

# Digital Divide and Access Grid Technology

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## Abstract

*In April, 2005, the University of Louisiana at Monroe hosted a national conference for Children and Rural Education (CARE). The mission was to establish a research agenda for dealing with the problems which rural educators face. An exciting aspect of the conference was that Access Grid Node (AGN) technology would be utilized as a means of connecting with five other remote sites allowing full participation from a truly national audience. This paper examines the use of access grid technology as a means of bridging the gap between rural and urban/suburban educations and the effect of the Digital Divide on the use of AGN technology. During each step of implementation, the following areas are identified: problems encountered, lessons learned, and implications for the future.*

**Keywords:** access grid node, digital divide, ITEST, rural schools

## 1. INTRODUCTION

In 2004, as the No Child Left Behind legislation began to cause many rural school systems to worry about how they could provide highly qualified teachers for their students, the University of Louisiana at Monroe (ULM) applied for and received funding from the National Science Foundation (NSF) for a national conference focused on the problem. Specifically, the ULM faculty and staff members who wrote the proposal for the Children and Rural Education (CARE) Conference wanted to get a national conversation going about the problems of recruiting and retaining highly qualified science, mathematics, and technology teachers in rural school systems. From this conversation, the CARE planners wanted to establish a research agenda focused on solving this problem.

ULM has a long track record of being involved in the pre- and post-service preparation of rural teachers. ULM was a major player in the Delta Rural Systemic Initiative (RSI) which was funded by NSF. In the 1990's, it also had two NSF-funded teacher enhancement projects focused on training K-12 science and mathematics teachers to use technology in their classrooms. Currently, ULM has an NSF-funded ITEST project focused on the use of agriculture and technology to teach science and

mathematics in middle- and high-school. Each of the CARE planners was directly involved in one of these projects and therefore very aware of the problems faced by teachers in rural schools.

Likewise, since ULM is located in a small town in a rural area that includes some of the poorest school systems in the nation, the CARE planners knew that it was imperative that they find a way to include as many people as possible from poor rural school systems without spending a lot of money. This became even more important after NSF reduced our original budget from \$250,000 to \$200,000.

The solution which seemed most feasible was to utilize the Access Grid Node (AGN) system. In 2004, ULM had recently established a small AGN conference room. The AGN technology seemed like the perfect way to reach a large number of people living in rural communities. This paper will focus on the use of AGN at the CARE Conference and the effect of the Digital Divide on the use of AGN technology. It will look at the methodology used, problems encountered, lessons learned, and implications for the future.

## 2. BACKGROUND

### Digital divide

For the past decade, researchers have studied the gap between those with and without access and ability to use digital technologies [8][13]. The "digital divide" that occurs is most often referenced in terms of Internet use; however, any digital media that is not accessible to an entire society has the potential to create inequalities within that society [1]. The digital divide is not always clearly defined; researchers often debate whether a divide exists and whether an intervention should take place. Some of the dimensions that exist include: international, national, regional, local, institutional, individual, etc. Disadvantages often result from lack computer performance, bandwidth, access to a technology, and technological expertise [1] [7].

As researchers have studied disparities related to the Internet, ease of access and effective access have been found to be underlying factors creating the gap which forms the digital divide. Not only must one have access to the Internet, but the connection must be effective, and the individual must possess technical skills [2].

Another context in which the digital divide has been studied is the variation of technology used among nations. The concept of a digital divide becomes clearer when comparing technologies used in various countries. Some countries are more technologically advanced than others, and the disparities are quite visible. National interests for closing the digital divide exist in economic equality, social mobility, social equality, democracy, and economic growth [16].

The differences in technologies available to the different types of educational institutions create a divide in education as well. In higher education, research institutions benefit first from technologies such as Internet2 and Access Grid Nodes, while other institutions must wait until it becomes more affordable [7]. K-12 schools are usually the last to receive access to advanced technologies, particularly in rural communities [12].

Another context in which the digital divide is prevalent is with rural areas and urban and suburban areas. Statistics from the Pew Internet & American Life Project show that while Internet use has grown in rural areas, a gap exists between rural and other communities in America [9][12]. Researchers believe that the average demographics of rural communities may account for the gap that exists. Typically, rural communities have higher percentages of older, less wealthy, and less educated people. Other factors include lack of access to the Internet, broadband technology, and technical training [12]. Studies show that a 24.7 percent of Internet households have broadband connections in rural areas, compared to 40.4 percent in urban areas. Rural households with dial-up connections claim that the reasons for not having high-speed connections are as follows: not available - 22.1 percent, too expensive - 31.1 percent, no need - 41.4 percent, and other - 5.4 percent. In comparison, urban households with dial up connections claim that the reasons for not having high-speed connections are as follows: not available - 4.7 percent, too expensive - 42.1 percent, no need - 45.2 percent, and other - 8.0 percent [9].

