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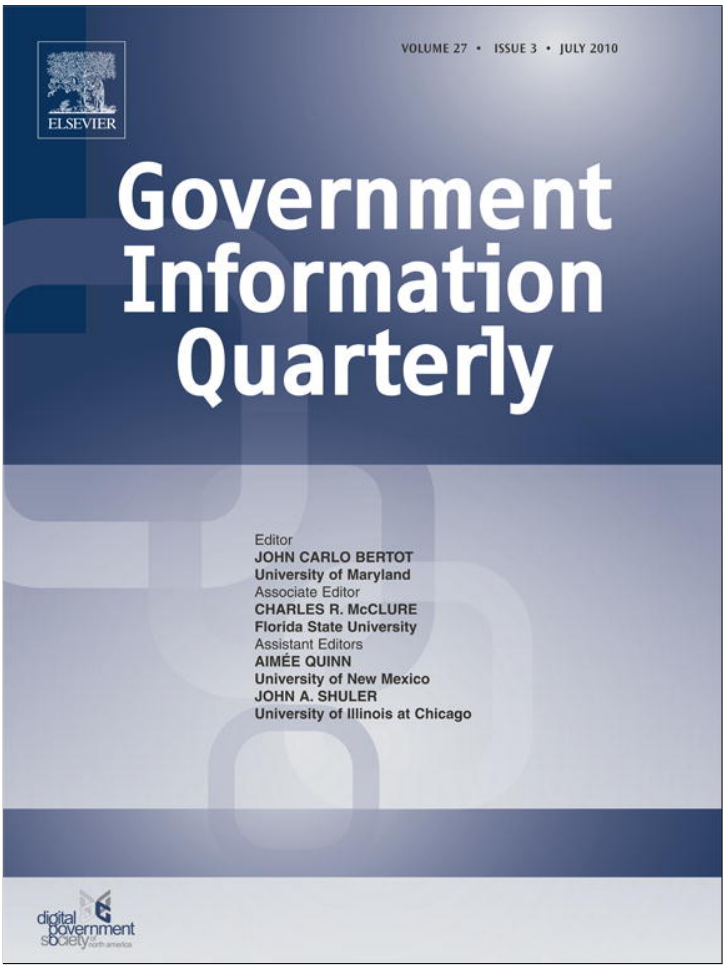

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Broadband for public libraries: Importance, issues, and research needs

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ABSTRACT

U.S. public libraries provide free public internet services to the communities that they serve, but require robust, high-speed broadband internet connections to continue meeting public demands. The 2008–2009 *Public Library Funding & Technology Access Study* (*PLFTAS*) illustrates challenges that public libraries encounter in achieving broadband connectivity and equipment upgrades, and maintaining acceptable levels of services as they meet continually increasing internet-enabled service demands. This article: 1) analyzes the ability of public libraries to serve as a community-based public internet access point in the context of limited funding and access to telecommunications services and equipment; 2) discusses key policy issues that affect the provision of public library internet-enabled services through broadband; 3) provides recommendations for policy makers to include libraries as part of a larger national-level telecommunications policy; and 4) identifies a number of topics and issues that need further investigation and research in this shifting policy environment.

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1. Introduction: importance of broadband for public libraries

U.S. public libraries serve a critical role in society by providing free public internet and computer access and internet-enabled services to millions of Americans. Public libraries are often the only places making free internet available in a community, facilitating access to the Information Society, which the World Summit on the Information Society defines as:

> a people-centered [sic], inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life, premised on the purposes and principles of the Charter of the United Nations and respecting fully and upholding the Universal Declaration of Human Rights (2010, 1.1).

For Americans to engage in the global Information Society, it is critical that the free public internet access offered by public libraries be robust and high capacity. However, public library internet services are provided within the context of internet and computer access barriers such as limited and declining funding, untrained staff, inadequate buildings, and lack of available infrastructure and connectivity.

Analysis of the 2008–2009 *Public Library Funding & Technology Access Study* (*PLFTAS*) funded by the American Library Association (ALA) and the Bill & Melinda Gates Foundation offers a clear national understanding of the context of U.S. public library internet access and service provision. The main objectives for the *PLFTAS* are to provide data that inform policy makers, researchers, practitioners, and others about the extent to which public libraries (Bertot, McClure, Wright, Jensen, & Thomas, 2009):

- Serve as a high quality public internet access venue within the libraries' communities for content, resources, services, and technology infrastructure (e.g., workstations and bandwidth);
- Offer, sustain, and plan for public access internet services and resources that meet community public access needs;
- Install, maintain, and upgrade the technology infrastructure required to provide public access internet services and resources;
- Serve as community-based technology and internet-enabled resource and service training centers;
- Identify issues that public libraries encounter in maintaining and enhancing their public access technology infrastructure and services;
- Serve as providers of and access points to e-Government services; and
- Fund their information technology (IT) investments.

The 2008–2009 survey continues the research of previous surveys conducted by Charles R. McClure and John Carlo Bertot, with others, since 1994 (Bertot & McClure, 1998a,b, 2000, 2002; Bertot,

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McClure, Barton, Thomas, & McGilvray, 2007; Bertot, McClure & Fletcher, 1997; Bertot, McClure, & Jaeger, 2004, 2006, Bertot, McClure, Wright, Jensen, & Thomas, 2008; Bertot, McClure, et al., 2009; Bertot, McClure, & Zweizig, 1996; McClure, Bertot, & Zweizig, 1994), and it explores new areas of library network-based services, e-Government roles of public libraries, and issues associated with maintaining, upgrading, and replacing a range of public access technologies.

To successfully fulfill the critically important role of internet access and service provision, public libraries need funding and infrastructure to support high-speed broadband internet connectivity, including workstations and other peripheral equipment. Funding and infrastructure expansion and support are where the National Telecommunications and Information Administration (NTIA) and the broadband provisions of the American Recovery and Reinvestment Act (ARRA) such as the Broadband Technology Opportunities Program (BTOP) can help libraries succeed in improving the provision of free broadband internet access (for more information on ARRA, see: http://www.recovery.gov/), though it remains unclear as to how or if libraries will benefit in terms of broadband enhancement from this program in its current form due to BTOP's emphasis on broadband to the consumer.

2. Methodology and objectives

This article uses findings primarily from the 2008–2009 *Public Library Funding and Technology Access* national survey (Bertot, McClure, et al., 2009). The survey employed a web-based survey approach to gather data which were collected between September 2008 and November 2008. The study obtained both national and state level data, with breakdowns by the following categories: Metropolitan status (e.g., urban, suburban, and rural), which was determined using the official designations employed by the Census Bureau, the Office of Management and Budget, and other government agencies; Poverty (less than 20% [low], 20%–40% [medium], and greater than 40% [high]); State (the 50 states plus the District of Columbia); and National. Given the quality of the data, findings could be generalized to each of these four categories, though the study only received adequate and representative responses from 45 states plus the District of Columbia. Finally, the survey explored topics that pertained to both public library system and outlet (branch) level data. Thus, the sample required for this study was complex. As analysis was required at both the state and national level, the survey team drew a stratified, proportionate sample to ensure the data could be generalized within the states and analyzed nationally, across and within metropolitan status and poverty strata.

