A Proud Past,
A New Vision.

Appalachian Regional Commission

Tearing Down the Access Barrier:

Wireless Broadband and Rural Communities

An *Information Age Appalachia* Report

May 2003

A Regional Vision: Appalachia is a prosperous and vibrant region with full access to the tools of the Information Age and has the knowledge and capacity to use those tools to compete successfully in the 21st century economy.

- ARC's *Information Age Appalachia*

With the proper telecommunications infrastructure available, there is no reason why high-tech companies can't succeed in Appalachia as they do in the nation's high-tech centers. Moving NuRelm from Austin to Appalachia allowed us to rejoin the area we love so much while operating a company that relies on access to a high-speed Internet connection with no negative impact.

- Mona McGraw, Co-Founder
NuRelm Software

As the IT [information technology] sector has grown faster than the economy as a whole, its share of the economy has increased. IT also is commonly credited as being a key factor in the economy's structural shift from manufacturing to services. The widespread diffusion of IT is largely responsible for the growth in existing services (such as banking) and the creation of new service industries (such as software engineering). In addition to its role in changing the structure of the economy, IT affects productivity and economic growth overall…

- National Science Foundation

Connectivity is Essential to a Competitive Economy

Information and Communication Technologies (ICT) play a critical role in the economic development and competitiveness of national, regional, and local communities. A diverse group of organizations from the World Bank[1] to the Congress of American Indians[2] have made the case that without access to ICT, rural communities cannot hope to support a competitive economic environment.

From Austin to Appalachia

The founders of NuRelm, Inc., (www.nurelm.com) a software development company that creates web management products, are Appalachian natives who wanted to return to the region and keep their company vital. They relocated a high-tech Austin business to Appalachia, where they can use cable modems to connect to the Internet, with little impact on their productivity—and an improvement in their lifestyle. NuRelm now employs 14 people in Uniontown, Pennsylvania. Without access to the high-speed cable modem they would have been unable to relocate the company in Appalachia.

The ICT requirement for the future will not be access alone, but *broadband* access. Indeed, the construction of a national broadband network has been suggested and has received support from a variety of legislators,[3] trade associations, and policy makers. One study[4] estimates that such a network would result in the creation of 1.2 million jobs, the majority of which would be in technology as opposed to pure telecommunications-related jobs. Another estimate[5] is that $500 billion a year for the next 10 years would be pumped into the American economy if broadband was available universally.

Yet for rural communities—particularly many of the communities served by the Appalachian Regional Commission (ARC)— lack of access to a modern telecommunications infrastructure has denied them the opportunity to compete equally with more-connected regions that are in or adjacent to metropolitan areas.[6]

The Commission recognized this barrier and adopted the *Information Age Appalachia* program to promote access to a modern telecommunications platform for the Region, and to ensure that its residents can take advantage of the opportunities ICT allows.

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[1] See http://www.developmentgateway.org/
[2] See http://www.indiantech.org/main/pages/economic_dev/index.asp
[3] See for example, Senator Leiberman's white paper, "Broadband: A 21st Century Technology and Productivity Strategy."
[4] *Building a Nationwide Broadband Network: Speeding Job Growth*, TeleNomic Research, February 2002 (http://www.newmillenniumresearch.org/event-02-25-2002/jobspaper.pdf)
[5] U.S. Chamber of Commerce Broadband Campaign. http://www.uschamber.com/government/issues/technology/broadband.htm
[6] See ARC's Information Age Appalachia (http://www.arc.gov/index.do?nodeId=21)

Barriers to Access in Appalachia—Cost, Landscape, and Perceived Demand

Lack of access in the Region is the epitome of the classic chicken-and-egg scenario: lack of access suppresses demand, while lack of demand leads to lack of access.

Telecom providers—primarily the local telephone company, but also a growing number of alternative providers, such as cable TV franchises—don't typically view rural communities as ones in which the investment to physically run wires will pay off with usage fees in a reasonable timeframe.

In rural areas, mountainous terrain and long distances often drive the cost of building the infrastructure to extremely high levels compared with urban settings. High cost, paired with the perceived lack of demand for advanced telecommunications services, makes providers reluctant to build infrastructure to remote and/or sparsely populated communities.