Differences in Internet use at the individual level have been shown to be tied to age, gender, income, education, and race. Studies have shown that when given access to technologies such as email, chatting, and newsgroup activities, that the majority of those participating in the study failed to utilize the technologies available. Researchers believe that until access is more prevalent in the underserved populations, the technologies will be underutilized by those who have access [6].

The use of broadband technology has grown faster than any other technology in history [9]. According to statistics from a 2002 survey by Pew Internet, 23 percent of American adults had never used the Internet or lived in a household with Internet access. In 2005, the rate decreased by 1 percent indicating that 22 percent of American adults had never used the internet or lived in a household with Internet access [11]. While access to internet was the major challenge in 2002, a new challenge has

created a new divide in 2005 studies – access speeds. Currently, 53 percent of home internet users have high-speed connections compared to 21 percent in 2002 [11]. Of the remaining Internet users, there seems to be little demand for conversion to broadband for reasons which may include high cost, lack of technical skills, or lack of effective access [5]. Of those having high-speed connections, the majority are between the ages of 18-29, are college graduates, have household incomes of \$75,000 plus, and live in urban or suburban areas [11][12]. Thus, the digital divide widens.

Despite the efforts to decrease the digital divide, the gap continues to widen as technology advances [8][12]. As governments, public and private institutions, and learning structures integrate technology into their operational activities, those that are privy to effective access to the digital technologies and have had adequate technical training will thrive, while those who have not will struggle [4].

More and more, broadband is “transforming the way we live, work, and learn,”[9] so much that President Bush has established a national goal for “universal, affordable access for broadband technology by the year 2007” [9]. The following excerpt from *A Nation Online* describes the possibilities that broadband brings:

...[H]igh-speed connections promise to enhance our Nation’s productivity and economic competitiveness, improve education, and expand health care for all Americans. High-speed networks provide the power to erase geographic, economic, and cultural gaps. With high-speed connections, American workers can find jobs; small businesses can have global markets; rural doctors can consult with specialists; and students can take classes that are taught from across the country. [9]

As the previous passage indicates, broadband has the potential to bring many great things to those who utilize it. While broadband was once considered a luxury, high-speed connections are increasingly becoming a necessity for accessing and relaying information.

Several communication theories aid in understanding the consequences of the divide, such as diffusion of innovations, increasing knowledge gap, and structuration theory [8]. Diffusion of innovations theory suggests that first adopters are those with more resources, thus creating knowledge gaps as new technologies are introduced [14]. Knowledge gap hypothesis states that those with higher socio-economic status and those that are well-informed have a greater potential to know of the uses for technology and therefore adopt those technologies [15]. Structuration theory claims that human communication creates, alters, and maintains the rules which exist for society [3]. Because those that adapt new technologies are more knowledgeable about potential uses of the technologies and have the greater opportunities to use the technologies, there exists the potential for them to be influential to those with higher levels of power. Thus, those having more resources have more opportunities to change society. This suggests that the digital divide creates inequalities in all realms of society [8]. Public policymakers must seek to hear the voices of all groups within a society in an effort to learn what is needed to eliminate the digital divide [10].

The relatively new access grid technology is one that was designed to bridge some of the gaps brought about by the digital divide in rural areas and in education.

**Access Grid (AG) technology**

Access Grid technology is designed to bring collaborations over the Internet using audio, video, and text as a foundation. It is a network of sites allowing multiple group-to-group communications via high-speed networks over the Internet. As many as 20 groups can collaborate together at one time with comfortable interaction and rich communication. The AG creates an interactive system conducive to collaboration allowing the open exchange of ideas. The AG environment is described as one that “allows the participants to feel as if they are engaged personally rather than in the stiff structured environment of a typical videoconference” (<http://www.accessgrid.org/agdp/guide/building-an-access-grid-node/2.4.6/ag-book.pdf>).

Requirements for the AG include: space, such as a conference room, classroom, or auditorium, with wall space, phone-lines, etc.; networking, a multicast enabled 100bT connection, and at least DS3 bandwidth to the Internet from the node; and hardware, including cameras, projectors, screens, consumer-grade computers, audio speakers, microphones, a KVM switch, an echo cancellation device, and a load balancing device (<http://www.accessgrid.org/agdp/guide/building-an-access-grid-node/2.4.6/ag-book.pdf>). Standard cost for the basic AG setup is approximately \$50,000 not including room renovations or elaborate display walls (<http://www.accessgrid.org/agdp/guide/building-an-access-grid-node/2.4.6/ag-book.pdf>).