The study team used the 2005 public library dataset available from the National Center for Education Statistics (NCES) as a sample frame, which was the most recent file at the time. There were 16,620 library outlets in the sample frame. From these totals, the researchers used SPSS Complex Samples software to draw the sample for the study. The sample needed to provide the study team with the ability to analyze survey data at the state and national levels along the poverty and metropolitan status strata discussed above. The study team drew a sample that used a 95% confidence interval for data analysis purposes. The sample drawn used a replacement strategy and totaled 5907 libraries. The survey received a response rate of 72.8% ($n = 4{,}303$), but another 1808 surveys were added to these responses to bring the total number of analyzed surveys to 6111. These additional libraries were required to participate in the survey due to their participation in a Bill & Melinda Gates grant program.

Using the national survey as the main source of data, the purpose of this article is to:

- Explore how U.S. public libraries' ability to provide critical free public internet services is hampered by a complex, changing, and unclear U.S. broadband deployment policy;
- Assess the extent to which public libraries will be able to continue their support of public access technologies to their communities given budgetary restrictions, staff expertise levels, costs, and broadband access issues;
- Offer policy recommendations for policy makers, particularly the Federal Communications Commission (FCC), as a national broadband plan develops and is implemented in considering the role of key community institutions such as the public library; and
- Offer future research directions to further understand the public library roles, limitations, and capabilities in providing internet-enabled services to the communities that they serve.

This exploration and analysis offers critical insights into the ability of public libraries to maintain, enhance, and/or innovate with their public access technology services and resources. And by extension, the ability of the public library to move forward with its public access services impacts the extent to which those dependent on public library access are able to engage in increasingly dependent educational, e-Government, employment, and other internet-dependent services.

3. Background: public libraries and internet access

The ability of U.S. public libraries to provide free public internet access and internet-enabled services to American communities is impacted by the speed and bandwidth of the libraries' internet connections. In public libraries, multiple consumers simultaneously access internet services via the same internet connection, further hindering the libraries' broadband connections. In fact, the majority of U.S. public libraries report insufficient internet connection speeds (Bertot, McClure, et al., 2009). But importantly, the *PLFTAS* collects broadband data for a particular library building, and the *actual* connection speeds at the public access workstations are oftentimes only moderately better than dial-up connections due to multiple simultaneous users on library workstations, users on their laptops accessing the library's Wi-Fi, local area network configurations, and workstation configurations (e.g., processor, operating system, memory) (Bertot, 2009). Increased bandwidth can enhance the user internet experience, and there is a need to update public library technology standards for internet connectivity and public access internet workstations to ensure that all U.S. public libraries are connected to the fastest speed and highest bandwidth broadband internet possible.

The FCC defines broadband as 200 kilobits per second (kbps) or .2 megabits per second (Mbps), in at least one direction (Federal Communications Commission, 2010). This definition is grossly below average advertised download speeds. In an Organisation for Economic Co-operation and Development (OECD) 2008 study, the average advertised download speed of 9640 kbps or 9.64 Mbps in the U.S. significantly exceed the FCC minimum (OECD, n.d.). That average ranked the U.S. 19th worldwide, with Japan leading the world with 92,846 kbps or 92.85 Mbps average advertised download speed (OECD, n.d.). In the global Information Society, U.S. connectivity is much slower than other nations' connectivity and the FCC's definition of broadband seems archaic. But even this definition has its limitations, as the FCC and international definitions are designed for consumer services, and the public library is a public access venue that permits multiple, simultaneous users to continually use the public library's broadband and public computing infrastructure (Bertot, 2009). For this article, high-speed broadband internet refers to the average advertised download speed in the U.S. and not the FCC minimum definition that is insufficient for most public library services.

3.1. Public library internet access, connectivity, and service provision

Free public internet access at public libraries is crucial to those Americans who lack home broadband access and rely on the public library or other public spaces to get high-speed internet access (Communication Workers of America, American Library Association, & Speed Matters, n.d.). The Pew internet and American Life Project 2009

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survey shows 63% of adult Americans now have broadband internet connections at home, an increase of 15% from 2008 (Pew, 2009), but broadband connection costs also increased. Simultaneously, 71.4% of U.S. public libraries report they are the only provider of free public internet and computer access in a community (American Library Association, 2009), and increasingly, broadband is considered "the essential communications infrastructure of the 21st century" (Turner, 2009, p. 83). Given this, it is critical to consider the quality and sufficiency of the library's internet connection. In fact, NTIA has said that public schools and libraries have critical roles to fill in internet access (1995).

Microsoft notes that public libraries rely on "minimally useful" T1 connections and "increasingly strained" DSL and cable-modem connections (Boyd & Berejka, 2009, p. 7), and that they lack the resources to upgrade their connections (Golston, 2009). These stresses on public library internet connections will only increase in the face of exponential growth of the demand for internet services and applications. But how much broadband, and what levels of services are appropriate for public libraries? Florida, Kansas, Texas, and Wisconsin define connectivity standards by services that can be provided, not by specific speeds (Florida Library Association, 2006; Kansas State Library, 2006; Texas State Library and Archives Commission and Texas Library Association Joint Task Force on Public Library Standards and Accreditation, 2004; Wisconsin Association of Public Libraries, 2005). Only Kentucky and Virginia define their public library internet connectivity standards in terms of specific speeds (Kentucky Public Library Association and Kentucky Department for Libraries and Archives, 2009; Worley, 2000). See Table 1 for more detail on public library technology standards in these selected states. In short, even states that have some set of technology and services standards use vague definitions and broad categories.

Given the ambiguity of broadband definitions, the expansion of internet service roles, and the demand that new internet-enabled applications and services place upon service providers for increased speeds, the standards established by most states fall far short of serviceable connections. Also, these state connectivity standards are for "front door" speeds which may differ widely from speeds experienced at the workstation, as evidenced by a Florida needs assessment study that found a 35 Mbps connection at the front door of a main library supporting 21 branch libraries with numerous workstations and peripherals at each branch actually provided only 19 kbps download speed at one branch's workstations (McClure, Ryan, Mandel, Snead, & Bishop, 2009). Although connection speeds to the workstation can be upgraded by purchasing new workstations, routers, and switches for public libraries, as well as consulting time to assess and improve the efficiency of library networks, the lack of speed and capacity remain paramount.

