

# Broadband Improvements: Free Planning Tools for Libraries

LIBRARY



# Project Managers



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(CAP)

## About Stephanie Stenberg

- Works with regional networking partners, community anchor institutions, and Internet2 membership organizations to support networking, trust and identity services, and advanced applications
- Since joining Internet2 in 2018, she has been part of three Institute of Museum and Library Services-funded grant projects focused on libraries and connectivity



**Carson Block**  
Library Technology Consultant  
Carson Block Consulting, Inc.

## About Carson Block

- 25 years of library technology experience
- Full-service library technology consulting firm since 2010
- Purpose: To increase technological and other capacities in libraries to serve people everywhere, with a special focus on rural connectivity, staff skills and comfort, "complex situations"

# About the Toward Gigabit Libraries Toolkit



The **Toward Gigabit Libraries (TGL) Toolkit and Broadband Improvement Plan** is a powerful, FREE tool to help libraries learn about and improve their current broadband infrastructure and internal information technology (IT) environment.

Using the TGL Toolkit and Broadband Improvement Plan, librarians will be better equipped to improve their broadband services and become stronger advocates for their libraries' broadband infrastructure needs.

# Institute of Museum and Library Services (IMLS)

## Grants that Made the TGL Toolkit Possible



### **2015 Toward Gigabit Libraries (TGL) IMLS grant (RE-00-15-0110-15)**

- Two-year grant developed training curriculum and self-assessment material ("Toolkit") for library broadband infrastructure (with one-year extension)
- Targeted rural and tribal libraries
- Partners included State Library offices and Research & Education Networks
- Initial goal was to pilot toolkit in at least 30 libraries— we were able to reach nearly 60 libraries

### **2020 Gigabit Libraries and Beyond (GLB) grant (RE-246219-OLS-20)**

- Two-year grant to improve upon the toolkit and expand its reach throughout the United States
- In addition to focusing on rural and tribal libraries, will expand the toolkit's audience to address the needs of urban libraries in "tech deserts"



# **Toolkit Overview**

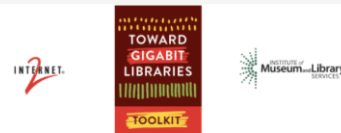
# Download the Toward Gigabit Libraries Toolkit

Download the exclusive Version 1.5 Draft of the Toward Gigabit Libraries Toolkit:

<https://bit.ly/TGL1-5WebJunction>

Watch this fun, short video for a great overview of the TGL toolkit:

<https://youtu.be/PXWv3-HYm-I>



WELCOME TO INTERNET2'S TOWARD GIGABIT LIBRARIES TOOLKIT, FUNDED BY THE INSTITUTE FOR MUSEUM AND LIBRARY SERVICES (IMLS). THIS TOOLKIT IS DESIGNED FOR SMALL, RURAL, TRIBAL, AND URBAN LIBRARIES WITH LIMITED INFORMATION TECHNOLOGY SUPPORT. THE GOAL IS TO IMPROVE AND EVOLVE THE LIBRARY STAFF'S UNDERSTANDING OF AND INTERACTION WITH THE LIBRARY'S BROADBAND CONNECTION AND SERVICES.

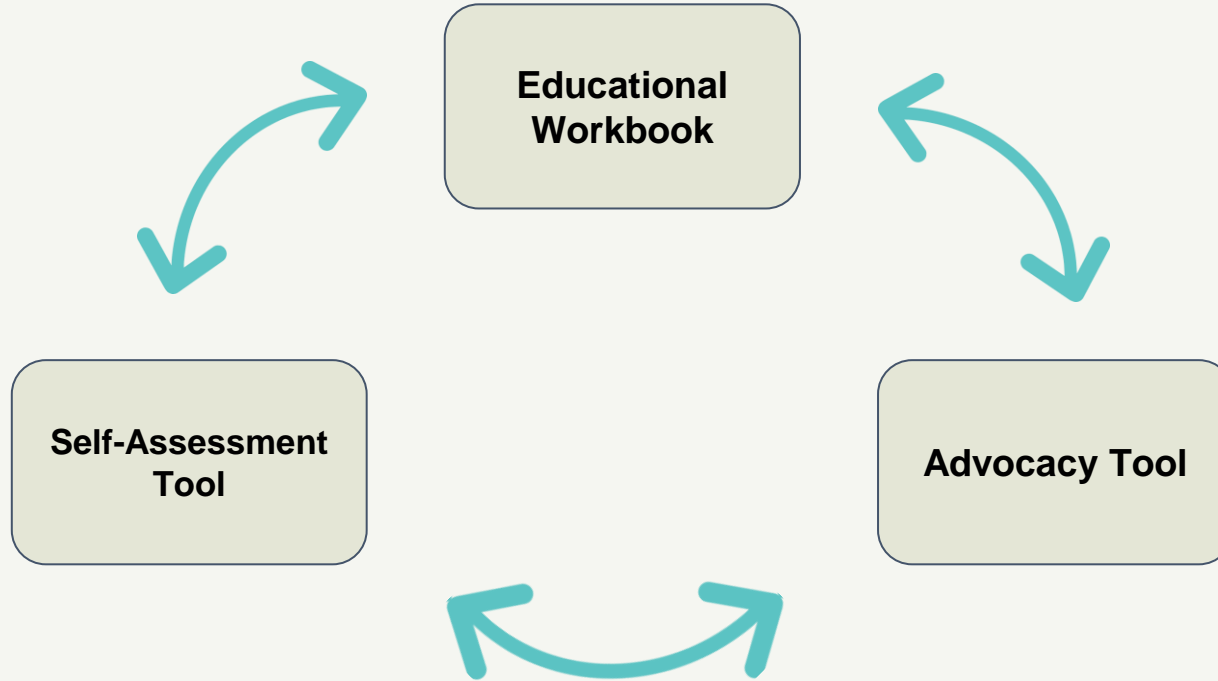
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# What is the Toolkit?