As a result, many rural ARC communities have limited telecommunications options, including—

- Poor quality dial-up lines that don't support modem use;
- Long distance dial-up access at prohibitive costs (and slow speed); and
- Long-haul leased lines at exorbitant rates.

The Connectivity Conundrum

It has been said that technology makes distance and location irrelevant. Indeed, when available *and* affordable, advanced telecommunications services deliver benefits particularly relevant to rural communities—distance learning, telemedicine, and e-commerce add more value to remote users than to those in metropolitan areas.

So we are left with the Connectivity Conundrum: those who would benefit the most from the availability of a broadband network have the least access to it.

Wired Broadband Options: DSL, Cable Modems, and Dedicated Leased Lines

Although the term "broadband" has connotations of vast speed and limitless capabilities, it does not have a universally accepted definition. Nonetheless, we will adopt the term to distinguish the *status quo*—dial-up connections with 56Kb modems, represented by the Connectivity Conundrum—from the desired state, which is broadband access. The status quo won't be able to support the applications that will enhance communities' economic development strategies.

Digital Subscriber Lines and Cable Modems are Hard to Come By In Rural Areas

Alternative options for access, such as DSL and cable modems, popular in metropolitan centers, typically are not available in rural communities. Indeed, in many areas, basic cable TV is not available. Each of these alternative options requires a significant investment by the provider to upgrade equipment and to deliver the expanded bandwidth.

Digital Subscriber Lines leased from the phone company, or cable modems that allow computers to access the Internet through a community's cable TV infrastructure provide a higher level of connectivity than dial-up modems. While primarily marketed for residential use, DSL is capable of supporting some small business applications (see sidebar on page 2). However, neither DSL nor cable modems are prevalent in the ARC service region.

Dedicated Leased Lines—A Starting Point for Broadband, but Still Prohibitively Expensive

The only remaining option in most areas is a dedicated leased line. Dedicated leased lines from the telephone company are generally the most available method of gaining a quality, high-speed connection. The typical leased line is known as a "T1."[7] One T1 line delivers 1.5 megabits per second of content, or about 30 times the bandwidth of a standard (56kb) dial-up modem. Multiple lines are often leased by large organizations to provide sufficient bandwidth for advanced applications or large numbers of users. Leased line rates are usually dependent on the distance traveled— the greater the distance, the higher the cost.

In rural areas, only relatively large organizations such as colleges, hospitals, or manufacturing plants can typically afford to run a T1 (or similar) leased line to their location from miles away. Often the loop costs[8] will be significantly more than the cost of the Internet access. Therefore, the high cost of leased lines is a barrier that essentially prohibits access to most rural communities.

Nonetheless, for this discussion we can think of a T1 as being the entry point for broadband. A T1 connection can support some of the advanced applications that define the minimum requirements to support economic development efforts.

Compared to a standard office Ethernet network connection, which is typically 10 Mbps, and internal office networks of 100Mbps, a T1 is slow and expensive. For future applications one might consider 10Mbps to be the entry point for broadband, as applications will increasingly require expanded bandwidth.

[7] T1 (or Trunk Level 1) technology was developed in the late 1950s and represents the initial digitalization of the analog, voice phone system. Faster speeds, e.g. "T3", are available as are slower speeds by leasing a portion of the channels known as a "fractional T1."

[8] "Loop costs" can be thought of as "mileage charges" for operating a circuit linking a facility to the Internet. In rural areas with long distances to cover these charges can be substantially more than access charges themselves.

Wireless Broadband

The evolution of fixed[9] wireless broadband technology presents an opportunity for rural communities to tear down the access barrier. As the name implies, connectivity to commercial and residential buildings is provided by way of a central access point akin to a transmitter and received by way of an antenna mounted on an outside wall or roof (both antennae actually transmit and receive). Both the transmitter and receiver antennae are small and require few special power requirements, which makes them easy to install and quick to implement.

Wireless Technologies Reduce Infrastructure Costs

Wireless technology eliminates the need to run physical wires, and in doing so, avoids the enormous infrastructure costs involved in a conventional wired environment—costs that most providers view as prohibitive in rural or sparsely populated communities.

Wireless Floats Their Boats

The C and C Marine Services Company had trouble scheduling the 223 barges in their fleet, as the managers were unable to determine the barges' exact position and thus plan their availability for additional work. As a result, some barges sat empty and customers were not served effectively. With help from the Carnegie Mellon University e-commerce practicum, a wireless application was developed that allowed communication between the fleet and C and C headquarters, as well as provided continuous GPS-based location data. Now the company instantly knows the position of barges in its fleet and can schedule them more effectively, decreasing downtime and response time to customer requests while increasing sales.