3.2. Public library internet-enabled service roles and their impact on U.S. communities

In addition to traditional library service roles such as Community Activities Center, Community Information Center, and Popular Materials Library (McClure, Owen, Zweizig, Lynch, & Van House, 1987), McClure and Jaeger (2009) have identified internet-enabled service roles that public libraries now fulfill, including:

- Place for public access to the internet;
- e-Government services provider;
- Emergency and disaster relief provider;
- Internet and technology trainer; and
- Youth educational support provider.

The ability of public libraries to provide these internet-enabled services rests on the libraries' access to broadband, trained staff in both technology and service skills, adequate building infrastructure, and other factors identified as challenges by the 2009 *PLFTAS* national survey (Bertot, McClure, et al., 2009). U.S. public libraries are important resources that help people find jobs, provide access to information and telecommunications services, and enable civic engagement by providing access to and assistance with e-Government and disaster management services and promoting openness and transparency in government (American Library Association, 2008). Also, libraries are critical to the goal of equitable access to internet and broadband resources.

The Bill and Melinda Gates Foundation reports that millions of Americans rely on public libraries for economic, educational, and social opportunities they would not have otherwise (Golston, 2009; Kranich, 2006). One major component of this is the ways libraries train their constituents to use IT and information resources. U.S. public libraries reported in 2008 that IT training has an impact by helping students with homework (38.4%), helping users access and use e-Government services and resources (21.8%), and helping users complete job applications (22.9%), among other impacts (Bertot

Table 1
Comparison of selected states' public library internet and PAC workstation standards.

Service levels	Connectivity standards	PAC[a] standards
Florida		
Essential	All — up-to-date, speedy, and easy access to on- and off-line electronic information resources	1 PAC/3000 pop
Enhanced		1 PAC/2000 pop
Exemplary		1 PAC/1000 pop
Kansas		
Gateway	All — broadband internet, not specifically defined	3 total: 1 staff, 2 PAC
Linking		5 total: 1 staff, 4 PAC
Service center		10 total: 4 staff, 6 PAC
Level I major service center		15 total: 5 staff, 10 PAC
Level II major service center		20 total: 5 staff, 15 PAC
Level I major resource center		40 total: 10 staff, 30 PAC
Level II major resource center		250 total: 80 staff, 170 PAC
Kentucky		
Essential	Dedicated internet connection supporting multiple workstations simultaneously	1 PAC/2500 pop
Enhanced	Dedicated internet connection supporting multiple workstations simultaneously while running broadband-intensive applications + wireless access	1 PAC/2000 pop
Exemplary	Not specified	1 PAC/1500 pop
Texas		
Basic	All — public and staff internet access, connectivity speed not specified	1 PAC/2500 pop or 2, whichever is greater
Enhanced		1 PAC/2000 pop or 2, whichever is greater
Comprehensive		1 PAC/1500 pop or 2, whichever is greater
Virginia		
Essential	Dedicated 56 kbps internet	2 total: 1 staff, 1 PAC
Aspiring	Faster than 56 kbps	Not specified
Excel	T1 or faster	Not specified
Wisconsin		
Service pop <5000	All — dedicated high-speed Internet supporting multiple workstations + public wireless	1 PAC/1000 pop, or sufficient so patrons have minimal wait
Service pop >5000		1 PAC/2000 pop, or sufficient so patrons have minimal wait

[a] PAC = Public access computer.

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et al., 2008). In addition to training people to use information, technology, and resources, public libraries have a major impact through the provision of e-Government and disaster planning and response services (American Library Association, 2008; Benton, Rintels, & Hudson, 2009; Bertot, Jaeger, Langa, & McClure, 2006; Bertot, Simmons, Borgardt, & McGilvray, 2009; Gibson, Bertot, & McClure, 2009; Goldman, 2009; Jaeger, 2009; Jaeger & Bertot, 2009; Jaeger, Langa, McClure, & Bertot, 2007; Kranich, 2006; McClure et al., 2009; Sheketoff, 2009a). Also, in a strained economic situation, public libraries provide essential services for job seekers such as assisting patrons with setting up e-mail accounts for job seeking and ensuring everyone has access to modern job search tools and resources (American Library Association, 2009; McGeehan, 2009).

In addition to internet services such as training, e-Government, disaster planning and response, and job seeker assistance, public libraries can serve as distributed hubs for improved internet access in their communities. When public libraries gain access to higher connectivity speeds and greater bandwidth, that access also has been brought into the community where last-mile connections can expand this high-speed internet into private homes and businesses (Boyd & Berejka, 2009; Charytan et al., 2009; Gupta, Berejka, Griffin, & Boyd, 2009; Hudson, 2007; Oblinger, Van Houweling, & Semer, 2009; Sheketoff, 2009a; Whitt & Lampert, 2009).

3.3. U.S. broadband policy and expanding public library broadband internet access

Compared to residents of Japan, Finland, Sweden, and China, Americans experience slower connection speeds and slower innovation and advancement in broadband technologies and deployment, while paying more per megabit of bandwidth (Turner, 2009; Windhausen, 2008). These other nations treat broadband as an essential infrastructure, whereas the U.S. does not. "The federal government must play a leadership role in assuring that all Americans have the access and skills needed to participate fully in the Digital Age" (Leslie Harris & Associates, 2002, p. 4). However, the U.S. government has historically focused on relying on competition and government encouragement to promote broadband growth (Picot & Wernick, 2007). A large range of factors — including geography, levels of urbanization, corporate priorities, local politics, and success in applying for E-rate funding – affect the levels of access to broadband available in any location, though these myriad factors have primarily been ignored in the U.S. government's approach to broadband development (Gabel, 2007; Grubesic, 2008; Jaeger, Bertot, McClure, & Rodriguez, 2007; Jaeger, McClure, & Bertot, 2005; Mack & Gruibesic, 2009; Sgroi, 2008). Obama's charge to the FCC to create a national broadband plan is an opportunity to close the digital divide and deliver on former President Bush's promise of universal and affordable broadband internet access (Turner, 2009).

However, ineffective government data collection efforts significantly hamper the ability to determine the degree to which Bush's goal of universal and affordable broadband by 2007 has been met (Flamm, Friedlander, Horrigan, & Lehr, 2007; NTIA, 2004). Thus far, government data collection efforts have been at aggregated rather than granular levels, impeding the ability to understand fully the impact that relatively short geographic distances can have on differences in broadband service availability and quality. The lack of broadband data leads to uncertainty of exact economic and societal impacts of broadband (Cambini & Jiang, 2009; Grubesic, 2008; Holt & Jamison, 2009). Horrigan (2007) cites a need for systematically collected and publicly available data on broadband adoption and deployment at the local level, to help rural and other communities see more precisely where there is broadband infrastructure available versus where there are broadband deployment gaps.