The AG is a useful tool for international collaborations in research since an AG room contains many cameras allowing different angles and shots to be taken. The AG promotes research across distances, joint course offerings, seminars, discussions, and large scale distributed meetings (<http://dmrl.latech.edu/Access-Grid/>).

**Table 1. Global Access Grid Node sites**

Country	# Sites
Australia	26
Austria	1
Brazil	1
Canada	15
Chile	1
Czech Republic	2
Finland	1
France	1
Germany	6
Italy	3
Korea, South	3
Malaysia	1
New Zealand	8
Peru	1
Philippines	1
Poland	1
Singapore	2
Spain	5
Thailand	2
United Kingdom	18
United States	63
Venezuela	1

As Table 1 indicates, AGN technology is not widely available as a global means of communication at this time, which further demonstrates the divide in digital access among nations. As the technology is still new, we have yet to see whether it will aid in bridging the gap of digital disparities or if it will in fact become another technology available only those that are already digitally advanced.

**3. METHODOLOGY**

Great care was taken in planning for the use of AG technology during the CARE conference. The project investigators had no experience with the use of the technology, only descriptions of what the technology could bring to the conference. Therefore, the investigators used a very methodological approach in planning for the event. The approach that was taken for securing AGN participants for the CARE conference was carefully planned and very purposeful. Since the conference was designated as a national conference, we wanted to ensure that there was an audience from all regions of the nation, not only in house, but through AG participation as well. Therefore, the first step utilizing AG technology was to select the remote sites. The next step involved onsite preparation for using the AGN. We had to make necessary arrangements with the state for needed bandwidth, buy additional projection equipment, and secure the technical support needed for the event. The third step

in the project was to recruit the participants for the remote sites. Since rural educators do not normally have opportunities to participate in such events, many do not realize the value of participating. Therefore, recruiting is often a challenge. Finally, the last step in the project was to test the AGN at the conference site in a trial run with the remote sites. We wanted to be aware of potential problems and have the opportunity to deal with them before the conference.

#### 4. IMPLEMENTATION OF THE AGN AT CARE

##### Site selection

The original plan called for at least five remote sites with an AGN-knowledgeable technician and a session moderator with academic credentials and rural education expertise. The plan for site selection was to contact universities with AGN capabilities, which were also located near RSI sites. After contacting all universities who fit the criteria, sites in seven states were identified as willing to participate: Colorado, Kentucky, Montana, North Carolina, North Dakota, New Mexico, and Washington. However, the sites in Colorado, Kentucky, and Washington eventually dropped out.

**Problems encountered:** The primary reason that sites could not participate is that they did not have the necessary bandwidth to actively participate. They could listen but they could not participate actively via audio and video. Another major problem that caused sites not to participate was that there was no one with the proper credentials who was willing to serve as the session moderator. Of the sites that initially agreed to participate, this was the reason that Colorado and Washington dropped out. Kentucky dropped out because no AGN-knowledgeable technician who was willing to provide the technical assistance needed.

**Lessons learned:** The selection of sites was much difficult than the CARE planners had anticipated. In general, the people with the technical expertise are not well acquainted with the people with the academic expertise needed to be the session moderator. Therefore, the task of identifying a session moderator involved a lot of cold calls which often resulted in negative responses.

**Implications for the future:** It is important to start this process early and to try to find a cooperative upper-level administrator at the remote site with whom to work.

##### AGN at ULM

The original plan called for ULM to have a portable AGN system that could be moved between the Conference Center in the ULM Library and a large auditorium in Brown Hall. The CARE planners worked with the technician in charge of the AGN site at ULM. With his advice, a large screen and rear screen projector were purchased to use with a similar screen and projector recently purchased by the University. Louisiana State University (LSU) in Baton Rouge agreed to loan ULM its portable AGN equipment and a technician to assist with the CARE conference.

**Problems encountered:** The ULM Conference Center had no screens installed at the time of the CARE Conference. Unfortunately the screens purchased for use with the rear screen

projectors were too large to use in the Conference Center. The logistics of moving the AGN equipment from Brown Auditorium to the Conference Center also proved problematic because of the need to re-establish communication with the remote sites. Therefore, AGN was not available in the Conference Center and the remote sites could not participate in the portions of the conference held there.

**Lessons learned:** The technician working with the CARE planners was relatively inexperienced and did not pay close enough attention to what was required. It is very important to have an experienced technician and to make sure that he/she really understands the specifications of the project.