Community connectivity to the Internet, or a high-speed backbone network, can be obtained either through leased lines—the cost of which the community can share—or through a wireless "back haul" that can cover dozens of miles.

Initial wireless broadband offerings from satellite or land-based systems such as MMDS[10] were rare and its costs prohibitive for most users, especially in most homes and small- to medium-sized businesses.

Commercial satellite service is now reasonably affordable. However, it offers modest bandwidth and is best used for low-demand applications, such as email and web browsing. Interruptions in the satellite signal due to the distance it must travel to space make this technology unsuitable for truly interactive applications. Also required for satellite service is an unobstructed view of the southern sky, which may not be available in all locations.

The Public Spectrum for Wireless Technology Makes it Affordable

Recently, technologies have been introduced that use a portion of the spectrum that requires no FCC license. By using this "public spectrum," one avoids significant license fees, resulting in affordable, wireless broadband service.

One solution attracting a lot of attention is Wi-Fi (for Wireless Fidelity, a take-off on "Hi-Fi"). Hotels and cafes are installing Wi-Fi networks in cities around the country. In these

[9] Advanced mobile applications, such as 3G, which use cellular technologies, have not proven to be sufficiently robust or widely available to support community-wide strategies.

[10] MMDS, or Multichannel Multipoint Distribution System, takes advantage of the digitalization of the analog television spectrum to provide data streams up to 35 miles.

locations, anyone with a Wi-Fi card in their laptop or handheld device can pay to access the network and surf the web while sipping a latte.

As impressive as wireless cafes are, Wi-Fi installations typically cover limited distances. As a result they will not, as currently configured, provide the distance and speed required to enable multiple, community-wide applications. Further, the spectrum that Wi-Fi uses—2.4GHz—is becoming increasingly crowded with wireless services.[11]

Technologies using spectrum in the 5GHz range (reserved for the National Information Infrastructure, a planned national network that was being envisioned in the early 1990s) provide another option. Known as the U-NII spectrum, it can easily allow wireless technologies operating in this portion of the spectrum to cover many miles.[12] Moreover, U-NII provides bandwidth comparable to a 10Mbps wired Ethernet office network.

Implementing Wireless Broadband Can Help Rural Communities Catch Up

Minimal costs for construction and equipment acquisition, along with the ease of configuration and maintenance represent a true sea change in technology, and provides the means for rural communities not only to catch up to their metropolitan counterparts, but to surpass them in the availability of bandwidth. For once, rural America can be a technology leader.

Wireless is Here to Stay

Several indicators suggest that the future of wireless broadband is secure—not a technological flash-in-the-pan. FCC Chairman Michael Powell has indicated his desire to promote increased use of the unlicensed spectrum.[13] Further, the government has recently reallocated additional spectrum in the 5GHz range from the Defense Department to the public.

Wireless technologies are predicted to grow by 20 percent a year for the near future, and wireless will soon account for 10 percent of all broadband revenues.[14] A recent study[15] by the National Telecommunications Cooperative Association shows that rural customers of wireless broadband are pleased with the service and most providers report retention rates of 90 percent or more.

Broad Applications for Broadband: Health Care, Education, and Economic Development

Once rural communities employ broadband, what can they do with it? ICT development is not limited to, or even focused on, "high-tech" related development. While high-tech related companies and individuals will certainly have more options in a connected rural community, existing organizations will be enhanced as they increasingly become

[11] The standards and capabilities of technology in this spectrum are, however, rapidly changing and increasing.

[12] Although the specs list an operating distance of two miles, a provider in Salem, Virginia, has customers over 12 miles away from the nearest network access point.

[13] Broadband *Migration III: New Directions in Wireless Policy*, Federal Communications Commission.

[14] Jim Wagner, *Internet News*, March 2002

[15] *NTCA 2002 Wireless Survey Report,* October 2002

dependent on broadband access. Consider using broadband for health care, education, and economic development.