The Institute of Museum and Library Services (IMLS) notes that "…public libraries are well positioned to play a greater role in providing access points to broadband services for people in both urban and rural areas and to families in need" (Pastore & Henderson, 2009, p. 2). Therefore, they argue that budget and policy decisions about broadband deployment should consider the role public libraries play in addressing state and local broadband priorities. Also, ALA and Microsoft support bringing fiber to every library as a mechanism for improving the quality of internet access in U.S. libraries, while keeping costs sustainable in the future. A first step toward this goal would be to spend ARRA funds to lay fiber to the library. Fiber lines would increase the connection speeds available to public libraries, thereby increasing the speeds available to the libraries' users — the American public. The California Broadband Task Force identifies the applications that varying internet connection upstream and downstream speed ranges can support (Goldman, 2009). See Table 2 for a comparison of services that can be supported at different connection speeds, and note that the current FCC broadband definition minimum is below the lowest speed range listed.

As critical service points for Americans to access broadband internet, public libraries are directly affected by national broadband policies. The ARRA and subsequent BTOP notice of funding availability (NOFA) identify public libraries as "community anchor institutions" and numerous comments to NTIA regarding distribution of BTOP funds and to the FCC regarding the national broadband plan specifically note the critical role of public libraries in facilitating broadband deployment. These comments come from private corporations such as AT&T (Byrd, Charytan, & Zachary, 2009) and Microsoft Corporation (Boyd & Berejka, 2009), as well as non-profit library supporters such as ALA (Sheketoff, 2009b) and EDUCAUSE (Luker, 2009), all of which suggest that funding these institutions is a way for NTIA to meet Congress' goal of promoting affordable access to the largest number of people at the highest possible speeds. However, NTIA has largely ignored these comments in awarding BTOP Wave 1 funds and publishing the Wave 2 NOFA, indicating that the Federal government may be saying one thing about libraries as community anchor institutions, yet funding other priorities instead.

Meanwhile, U.S. public libraries (and K-12 schools) rely on E-rate (Education Rate) discounts to provide free public access to the internet. The E-rate discounts are funded from the Universal Service Fund (USF), Schools and Libraries Program, established by the Telecommunications Act of 1996 (see http://www.usac.org/about/universal-service/ for more information). Continuing this funding is

Table 2
Comparison of internet services possible at different speeds.

Speed range	Possible services that can be supported
500 kbps–1 Mbps	Voice over internet protocol (VoIP), short message service (SMS), basic e-mail, web browsing simple sites, streaming music using caching, low quality and highly compressed video
1 Mbps–5 Mbps	Web browsing complex sites, e-mail with larger file attachments, remote surveillance, internet protocol TV-standard definition (IPTV-SD), small and medium size file sharing, ordinary telecommuting, one channel of digital broadcast video, and streaming music
5 Mbps–10 Mbps	Advanced telecommuting, large size file sharing, multiple channels of IPTV-SD, switched digital video, video on demand SD, broadcast SD video, two to three channels of video streaming, high definition (HD) video downloading, low definition telepresence, gaming, basic medical file sharing and remote diagnosis, remote education, and building control and management
10 Mbps–100 Mbps	Telemedicine, educational services, broadcast video SD and some HD, IPTV-HD, complex gaming, telecommuting with high quality video, high quality telepresence, HD surveillance, smart building control
100 Mbps–1 Gbps	HD telemedicine, multiple educational services, full HD broadcast video, full IPTV channels, video on demand HD, immersion gaming, and telecommuting with remote server services
1 Gbps–10 Gbps	Research applications, uncompressed HD video streaming telepresence, live event digital cinema streaming, telemedicine with remote control of medical instruments, interactive remote visualization and virtual reality, sharing terabyte size datasets, and remote supercomputing

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critical for maximizing public libraries' ability to provide free public access internet to U.S. communities. Indeed, Senator Rockefeller recently sent a letter to the FCC requesting that the agency allow for inflationary adjustments to the E-rate USF fund so that the funding is not eroded over time. In his letter, Senator Rockefeller noted that "The E-rate program has been the singularly most effective and powerful of all of the [FCC's] universal service programs at supporting the expansion of broadband service," (Rockefeller Seeks, n.d., para. 4).

3.4. Summary

In the Information Society of the twenty-first century, public libraries are the primary organizations that have taken up the responsibility of performing numerous internet-enabled service roles and providing free public internet access — the only free internet access in the majority of U.S. communities. However, this internet access is at varying connection speeds, speeds that libraries report are insufficient to meet patron demands some of the time. If public libraries are to remain vital public servants and internet access centers in the twenty-first century, they require quality, high-speed broadband internet connections. The Obama Administration, ARRA, BTOP, and the National Broadband Plan offer opportunities to include public libraries in U.S. broadband policies, as well as plans to expand and equalize access to broadband internet. See Table 3 for a summary of key points discussed in this section.

4. *PLFTAS* findings: U.S. public libraries and internet access

Recent findings from the *PLFTAS* (2008–2009) demonstrate that public libraries offer a broad range of services to patrons and that the internet and computer access they provide is becoming increasingly important to patrons. However, the study finds that public libraries are finding it more and more difficult to provide high-speed broadband at the workstation that meets current demand, to say nothing of future demand. The *PLFTAS* findings are as follows:

- Illustrate the important role public libraries play in providing free public access to computers and the internet in the United States;
- Highlight the barriers impeding public libraries from improving that access, such as limited funding, physical space, and access to broadband internet; and
- Identify key public library internet-enabled service areas that remain challenged.

These findings are based on national averages; for a more detailed data analysis by metropolitan status and poverty level as well as an explanation of the survey methodology, see Bertot, McClure, et al. (2009).

4.1. Issues of internet access and connectivity

Data from the 2008–2009 *PLFTAS* indicate that nearly all U.S. public libraries provide free public internet access (98.7% overall), and this access has remained relatively stable since 2004. Moreover, 71.4% of public libraries report that they are the only provider of free access to these services in their communities. In addition, the speeds of that free internet access have increased from 2004 to 2009 (see Fig. 1). In 2004, 21.1% of public libraries reported speeds less than or equal to 256 kbps, whereas only 3.4% of public libraries report speeds that slow in 2009. In addition, the percentage of public libraries reporting speeds faster than T1 (1.5 Mbps) has increased from 20.3% in 2004 to 44.5% in 2009. Prior to 2007, the survey grouped all speeds faster than 1.5 Mbps into one category, so comparison of increases in maximum advertised speeds that exceed 10 Mbps is limited to 2007 (8.6%), 2008 (8.6%), and 2009 (12.3%). More libraries report maximum speeds above 10 Mbps in 2009 than the previous 2 years, but less than one-quarter of all U.S. public libraries report these faster speeds that are necessary for libraries to support the range of internet applications and services their patrons demand.

Public library internet connections vary by type, speed, and sufficiency. The majority of public libraries are connected to the internet via digital subscriber line (DSL) (25.8%), cable (22.0%), and leased-line connections (23.3%), but other connection types are also in use (Table 4). Another factor to consider is that these reported speeds are based on the speeds advertised by the libraries' internet service providers (ISPs), but they do not indicate how sufficient these speeds are to meet the needs of libraries that support multiple users at one time.