**Implications for the future:** The lack of technical expertise was partly the result of the newness of the technology but it also related directly to the Digital Divide between rural and urban areas. In general, the AGN technology was first available at the larger campuses in urban areas and then spread to campuses in rural areas. As a result, some of the technicians working with the CARE Conference were relatively inexperienced. As AGN technology becomes more widespread in rural areas, technicians will better understand what is needed to make it work well in all situations.

##### Recruitment of participants at remote sites

The original plan was to have fifty participants at each of the remote sites. The recruitment of these fifty participants was the job of the session moderator for the remote site. The recruiting materials were provided by ULM. Money for refreshments and supplies for the remote sites was provided by the CARE grant.

**Problems encountered:** None of the remote sites had fifty participants because the CARE planners and the session moderators underestimated the difficulties of recruiting participants from rural areas. A major problem was that the targeted populations were just so wide-spread. The sites that had the most difficulty recruiting participants were in Montana and North Dakota. When it became apparent that recruitment for the remote sites was going to be a problem, the CARE planners offered travel money for participants as an incentive. However, the travel money made little difference. The most successful recruiting was done in New Mexico, which was ironic given the technical problems encountered in establishing the AGN connection with the CARE Conference.

**Lessons learned:** The difficulty in recruiting participants from rural populations is a direct result of the Digital Divide. The remote sites were chosen because they were “close” to the targeted populations and therefore more accessible to participants from “nearby” rural communities. However, in areas like Montana and North Dakota, the population is sparse and wide-spread and “nearby” can mean driving many miles to get to the remote site. Even at ULM, the participants from the poorest parishes targeted by the CARE planners were one hundred miles away.

**Implications for the future:** Until AGN technology becomes more widespread in rural areas, the problems of recruiting rural participants will remain unsolved.

### Testing of remote sites

Five remote sites were finally identified for the CARE Conference: East Carolina University, Montana Tech University, North Dakota State University, Northern New Mexico Network, and Rio Rancho New Mexico. ULM's technician worked with the technicians from each of the other institutions confirming the technical requirements of the setup and scheduling a date in March 2005 for a trial run.

**Problems encountered:** During the testing in March, the sites in New Mexico were very problematic because there was really only one technician available for both sites. A decision was made to have all participants at one site so that a technician on site during the conference. However, no successful test of the New Mexico site was made in March because of scheduling conflicts with the New Mexico technician. The New Mexico technician assured the ULM technician that he was confident that there would be no problems connecting with ULM during the CARE Conference.

A second test was scheduled for the weekend immediately prior to the CARE Conference. At this time the LSU technician brought the portable AGN equipment to ULM and set it up in Brown Auditorium. Successful tests were made with the remote sites at East Carolina University, Montana Tech University, and North Dakota State. However, the New Mexico site was problematic. Despite the assurances from the New Mexico technician that the site met the technical specifications needed to participate, it became apparent during the testing that New Mexico did not have the bandwidth needed to participate via audio and video. The technicians finally decided that New Mexico would have to participate via audio only. This was a less than satisfactory solution and even the audio contact with New Mexico was very difficult to maintain during the CARE Conference.

**Lessons learned:** The difficulties with New Mexico were clearly the result of the Digital Divide. The New Mexico technician did not truly understand the technical requirements for audio and video participation. The ULM technician underestimated the amount of time needed to test the connections with the remote sites. He also failed to communicate clearly the technical requirements to the New Mexico technician because he assumed that the New Mexico technician was more knowledgeable than he was.

**Implications for the future:** An experienced, knowledgeable technician who understands the technical requirements for audio and visual participation in an AGN conference is absolutely necessary at each site – especially the host site. The technician at the host site also must not make any assumptions about the knowledge and experience of the other technicians and must communicate instructions clearly. Finally, testing should be scheduled early in the process to ensure that fatal problems will not occur during the conference itself.

### 5. ONE YEAR LATER

Although the CARE Follow-up Conference was not part of the original grant proposal, NSF allowed rebudgeting of remaining funds to cover the cost of the follow-up meeting. The plan for the CARE Follow-up Conference was for thirty participants to

meet for one and one-half days at the ULM Conference Center to consider collaborative research projects aimed at solving the problems discussed at the CARE Conference. All original CARE Conference participants were invited to volunteer to present research findings from their current research projects. The thirty participants for the CARE Follow-up Conference were chosen from those who responded to the invitation.

**Problems encountered:** Because of problems remaining from Hurricanes Katrina and Rita scheduling the CARE Follow-up Conference proved to be problematic. Finally, a date was chosen in late May 2006 for the meeting at ULM. Unfortunately, two of the scheduled speakers had unexpected schedule conflicts and had to decline the invitation. A third speaker from LSU in Baton Rouge also had a schedule conflict but arrangements were made to allow him to participate via AGN. Unfortunately, the other two speakers were from rural K-12 schools and did not have access to AGN technology.