Health Care

Broadband uses for patients. Broadband networking can enhance the medical care of residents in rural communities. Through telemedicine residents can have access to remote specialists that would otherwise be unavailable. Elderly and other mobility-impaired patients can thus avoid the expense and hassle of traveling long distances for expert consultations. Telemedicine also brings instant access to distant specialists to support diagnostic and treatment services. And patients' with access can save money on prescription drugs ordered online and can take part in medical support groups.

Broadband uses for the industry. Local health clinics can be linked to regional hospitals to better serve patients. Federal regulations will soon require hospitals and caregivers to submit Medicare and Medicaid claims electronically; those who fail to do so risk losing substantial reimbursements. Cost savings in records management and other administrative duties can be substantial.

Broadband uses for professionals. Distance learning applications enable health care workers to participate in continuing education programs. Participation in professional organizations and online communities allows rural practioners to keep up with advances in the field.

Education

The benefits of integrating technology into K–12 schools are substantial and well documented.[16] The wealth of information on the Internet opens a world of knowledge to children that was unimaginable only a few years ago.

Distance learning opportunities allow rural children to have access to subjects not available locally and to engage in programs such as advanced placement, which local schools often cannot support. With a broadband connection students can have access to cutting edge technology like Internet2, where tomorrow's applications are being developed.

There are also significant resources for teachers to integrate technology into the classroom, as well as to maintain their own skills.[17]

Tech Drives Development

"Although high-tech is not the only development strategy to pursue, it will be the key distinguishing feature of regional vitality in the 21st century….States that recognize these changes and alter course quickly will be ahead in the economic development game." — Milken Institute, *State Technology and Science Index,* 2001

Economic Development

Access to advanced telecommunications is increasingly required for small- and medium-sized businesses common in rural areas. According to the U.S. Chamber of Commerce, more than 90 percent of small businesses reported that productivity gains meet or exceed the monthly cost of broadband.[18]

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[16] See the International Society for Technology in Education (http://www.iste.org/) or the U.S. Department of Education Office of Educational Technology (http://www.ed.gov/Technology/).
[17] See Tech Corps (http://www.techcorps.org/) Web Mentor and Techs4Schools programs.
[18] *The Donahue Letter*, "Broadening the Internet's Reach," 5 December 2002.

With broadband access, the tourism and crafts industries can significantly expand their potential customer base and increase profits. Banks and other traditional Main Street businesses can work more efficiently and interact more easily with customers and suppliers. Small, rural telephone companies have the opportunity to dramatically increase the level of service they can afford to offer, and by extension, increase their revenue. And technology-related businesses and incubators can be sustained in the Region, whereas in the past entrepreneurs and high-tech firms were forced to leave to be viable.

Considerations for Implementing Broadband

Implementing Broadband Requires Community Planning

A key component of ICT development in rural communities is the large number of people who actively participate in the planning process,[19] the opposite approach of planning processes used in metropolitan areas, where infrastructure availability is the product of commercial and regulatory forces.

It is likely that the community will share the connectivity, so the needs of every member should be considered when connectivity is being configured. Further, although wireless broadband is relatively inexpensive, some investment is necessary. By configuring the network to best meet the needs of the entire community, the cost may be reduced. In addition, your community may or may not want to complete an inventory; you may or may not want or need to hire a consultant to assist through the process.

Wireless Phoenix

A typhoon hit the rural Japanese community of Nangoku in 1998, wiping out the telecommunications infrastructure. Not content to wait to replace the wired environment, the city's residents, led by university professors, installed a wireless infrastructure. The new network is credited with stimulating additional development and new job creation.

See Appendix A for a list of resources to help plan for broadband implementation.

Communities Should Target the Highest Level of Bandwidth Possible

There are many broadband technologies and many ways to implement them. Regardless of the technology, it is almost certain that broadband access will become a prerequisite for any type of application. When adopting a telecommunications strategy, communities are best advised to target the highest level of bandwidth they can reasonably afford and to avoid technologies that may well become obsolete in the near future.

Security, Line-of-Sight, and Environmental Considerations for Implementing Wireless Broadband

As with any technology, communities implementing a wireless broadband network need to be mindful of constraints and plan their installation accordingly. Properly configured, installed, and managed, a wireless network will approach the robustness and quality of

[19] See *Community-oriented Communication Development in Rural Japan*, Takeshi Shinohara, June 2002.

service typical of a wired environment, at a fraction of the cost. Some striking factors to consider include:

- Security. Data transmitted through the air instead of through discrete wires is inherently easier to intercept. Network managers must implement the proper security protocols and encryption software to ensure that stray signals remain secure from intentional hacking or unintentional use.