Although 70% of all public libraries report maximum speeds of 1.5 Mbps or higher in 2009, only 39.9% of all public libraries report the connection speed is sufficient to meet patron needs at all times. This supports suggestions by Microsoft (Boyd & Berejka, 2009; Gupta et al., 2009), the Bill & Melinda Gates Foundation (Golston, 2009), and Comcast (Zachem, Don, McManus, & Waz, 2009) that public libraries' internet connections need to exceed the FCC's definition of broadband to be sufficient to meet user needs. Public libraries face several barriers to improving access, with the largest inhibitors being lack of access to telecommunications services (26%) and cost (22.9%). In

Table 3
Key points related to public library internet service provision.

Main themes	Key points
Public library internet access and service provision impacts U.S. communities and enables Americans to succeed in the global Information Society.	U.S. public libraries provide to communities the following internet services: • Free public internet access; • e-Government services and emergency and disaster relief; and • Equitable access to internet and broadband resources.
Public libraries provide internet access and connectivity within a computing context that requires increasing connectivity.	U.S. public library internet access exists within the following context: • Varying but largely insufficient internet connection speeds; • Serving underserved, vulnerable populations; and • Needing quality, high-speed broadband connections to remain vital in the Information Society.
Public library broadband internet access needs to be expanded, but libraries face barriers to expanding that access.	Barriers to expanding internet access in U.S. public libraries include: • Limited budgets; • Lack of knowledgeable staff; • Outdated computer and network infrastructure equipment; and • Inadequate access to internet bandwidth. To expand access, libraries need the following: • Updated computing and network infrastructure equipment; and • Additional bandwidth.
U.S. broadband policy directly affects public library internet access and service provision, but that policy is confusing and complicated.	The Obama Administration brings new opportunities for public libraries in U.S. broadband policies, including: • Increased Federal funding for broadband deployment and expansion through ARRA, BTOP and other Federal programs; • Definition of public libraries as community anchor institutions, deserving targeted funding and broadband expansion efforts; and • Calls for using the national broadband plan to close the digital divide and deliver universal and affordable broadband internet.

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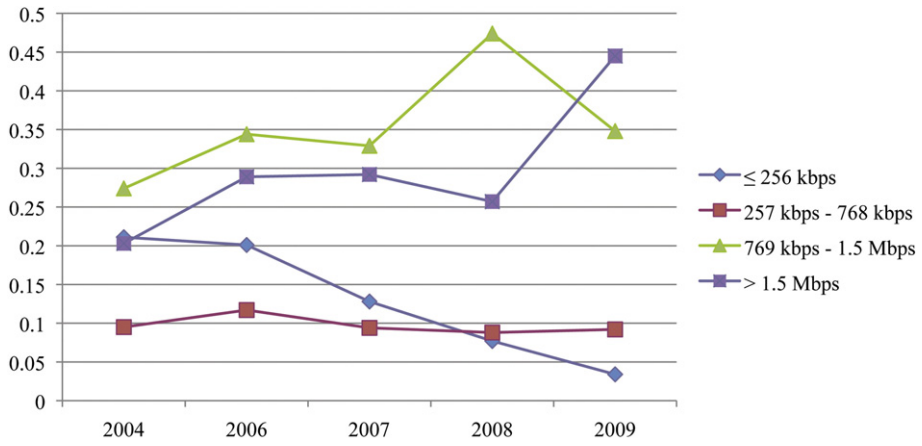

Fig. 1. Change in maximum internet speeds in U.S. public libraries, 2004–2009.

addition, 26.5% of libraries report that the connection speed is already at the maximum level available to them, and this affects rural (30.9%) and low poverty (27.3%) outlets more than any other type.

The E-rate program is designed to help subsidize public library internet connection costs, and many libraries apply for discounts through the program. Overall, 38.7% of library systems reported applying for an E-rate discount in FY2008–2009, and another 13.9% had another organization (e.g., a consortium) apply on its behalf. Similarly to previous years, the largest application of the E-rate discount is for telecommunications services, reported by 76% of library systems. This is a relatively large decrease from the 85.5% reporting the same in FY 2007–2008 and the 83.2% reporting in FY 2006–2007, but shows that library systems still find telecommunications services to be the most important use of their E-rate discounts. Although the E-rate discounts are most frequently applied to telecommunications services, the importance to libraries of E-rate discounts for internet connectivity should not be minimized with over half of all public library systems (50.4%) reporting receipt of E-rate discounts in this category.

4.2. Issues of computer access

Public libraries provide free internet access in conjunction with free PAC workstation access. In 2005, the study team had identified that the number of PAC workstations was reaching a plateau of an average of 10.4 workstations. That number rose to a peak of 12.0 workstations on average in the 2007–2008 study, but the 2008–2009 study shows a slight decline (11.0) (see Fig. 2). The ability to add workstations is fundamental to improving computer and internet access in public libraries, but there are numerous barriers to doing so. The largest factors affecting the ability to add PAC workstations or laptops were reported as being space limitations (75.9% overall), cost factors (77.4% overall), and availability of electrical outlets, cabling, or other infrastructure (34.0% overall), with additional factors including the availability of enough bandwidth to support those additions and staff and maintenance required for equipment support and upkeep (see Table 5 for details on these and other factors).

The age of public library public access computers varies from under 1 year (5.5 on average) to 5 years (5.1 on average). Many computers fall in between these ages, with an average of 5.0 that are 1 year old, 5.5 that are 2 years old, 5.3 that are 3 years old, and 5.7 that are 4 years old. Workstations older than 3 years are less capable of achieving broadband internet speeds than newer workstations, so replacing these older workstations becomes critical to maintain and expand broadband internet access in U.S. public libraries. Libraries report cost factors as being the largest hindrance to replacing workstations (89.6%), but maintenance, upgrade, general upkeep (33.1%), and availability of staff (17.2%) also impact libraries' ability to upgrade workstations.

Just as looking at the provision and availability of internet connectivity is not enough to understand the full picture of internet access in U.S. public libraries, focusing on the number of available workstations without considering the adequacy of those workstations to meet user needs is insufficient. Overall, 18.8% of U.S. public libraries report there are consistently fewer PAC workstations than patrons who wish to use them throughout a typical day and 62.4% of U.S. public libraries report there are fewer PAC workstations than patrons who wish to use them at different times throughout a typical day. An issue compounding this insufficiency is the amount of time workstations are down for maintenance, with nearly half of public libraries reporting maintenance causes workstations to be down two or more days (48.5%). Future waves of BTOP applications need to consider the factors that influence public libraries' ability to add, upgrade, and maintain PAC workstations so that libraries can use ARRA funds to purchase bandwidth and expand physical facilities, in addition to purchasing internal networking and computing equipment.