# Toolkit Components and Process

- *Technology Inventory*
- *Broadband Connection*
- *Wired Network*
- *Network Devices*
- *Wireless/WiFi Network*
- *Computer/End User Devices*
- *Broadband Services and Activities*
- *Broadband Services and Activities*
- *Broadband Technology and Operations Support*
- *Building a Network of Support & Advocating for Your Library*
- *Broadband and IT Funding Opportunities*
- *Additional Resources and Best Practices*

Pilot Site

Intake Survey

Pilot Visit/  
Toolkit

Broadband  
Improvement  
Plan

Post-Pilot  
Survey



# Toolkit Approach

Questions are presented first, and additional information and resources follow in text boxes to help you answer all the questions

7. Next, let's test the quality of your broadband service, specifically, the latency, jitter, and packet loss for your network connection.

Revisit your Measurement Lab speed test results page

(<https://speed.measurementlab.net/#/>). Record your results in the table below.






## Connection Quality Results

Latency		Milliseconds (ms)
Jitter		Milliseconds (ms)
Packet Loss		Percent (%)
Other		

Along with broadband speeds, the “quality” of your broadband connection is important, especially for video and audio applications.

The same Measurement Lab test (<https://speed.measurementlab.net/#/>) we used for speed will also provide the additional “quality” measurements for your broadband connection.

## Results

	Test Server	Denver, US
	Download	194.39 Mb/s
	Upload	34.72 Mb/s
	Latency	4 ms
	Retransmission	0.00%

There are a number of technical factors that add up to an excellent - or poor - connection to the internet. While all Internet speed tests measure how fast a connection can download and upload data, some also measure the **quality** of the connection. Some common quality measures include latency, jitter, packet loss, and retransmission.

**Latency**, Sometimes called “ping,” is the amount of time required for a data packet to get from point A to point B. It is usually measured in terms of round-trip delay expressed in milliseconds (ms). Higher quality connections have latency in the <100 ms range, the lower the better. Low latency is especially critical for real-time applications, such as live streaming video and interactive videoconferencing. For example, high latency causes a delay between when a person speaks and the party on the far end hears them, which can make two way conversations difficult. In other words, the video of the person speaking is delayed or out of sync with the audio.

**Jitter** is the amount of variation in the latency observed over time. Zero jitter means the amount of time it took for packets to go from point A to B were exactly the same every time. Anything above zero is the amount of time by which they varied. Similar to latency, you want

# Using the Toolkit



*iStock Photo*

- Free, open-source technology learning, diagnostic, and advocacy tool
- Many ways to use the toolkit:
  - Record a shareable snapshot of your library's IT and broadband infrastructure
  - Prepare E-rate requests and budget cycles
  - Help open communication between library staff and tech workers
  - Address specific problems in your library by just completing certain sections
  - Get a baseline for proposed IT and broadband improvements
- ***The best part: No techies required!***



# **Toolkit Sections**

# Technology Inventory

In this section, you will inventory some of the key pieces of the technology inside your library, including your network, computers, and other important technology components.

This inventory will help you understand what sort of equipment you have now and determine if you need different or additional equipment for the future.

- Broadband Connection
- Network Devices
- Wired Network and Power
- Wireless Network and Power
- Computer and End User Devices

## 2. What is the make/model of your broadband router?

Make:	
Model #:	

## 3. Do you have more than one router? If so, what is the make and model?

Make:	
Model #:	

A router is a networking device that forwards data packets between computer networks. A router is connected to two or more data lines from different networks. Your router is often a gray, black, or white device with multiple Ethernet ports for Ethernet cables.