  Another security concern is the attractiveness of computers on high-bandwidth networks to hackers looking for unknowing hosts to spread viruses. Firewalls are necessary to protect against this threat, even on individual PCs.

- Line-of-Sight. Wireless applications should be considered as pure line-of-sight connections. The technology is reasonably robust and will likely operate adequately with interference from trees and even walls, but don't assume that will be the case.

- The environment. Bad weather can occasionally affect a network's speed and availability. Antennae should be protected against lightening. Ice impacts antennae more than other environmental conditions. So, in areas where significant icing occurs, protecting the antennae from ice is advisable.

Technical Specifications for Implementing Broadband Vary

The technical specifications of acquiring broadband access may vary from community to community, depending on what is commercially available. And access may run the gamut from DSL to wireless. The specifications for broadband can even change within a single technology, as with the various Wi-Fi implementations or cable modems.[20]

For some applications a T1 will suffice; for others only an Ethernet-level speed of 10Mbps will work. Advanced networks such as Internet2 provide speeds and capacity well beyond that. Access to this network is available for K–20 educational institutions, libraries, and museums through a university sponsor.

Data connections are two-way streets, and traffic on one side can have a higher "speed limit," as it were. The federal government tends to view broadband as any technology that provides downstream access (i.e., from the Internet to the user) at a minimum of 200Kbps. This speed may be sufficient for standard web browsing, when the data transmitted from the user to the Internet is typically small, and when data delivered to the user is typically substantial. However, for uses such as telemedicine or distance learning, this level of broadband may not be sufficient for interactive applications.

Best Practices

Rural communities around the world share some of the same challenges and barriers to broadband access. No better example exists than the Connectivity Conundrum. Many

[20] For example, a cable modem service may be advertised as providing "up to" 1.5MB of throughput. However, that throughput is generally shared by others on the same segment of the network. So, as the number of active users grows within that segment, there will be significant decreases in throughput. What may be broadband speeds when you're online alone slows to speeds more akin to dial-up when your neighbors start logging on.

international development organizations and governments who focus on rural issues have addressed the access problem and implemented programs to solve it. Organizations such as the World Bank and the Inter-American Development Bank are active in this area, and countries as diverse as India, Australia, Canada, and Japan have established national programs to stimulate telecommunications delivery in their rural areas.

Although Appalachian communities certainly have unique characteristics, lessons can be learned from the experiences of others.

See the Appendix for a list of best practices for research and study.

Appendix A: Online Resources

The following links are provided for informational purposes only. No endorsement of any product or viewpoint that may be made by these sites is implied or intended.

Nonprofit Organizations

Development Gateway Foundation
http://www.developmentgateway.org/node/118859/en/index
Its mission is to reduce poverty and support sustainable development through the use of information and communication technologies (ICT).

Digital Divide Network
http://www.digitaldividenetwork.org/content/sections/index.cfm
This web site offers a range of information, tools, and resources that can help practitioners stay on top of digital divide developments. The network looks at the causes and effects of the divide from four distinct angles: technology access, literacy and learning, content, and economic development. In each of these areas, particular attention is paid to the role of local individuals and organizations in bridging the divide.

Digital Dividend
www.digitaldividend.org
Digital Dividend seeks to identify and promote business solutions to the global digital divide—sustainable models that create social and economic benefits in poor communities around the world. The site includes a clearinghouse of digital or digitally enabled projects providing services to underserved populations, and a section on case studies, or best practices.

Foundation for Rural Education and Development
http://www.fred.org/
The foundation promotes activities that improve rural educational, social, and economic conditions. The foundation awards over $180,000 in scholarships and grants each year to rural students, residents, and communities.

National Association of Development Organizations
http://www.nado.org/
The National Association of Development Organizations (NADO) provides training, information, and representation for regional development organizations in small metropolitan and rural America.

State Science and Technology Institute
http://www.ssti.org/
SSTI is a national non-profit organization dedicated to improving government-industry programs that encourage economic growth through the application of science and technology.