Table 4
Types of public access internet service to which public libraries subscribe.

Type of internet access	Percentage of outlets subscribing
Digital subscriber line (DSL)	25.8%
Leased line	23.3%
Cable	22.0%
Wireless	21.0%
Fiber	17.5%
State network	12.5%
Municipal network	3.1%
Satellite	1.3%
Other	3.1%

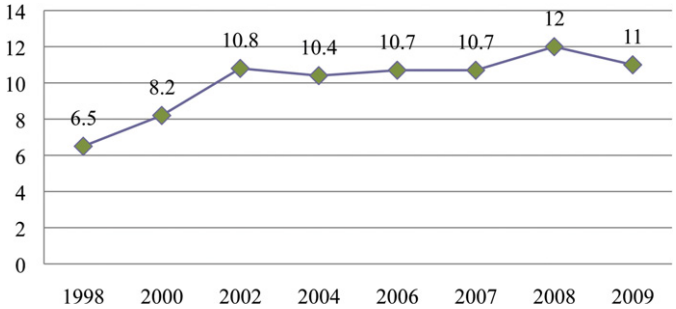

Fig. 2. Average number of public access computer workstations in U.S. Public Libraries, 1998–2009.

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Table 5
Factors influencing addition of public internet workstations/laptops.

Factor influencing addition of public access workstations	Percentage of outlets reporting influence
Cost factors	77.4%
Availability of space	75.9%
Availability of electrical outlets, cabling, or other infrastructure	34.0%
Maintenance, upgrade, and general upkeep	19.6%
Availability of bandwidth	15.3%
Availability of technical staff	12.1%
Availability of staff	8.9%
Other	2.8%

4.3. Summary of PLFTAS' findings

Nearly all U.S. public libraries provide free public internet access, and this is the only free internet access in the majority of U.S. communities. However, this internet access may be through dial-up, DSL, cable, or other internet connections; varying connection speeds and aging workstations may be contributing to slow connection speeds. The majority of U.S. public libraries report that their internet connection speeds and the number of public access workstations are insufficient to meet patron demands some of the time. If public libraries are to remain vital public servants and public internet access centers in the 21st Century, they require quality, high-speed broadband internet connections and increased quantities of new PAC workstations, along with funding for infrastructure improvements, additional facility space and staff, as well as education and training in information technologies, especially regarding broadband deployment and network maintenance and infrastructure.

Although the E-rate discounts are most frequently applied to telecommunications services, the importance to libraries of E-rate discounts for internet connectivity should not be minimized. Over half of all public library systems (50.4%) report receiving E-rate discounts in the category. This application is vitally important to urban, medium and high poverty public library systems in which nearly 60% of libraries in the three categories report receiving E-rate discounts for internet connectivity. This suggests that the E-Rate subsidies need to continue, regardless of new funding sources such as BTOP that provide libraries with the opportunity to upgrade workstations, but do not increase bandwidth or sustain payment of ISP subscriber fees.

5. Policy perspective

This section identifies and discusses key policy issues related to key issues identified in Table 3 and the 2008–2009 *PLFTAS* findings. The key policy issues discussed in this section are the following:

- *Telecommunications policy*: The impact of national telecommunications policies on public libraries' broadband provision;
- *Broadband mapping*: Some problematic issues related to the collection of broadband service availability and the creation of statewide broadband maps; and
- *Public libraries and telecommunications policy*: U.S. public libraries' broadband provision could benefit from a clear national agenda.

This section will discuss each of these issues with an emphasis on public libraries and the 2009 *PLFTAS* findings.

5.1. Telecommunications policy

The ARRA necessitates that the FCC deliver a National Broadband Plan to Congress by 2010 and mandates that the National Broadband Plan "shall seek to ensure that all people of the United States have access to broadband capability and shall establish benchmarks for meeting that goal" (ARRA, 2009, p. 402). Although the ARRA calls for the FCC to develop the plan in conjunction with NTIA, this plan and its goal of universal broadband will be formulated and released well after the announcement of BTOP awards. The deployment of broadband infrastructure to increase capacity seems in harmony with the FCC's charged goal of universal broadband; however, the syncopated release of awards and a National Broadband Plan suggests that FCC, NTIA, Congress, and other stakeholders are not in concert. The lack of organization amongst policymakers and their ill-defined roles will continue to complicate the role of public libraries through a lack of any clear funding mechanisms for public libraries' broadband provision and creates difficulty for forming a public library national agenda.

Another challenge stems from the ways "underserved" and "unserved" individuals and areas are defined. The BTOP NOFA availability defines underserved as:

> One or more contiguous census blocks with either no more than 50 percent of households in the proposed funded service area have access to facilities-based, terrestrial broadband service at greater than the minimum broadband transmission speed (i.e., 768 kbps); or an area with no fixed or mob broadband service provider advertises broadband transmission speeds of at least three megabits per second downstream in the proposed funded service area; or an area with a rate of broadband subscribership for the proposed funded service area of 40 percent of households or less. (Broadband Technology Opportunities Program, 2009, p. 33109).

The notice also describes an unserved area as "one or more contiguous census blocks, where at least 90 percent of households lack access to facilities-based, terrestrial broadband service, either fixed or mobile at the minimum broadband transmission speed" (i.e., 786 kbps) (Broadband Technology Opportunities Program, 2009, p. 33109). What is not clear in the notice is how to obtain the data (Census or otherwise) to determine any of these underserved and unserved areas.

No matter the definition of underserved or unserved, ALA argues that a public library's service area and whether it qualifies as unserved/underserved based on residential broadband availability should not disqualify a public library from BTOP funding when the library provides access to citizens who are otherwise unable to access a broadband connection (Sheketoff, 2009b). Another issue overlooked in the underserved and unserved definitions is that a definition of a suitable broadband speed for libraries where dozens of patrons and library staff are accessing the internet at the same time and often on a shared network with the library's wireless internet does not equate to the speed suitable for residential consumers with one or two computers accessing the internet at a time (ALA Office for Research and Statistics & Bertot, 2008). *PLFTAS* findings indicate that many libraries could benefit from increased connectivity, such as the 60% of all public libraries reporting connection speed insufficiency some or all of the time, but it is unknown how many of those libraries are located within areas the BTOP NOFA would deem underserved or unserved based on ISP's residential saturation.

5.2. Broadband mapping

Another issue related to public library broadband provision is broadband mapping. For libraries to facilitate universal broadband access for vulnerable populations, they need to be able to identify which libraries are in unserved and underserved areas and need increased connectivity to provide access to broadband for those people who cannot afford it or otherwise lack access to home broadband. In addition, the 26.5% of libraries reporting in the *PLFTAS* that the connection speed is already at the maximum level available to them indicates that numerous public libraries would benefit from

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increased broadband capacity and especially an increase in broadband infrastructure deployment where it is not currently available. In order to find where capacity should be increased, BTOP funded the collection of spatial data regarding broadband service availability and the creation of statewide broadband maps (State Broadband Data and Development Mapping Grant Program, 2009a), but the creation of accurate, timely, and open broadband mapping faces several challenges, including granularity of the data and the desire of telecommunications companies (telcos) for anonymity in reporting. In the context of mapping, granularity refers to the scale at which the data are aggregated, such as state level, county level, or census tract level.