**Lessons learned:** For those who have access to the necessary technology and expertise, AGN is a wonderful technology that can allow interactive audio and video conferencing with a number of sites. This time there were no problems with using AGN in the ULM Conference Center because over the past year ULM had acquired its own portable AGN equipment which can be moved any where on campus and the Conference Center has been equipped with the necessary screens for audiovisual presentations. Also, the ULM technician has become very knowledgeable and comfortable with the AGN technology. Of course, LSU had the necessary equipment and expertise at the time of the original CARE Conference. Unfortunately, it will be some time before the majority of K-12 schools have easy access to the necessary technology and expertise to use the AGN technology.

**Implications for the future:** The Digital Divide between rural and urban universities is getting smaller. However, the Digital Divide between rural and urban K-12 schools is still huge. All stakeholders who are interested in improving rural education must look for ways to minimize this problem. AGN technology offers great hope for minimizing the isolation of rural teachers and students. However, more study is needed on ways that AGN technology and expertise can be made widely and economically available to rural school systems.

### 6. REFERENCES

- [1] Alcatel. "Bridging the digital divide: An opportunity for growth for the 21<sup>st</sup> century", S. Marine and J.M. Blanchard (principal authors). Alcatel Telecommunications Review, 3<sup>rd</sup> Quarter, 2004 (available at [www.alcatel.com](http://www.alcatel.com)).
- [2] Davidson, E. and S.R. Cotton, "Connection discrepancies: Unmasking further layers of the digital divide", *First Monday*, 8(3), March 2003 (available at [www.firstmonday.org/issues/issue8\\_3/davison/](http://www.firstmonday.org/issues/issue8_3/davison/)).
- [3] Giddens, A. *The Constitution of Society*. Berkeley, CA: University of California Press, 1984.
- [4] Gordo, B. "Overcoming digital deprivation", *IT & Society*, 1(5), Summer 2003, pp. 166-180.

- [5] Horrigan, J.B. "Broadband adoption at home in the United States: Growing but slowing", *33<sup>rd</sup> Annual Telecommunications Policy Research Conference*, September 24, 2005.
- [6] Jackson, L.A., A. von Eye, F. Biocca, H.E. Fitzgerald, and Y. Zhao, "The impact of Internet use on the other side of the digital divide", *Communications of the ACM*, 47(7), July 2004, pp. 43-47.
- [7] Khan, J.I. "Worldwide emergence of research and education networks and a proposal for Bangladesh", Technical Report for Internetworking and Media Communications Research Laboratories, Kent State University, February 21, 2006 (available at <http://medianet.kent.edu/techreports/TR2006-02-01-UGC-REN-K.pdf>).
- [8] Mason, S.M., and K.L. Hacker, "Applying communication theory to digital divide research", 1(5), Summer 2003, pp. 40-55.
- [9] National Telecommunications and Information Administration. "A nation online: How Americans are expanding their use of the Internet", United States Department of Commerce, Washington, DC, February 2002 (available at [www.ntia.doc.gov/ntiahome/dn/index.html](http://www.ntia.doc.gov/ntiahome/dn/index.html)).
- [10] Payton, F.C. "Rethinking the digital divide", *Communications of the ACM*, 46(6), June 2003, pp.89-91.
- [11] Pew Internet. "Digital divisions", S. Fox (principal author). Pew Internet and the American Life Project, Washington, DC, October 5, 2005 (available at [www.pewinternet.org](http://www.pewinternet.org)).
- [12] Pew Internet. "Rural areas and the Internet", P. Bell, P. Ravani, and L. Rainie (principal authors). Pew Internet and the American Life Project, Washington, DC, February 17, 2004 (available at [www.pewinternet.org](http://www.pewinternet.org)).
- [13] Riggins, F.J. "A multichannel model of separating equilibrium in the face of the digital divide", *Journal of Management Information Systems*, 21(2), Fall 2004, pp. 161-179.
- [14] Rogers, E. *Communication Technology: The New Media Society*. New York: The Free Press, 1986.
- [15] Tichenor, P.J., G.A. Donohue, and C.N. Olien, "Mass media flow and differential growth in knowledge", *Public Opinion Quarterly*, 34, 1970, pp.159-170.
- [16] Wikipedia. "Digital divide", *Wikipedia the Free Encyclopedia* (accessed at [http://en.wikipedia.org/wiki/Digital\\_divide](http://en.wikipedia.org/wiki/Digital_divide) on June 14, 2006).