Telecommunications Organizations, Associations and Resources

Broadband Wireless Exchange Magazine
http://www.bbwexchange.com/
The site offers news, white papers, tutorials, business directories, a trade show calendar, and many other sources of information related to the Broadband Wireless industry. BWE's content enables readers, investors, and businesses to find the information they need to do business in the broadband wireless industry.

Broadband Daily
http://www.broadband-daily.com/
News on the broadband industry.

Cellular Telecommunications and Internet Association
http://www.wow-com.com/
An association representing all elements of wireless communication. The site offers market research reports, statistics, and case studies.

DSL Reports.Com
http://www.dslreports.com/
Post messages, review products and services, and learn about DSL and other broadband services.

Foundation for Rural Service
http://www.frs.org/
Promotes, educates, and advocates to the public, rural telecommunications issues in order to sustain and enhance the quality of life within communities throughout rural America. Offers youth education programs, publications, and other resources.

National Telecommunications Cooperative Association
http://www.ntca.org/
NTCA is a national association representing more than 550 small and rural independent local exchange carriers providing telecommunications services throughout rural America.

National Rural Telecommunications Cooperative
http://www.nrtc.org/home.cfm#
NRTC helps rural electric and telephone utilities strengthen their businesses with solutions uniquely suited to the needs of rural consumers.

Wireless Communications Association International
http://www.wcai.com/
WCA is a leader in government relations for issues vital to the success of the wireless broadband industry, including: auction rules, spectrum allocation, regulatory filings for flexible use, technical standards, and protection against interference. The WCA also organizes the world's largest annual business conference and exhibition devoted exclusively to wireless broadband.

Government, Regulatory and Policy Resources and Reports

Broadband : A 21st Century Technology and Productivity Strategy
http://www.senate.gov/~dpc/tech/techagenda107full.htm

Federal Communication Commission Wireless Bureau
http://wireless.fcc.gov/
WTB handles nearly all FCC domestic wireless telecommunications programs and policies.

Thomas.Gov
Search and track relevant pending legislation. This site is a service of the Library of Congress.

Best Practices

ALLCONET
http://www.allconet.org/
ALLCONET is the Intranet for Allegany County, consisting of a partnership of government and non-profit entities. ALLCONET is an innovative and creative approach to partnering to meet the information needs of schools, communities, and government agencies. ALLCONET is committed to being self-servicing, and dedicated to employ whatever new technology is available to improve service while reducing or eliminating all ongoing costs.

Ennis, Ireland, an Information Age Town
http://www.ennis.ie/cgi-bin/eiat.cgi?page=information_age_town.htm
The Information Age Town project was intended to be a live experiment to see what would happen when an entire town became "wired." This site chronicles the town's transformation and can serve as a model for other towns, in addition to fueling ideas for projects in other parts of the world.

South Waikato, New Zealand
http://www.swktodc.govt.nz/economic_development/econdev_broadband.htm
New Zealand's wireless community network. South Waikato identifies technology as a key economic driver. They believe that fast and low-cost Internet access is critical technology—and essential to economic development.

Application Resources

Telemedicine

American Telemedicine Association
http://www.atmeda.org/
The association educates the government about telemedicine as an essential component in the delivery of modern medical care; serves as a clearinghouse for telemedical information and services; fosters networking and collaboration among interests in medicine and technology; promotes research and education, including the sponsorship of scientific educational meetings and the *Telemedicine and e-Health Journal*.

International Society for Telemedicine
http://www.isft.org/
The society acts as a forum for the exchange of information and ideas among all those interested in the telemedicine field.

Telemedicine Information Exchange
http://tie.telemed.org/
Offers information about telemedicine, telehealth, and related activities. The site contains information on funding, and links to publications and tutorials.

Education

NetDay Compass
http://www.netdaycompass.org/index.cfm
This site contains an organized directory of web sites that include education technology information. These resources help education leaders make smart decisions about technology planning, infrastructure, funding, and classroom support.

Internet2
http://www.internet2.edu/
Internet2 is a consortium being led by 202 universities in partnership with industry and government to develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow's Internet.

Tech Corps
http://www.techcorps.org/
Tech Corps is a national nonprofit that mobilizes technology volunteers into schools, offering tech support and teacher training. They offer high quality technological resources that enrich K-12 teaching and learning and prepare tomorrow’s workforce.

E-government

Government Technology
http://www.govtech.net/
Articles, case studies, and news about issues affecting state and local governments.