One purpose of the mapping effort is to collect data that would enable calculations of the unserved and underserved areas by census block (e.g., a city block or much larger unit in rural areas). However, telcos view data that would reveal broadband connectivity and pricing as competitive intelligence that is time-consuming and costly to collect (Johnson, 2009). The telcos do not want to provide address-specific data that would divulge the speed and cost for each customer, as opposed to the granularity of a census block or larger area, which would only provide average values for an area and prevents detailed mapping of broadband connectivity at the address-specific level. Perhaps to dispel telcos' concerns, NTIA released a mapping clarification that no longer requires awardees to provide average advertised maximum speeds at the street address level; instead they may report at the Metropolitan or Rural Statistical Area (MSA or RSA) (e.g., Chicago and surrounding counties equals one MSA), a much less detailed view of the data (Johnson, 2009; State Broadband Data and Development Grant Program, 2009b). Until the broadband mapping program commences, the situation remains muddy as to what data will emerge, if it will be publically available or remain confidential, and at what level of granularity it will be collected, reported, and mapped.

Maps with missing data and/or broadband data reported at the MSA or census block will protect telcos' anonymity and dispel their confidentiality concerns, but may hamper public libraries' broadband provision. Unfortunately, reporting data at MSA or RSA levels of granularity hides actual gaps in service to individuals and makes it difficult to achieve the objective of using broadband mapping to reveal broadband service availability (State Broadband Data and Development Grant Program, 2009a). Data at the street level of granularity would be the only data that could be used to identify which institutions and individuals lack broadband service, but for now, telcos' competitive intelligence concerns trump any serious consideration for a complete map of the current availability of broadband. Data at a granularity of larger areas may conceal many underserved and unserved individuals and make it impossible to assess the degree to which the U.S. has or has not achieved the goal of universal broadband.

5.3. Public libraries and telecommunications policy

Currently, there is no clear national agenda for public libraries' broadband provision and the lack of consistent connectivity standards at state and local levels provides little upon which to build a national agenda. Vague definitions, such as T1 or faster and a wide variance of essential speeds from 56 kbps to faster complicate a message that should be simple — current connectivity is not fast enough, and as the House Communications Subcommittee suggests to the FCC, anchor institutions such as libraries need 100 Mbps to 1 Gbps connections for Americans to engage in the global Information Society (Eggerton, 2009; Worley, 2000). Despite the apparent complexity and instability of some key telecommunication policy issues addressed in this paper, the public library community may benefit from a single national agenda as opposed to many different (and sometimes competing) agendas from individual public libraries, library consortia, and state library agencies.

At best, some organizations (e.g., ALA and the Special Library Association) have pointed out perceived faults in current funding mechanisms and a lack of support for universal broadband (Sheketoff, 2009c; Special Library Association, 2009). For example, ALA has voiced its concerns over the first-round BTOP NOFA that focuses on unserved and underserved areas, potentially eliminating the eligibility of a large portion of public libraries that do not have adequate broadband but are located within urban or suburban areas leading to an inadvertent consequence that some census block groups may have a significant percentage of customers with broadband and a public library that does not (Sheketoff, 2009c). However, this does not equate to actionable objectives in a comprehensive national level telecommunications agenda that might help public libraries' broadband provision. For example, knowing what speeds and costs would be feasible and adequate for public libraries to operate may help solidify benchmarks and clarify national-level objectives.

Meanwhile, without some national agenda, few beyond the House Communications Subcommittee are advocating for increased connectivity for public libraries (Eggerton, 2009) and Wave 1 of BTOP awards lacks policy mandates to fund broadband directly in public libraries, especially since funds from the Public Computer Center (PCC) bucket cannot be used to purchase additional bandwidth and libraries are not allocated any set-aside funds. Until BTOP awards are announced, the inclusion of public libraries in broadband deployment at the local level is unknown and if that inclusion is at a low level, public libraries may remain beholden to local policymakers and telcos, leading to a question of how this affects public libraries' national position. Until NTIA announces Wave 1 BTOP awards and the FCC releases the National Broadband Plan, these issues will be unresolved and public libraries will not know which level of funding is the most appropriate mechanism through which to pursue broadband capacity expansion and sustainability: local, regional, state, or federal.

Besides the need for increased broadband bandwidth and speed, the *PLFTAS* findings demonstrate that public libraries would benefit from newer terminals to increase their current connection speeds through more efficient processing. Nearly 50% of public access computers in public libraries are three or more years old and require upgrading to improve network efficiency. Additional workstations may increase access, but unfortunately, more terminals on one network slow it down, and with staff and users on one network and more demand for wireless connections, an increase in terminals will not alleviate the connectivity shortfall. Public libraries will need *both* increased numbers of workstations *and* increased connectivity to expand broadband access, but Wave 1 BTOP PCC funds cannot be used to purchase additional bandwidth, only additional computers. This means that libraries that add computers through PCC funds need to find another funding mechanism through which to upgrade their bandwidth.

One option is E-rate funds and, given the existing reliance of public libraries on E-rate funds for internet connectivity and access provision, it is crucial that libraries remain eligible for E-rate dollars regardless of any funding awarded through BTOP and other ARRA funding programs. Libraries that receive ARRA funding to increase public computer center capacity will need to upgrade their internet connections, which requires initial investment dollars and ongoing funding to sustain that increased bandwidth. Libraries will need E-rate funds to help them upgrade their internet connections and maintain those upgraded connections at what will likely be higher rates than they currently pay since ISP rates increase as bandwidth increases. Acceptance of ARRA funding must not make libraries ineligible for E-rate funding; public libraries require both ARRA money to increase bandwidth and E-rate money to sustain free public internet access throughout the U.S.

5.4. Summary of policy issues

Several themes are pervasive in the key policy issues discussed in this section, notably that the fluidity of telecommunications policy and the conflicting roles of broadband policymakers underscore the

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key issues regarding telecommunication policy, broadband mapping, and public libraries and telecommunications policy. Telecommunications policy and broadband mapping affect the context in which public libraries provide broadband access to the American public and are therefore issues that public librarians should study and understand. The issues regarding public libraries and telecommunications policy are issues where the public library community has potential to take an active role in policy development and implementation. For example, a national-level public libraries telecommunications policy may help libraries have greater influence on developing policy that has a clear and consistent national agenda, rather than the complexity that results from each local and state public library community creating its own agenda with disparate objectives.

