innovative educational purposes.**

   We recommend the creation of a program that spans multiple federal agencies, in addition to the National Science Foundation. The Department of Education might play a key role, with a focus on education alongside scientific research.

   Ideally, this program would allow institutions to obtain project funding spread over a period of multiple years. A multi-year timeframe is desirable because it correlates with the typical budgetary planning horizons in higher education.

   In addition to the two primary recommendations above, the group also recommends consideration of the following:

3. **Create tax incentives for telecommunications carriers and network service providers that provide service to higher education institutions.**

   Because many of these smaller institutions are located in remote or underserved areas, or are quite small, telecommunications carriers often lack commercial incentive to provide necessary services to connect an advanced campus network. While the higher education community has and will continue to explore various methods of demand aggregation, we recommend the implementation of tax incentives for telecommunication companies that provide the necessary advanced services to smaller higher education institutions.

4. **Identify and support initiatives to help solve the shortage of network and other IT workers within higher education.**

   As noted above, smaller institutions have a major problem recruiting and retaining qualified IT personnel. We recommend a federal effort to help alleviate this problem. Specifically, a federally funded IT salary supplement program would help institutions compete more effectively with IT salaries offered by the private sector. We also recommend the creation of a student-loan forgiveness program for people who pursue IT careers in higher education.

   Another way the federal government could help avoid a digital divide in higher education is to effectively leverage higher education’s role in training the American IT workforce. Institutions with an advanced network infrastructure will be better able to train IT students, wherever they may be located. An advanced campus network will be essential for future IT students to become contributing members of the information economy and will be necessary for the campus to be an effective educator in the 21st century. Taken together, the need for advanced infrastructure and the role of smaller institutions in training the IT workforce calls for a program that enables campuses to obtain such an infrastructure, particularly if the campus is a preeminent producer of qualified IT professionals or the sole producer in its geographic area.
5. Enable a special White House and Congressional role for the education of executive leadership of smaller institutions of higher education.

As noted above, senior decision makers on campus need greater understanding and vision for advanced networks for higher education in the nation’s best interest. Sessions around the country that are oriented toward university presidents and other senior administrators (most likely appended to other meetings), if provided under the aegis of the White House, could significantly ease this difficult task.

6. We recommend an immediate, in-depth study of the requirements and costs of networking for smaller institutions, seeking hard data to support realistic and accurate consideration of necessary funding levels for the suggested programs.

Appendix I

Related Communities and the Digital Divide

Many minority serving colleges and universities in the United States are “smaller institutions” under the definition given for this conference. Often they are located in rural areas or in the central cities, and they serve the nation’s poorest communities. A confluence of digital divide issues surrounds these institutions. As the United States Department of Commerce said in its report, “Falling Through the Net: Defining the Digital Divide” (1997), “minorities, the less educated, and children of single-parent households, particularly when they reside in rural areas or central cities” are at the heart of those groups “that lack access to information resources.”

Reasons minority communities lack access to information resources include: distrust of specific new technologies; geographic remoteness or the urban isolation built inside our inner cities; weak community economic bases; lack of access to investment capital; poor targeting of specific governmental policies on the improvement of technology infrastructures in these communities; and fear of change, since so often in the community’s experience, change brings bad results. An example is the construction of inner city housing projects, which brought changes that ended up harming many poor communities.

These and other reasons put tribal colleges and universities, historically Black and predominately Black colleges and universities, and Hispanic-serving institutions into a different situation from that faced by other small colleges and universities. Institutions that serve minorities have the same needs and hopes as other small colleges and universities. In addition, these institutions fear that if they do not succeed at transferring the technology and culture of the Information Age into their communities, they will have failed the cause of racial and economic justice in minority communities for, perhaps, several more generations. They will have failed to help their people achieve the promise inherent in the new wealth and opportunity so much a part of the Information Age.

These small colleges and universities recognize that accomplishment is possible in places where hope dies often and quickly, but that it comes with much greater effort than that necessary in places where hope for success is a habit ingrained in the act of living. That’s why these institutions, which have grown as the clearest expressions of hope from their communities, need to master technology in order to jump a generation ahead so that they can, at long last, attain technological equity. By having the foresight to build a human infrastructure from their communities and a technology infrastructure that will bring the digital revolution to the nation’s poorest places, these colleges can help advance the noble causes of equality, justice, and opportunity upon which this nation was founded.

Still, special support will be needed to help minority colleges and universities succeed. Partnerships will have to be built between government, industry, and private foundations. This support should not supplant that needed by other communities to compete in this new age, but it should be built with vigor within the context of the larger community support. If this is achieved, and if the goals and programs detailed in this conference are implemented, minority colleges and universities will then have reason to believe their communities’ futures can be brighter than their pasts.
APPENDIX II

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