6. Policy recommendations

One goal of this paper has been to recommend a course of action for public librarians and broadband policymakers to ensure the widest possible deployment of broadband internet across U.S. communities and assist the FCC in meeting their charged goal of universal broadband via public libraries. Several approaches could be considered to address these key issues. Public libraries clearly could benefit from increased broadband connectivity and addressing the following recommendations could significantly advance their broadband provision to improve broadband resources and services to their communities.

- *Telecommunications policy*:
  - The Federal government needs to make clear the roles and organization of broadband policymakers through clearly stated policy mandates that are supported by funding mechanisms;
  - Future rounds of BTOP and other Federal funding mechanisms need to consider *individual citizen* definitions for underserved and unserved separate from *institutional definitions* for underserved and unserved in the context of public libraries and other community anchor institutions; and
  - Future rounds of BTOP and other Federal funding mechanisms need to consider *individual citizen* definitions for underserved and unserved separate from *institutional definitions* for underserved and unserved in the context of public libraries and other community anchor institutions;
- *Broadband mapping*:
  - The broadband mapping effort needs to focus on the data needs of all stakeholders, including policymakers, funding agencies, libraries, and other community anchor institutions, etc. and not include waivers that allow ISPs to withhold street-level data by claiming "competitive intelligence;"
  - Broad access to and transparency of broadband mapping results should be encouraged;
- *Public libraries and telecommunications policy*:
  - The national library community needs to take a cohesive and consistent approach to advocating libraries' telecommunications needs and concerns, and this should include a national public library broadband and telecommunications agenda;
  - Specific language describing the role and goals for public libraries regarding broadband should be included in the FCC's national broadband policy statement scheduled for release in spring 2010;
  - Future rounds of BTOP and other Federal funding need to allow libraries to purchase additional bandwidth as well as computers and network equipment, and the E-rate must continue to support sustainability of increased public library computing and broadband capacity; a 2009 report on the information needs of democracies recommended funding and other support for public libraries as centers of digital access and education (Knight Commission, 2009); and
  - These and related information policy issues, especially those related to broadband, should be incorporated into LIS curriculum and training for public librarians.

These are a few recommendations for national-level telecommunications policy that consider the roles public libraries already play in supporting broadband deployment and adoption, and mechanisms to support and expand upon those roles.

7. Directions for future research

There are various areas of needed research regarding public library internet access provision, free public computer services, broadband access, E-rate, and more. The following list briefly identifies of selected key research areas:

- *Economic, educational, and social impacts of public library free public internet and computer access*: Public libraries need to justify their value and specific requests for increased internet connectivity and workstations to funding and governing bodies. To be able to do so, public libraries need to have data that reflects the impacts of public library free public internet and computer access, especially impacts of library technology training, e-Government, and disaster services that require the development of performance measures and benchmarks;
- *Quality and sufficiency of public library free public internet and computer access, including longitudinal measures*: *PLFTAS*' data are based on library-reported data, but empirical measures, especially longitudinal measures, would help public libraries justify the need for more workstations and bandwidth, as well as determine benchmarks regarding adequate or sufficient public library public access internet and computer services, for example those that assess public library workstation and internet access quality and sufficiency in terms of workstation quantity, memory capacity, processing speed, bandwidth availability versus usage, types of simultaneous use of applications and services, and user satisfaction;
- *Impacts of extending high capacity broadband and/or fiber optic cable to public libraries on economics, society, community, and library services*: Public libraries are positioned to act as anchor tenants on fiber cable networks or distributed hubs for big broadband. However, it is important to measure the impacts of extending high capacity broadband to public libraries, such as the degree to which extending fiber to a library increases (1) home broadband access and adoption rates throughout a community, (2) revitalizes the community's economy, (3) the number of new or expanded services libraries are able to offer, and (4) usage of those services;
- *Efficiency and effectiveness of leveraging public library infrastructure as a mechanism for reaching the unserved and underserved with ARRA funding*: It is important to measure the effect of using BTOP funds and other ARRA broadband dollars to increase public library bandwidth; measurements should be taken of the impacts on broadband adoption and penetration rates in unserved and underserved communities with rates measured in terms of adoption and penetration rates for both *institutional* and *home* broadband subscribership; and
- *Telecommunications policy related to public libraries' broadband provision*: Information policy researchers need to continue following changes to federal telecommunications policy that includes potential funding for public libraries' broadband provision, such as defining of service areas, broadband mapping, and a national broadband provision agenda for public libraries, as well as longitudinal analysis of broadband and telecommunications policies and individual analysis of new policies as they develop.

These are just a few of the many possible research areas regarding public library free public internet and computer access that need further investigation. Each area accounts for multiple potential

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research questions and is ripe for continued research. Undoubtedly, other areas of needed research will be identified as these areas are explored, further expanding understanding of these specific areas as well as the overall area of public library internet access and provision.

8. Conclusion: improving broadband access and use for public libraries

U.S. public libraries fill the role of providing free public internet services, but require quality, high-speed broadband internet connections to continue meeting public demands. These libraries cannot add workstations without increased funding, staff, training, physical space, infrastructure, technology, and bandwidth. The 2009 study shows that public libraries, in some instances, need higher connectivity that cannot be obtained, as well as newer computers they cannot afford. Considering that U.S. public libraries provide free public internet access and often are the only free internet access in the majority of U.S. communities, their role as internet service providers becomes increasingly crucial. Public libraries are vital community institutions, and numerous studies of broadband penetration have determined that community-based efforts are a key element for successful adoption (Bouras, Giannaka, & Tsiatsos, 2009; LaRose, Gregg, Strover, Straubhaar, & Carpenter, 2007; Prieger & Hu, 2008). Public libraries' ability to serve as the public internet access point for many communities is illustrated by the 2009 *PLFTAS* study, but federal fiscal support of this role remains hampered by a complex and changing broadband deployment policy.

In addition to the findings related to challenges faced by public libraries in broadband provision, this paper discussed some of the challenges U.S. public libraries face in the context of limited funding and access to telecommunications services and equipment. Funding and infrastructure expansion and support from NTIA and the broadband provisions detailed in ARRA may help libraries succeed in the provision of free broadband internet access for all end-users. However, several key policy issues discussed in the policy section regarding telecommunication policy, broadband mapping, and public libraries and telecommunications policy complicate public libraries' broadband provision. How any funds will assist public libraries is unclear.

Amidst this fluid policy environment, public libraries would benefit from a national-level telecommunications policy containing clear objectives. Because libraries are internet providers to millions of Americans, broadband policymakers may benefit from partnering with public librarians to spread the deployment of broadband internet across U.S. communities and help the FCC meet their charged goal of universal broadband. Still, if public libraries hope to obtain a deserved seat at the table, they will need to demonstrate more clearly and frequently to other stakeholders their valuable roles as centers that provide internet access and resources, which are staffed by information providers retaining expertise, and facilitate internet-enabled services in almost every U.S. community.

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