You can find the make (manufacturer) and model (either the name of the device or a model number) of your router by looking at it - the information may be printed on the top of the unit (as in this picture) or it may be located on the side or bottom, sometimes printed on a special label.

You will have a broadband router that connects your library's network to the incoming broadband connection from the service provider, as well.

# Broadband Services and Activities

This section covers the types of broadband services and applications. The goal is to ensure that the library has sufficient bandwidth to support patron and staff use of various devices and applications both today and in the future.

- Bandwidth Needs
- Hot-Spot Lending
- Internet Filtering
- Offered Services

## 5. BROADBAND SERVICES AND ACTIVITIES

In this section, the types of broadband services and applications are discussed in order to ensure that the library has sufficient bandwidth to support patron and staff use of various devices and applications both today and in the future.

**1. How much bandwidth do you need?** This can be tricky to estimate, with download speed recommendations ranging from 512 kbps to 1Mbps per simultaneous user. Read the article below to get a better idea of the amount of bandwidth your library needs.

Identifying how much bandwidth your library needs based on the types of services offered, number of devices connected, etc., can be difficult, especially as needs change over time and at different times of day.

Although not a technical measure, you may already know through experience if you have enough bandwidth or not. If you consistently experience a slow Internet connection when you have many people using your library computers and WiFi at the same time, it's possible that your broadband connection is too slow for the demand.

For Erate applicants, the FCC says "With respect to libraries, the (Erate) Order adopts as a bandwidth target the American Library Association's recommendation that all libraries that serve fewer than 50,000 people have broadband speeds of at least 100 Mbps and all libraries that serve 50,000 people or more have broadband speeds of at least 1 Gbps."  
<https://www.fcc.gov/general/summary-erate-modernization-order>

Would you like to dig more deeply? This article offers an excellent description of an approach to produce a number:  
[http://www.broadband4education.nm.gov/uploads/FileLinks/a6cbda6b6c3345ecbadd0cafa50aa1ae/Edge\\_Benchmark\\_9.2\\_Bandwidth\\_Article\\_8.19.13.pdf](http://www.broadband4education.nm.gov/uploads/FileLinks/a6cbda6b6c3345ecbadd0cafa50aa1ae/Edge_Benchmark_9.2_Bandwidth_Article_8.19.13.pdf)

This approach requires you to do some counting (the inventory you may have performed earlier in this toolkit will come in handy) and also do a little math.

The Edge website also has resources on how to advocate within your community for better broadband: <https://www.libraryedge.org/>.

# Broadband Technical Operational Support

Technology in libraries is more than just a collection of gear. People, including library staff and those who provide technical support, are just as important.

In this section, you will learn more about the people who help make technology available in your library and determine if there are any areas where you could benefit from additional support.

- Available Technology Support
- Staff Training Resources
- ISP Technical Support
- ISP Service Requests
- ISP Service Guarantees

## 6. BROADBAND TECHNICAL OPERATIONAL SUPPORT

Technology in libraries is more than just a collection of gear. People, including library staff and those who provide technical support, are just as important. In this section you will learn more about the people who help make technology available in your library and determine if there are any areas where you could benefit from additional support.

### 1. Describe the technology support available to your library.

- ☐ Library staff expertise
- ☐ Community volunteer(s)
- ☐ Broadband provider
- ☐ IT service contract
- ☐ Consortium
- ☐ State library
- ☐ Local school district, municipal government or agency or other partnership.

**Describe the technical support you receive from these sources below. What additional support does your library need?**

Small, rural, and tribal libraries often have limited access or availability of technical resources to support the library's IT and broadband infrastructure and operations.

Your state library may offer technical support for your library ranging from online resources, site visits, and in person and online training programs for library staff.

List of state libraries and archives: <http://www.cosla.org/Directory>

See "Section 9: Additional Resources and Best Practices" below for links to even more technology support opportunities for your library.

# Building a Network of Support & Advocating for Your Library

Improving your library's broad and IT takes a village.

In this section, you will explore your community networks and identify key people and groups who can support your technology work within your library.

- Identifying your library's unique strengths
- How to build relationships to expand support for your initiatives
- Creating and executing an outreach strategy
- Evaluating your efforts

## Create and Execute a Plan for Outreach

### Who are your priority partners for impacting your project?

Once you've crafted your message and identified potentially supportive members in your community, it's important to make a plan to begin the process of reaching out and connecting with them. It can be really useful to outline who the potential organizations and individuals are, the priority for outreach, and the type of support you hope to receive.

As you plan and prioritize your outreach to partners consider:

- Who do they serve? What is the overlap with community members the library serves?
- What is their stated mission and/or vision?
- Do you have any common friends – or foes?
- What is the history of interaction between each stakeholder group and the library?

Organization / Individual	Type of Support	Connected Stakeholder	Priority



# Broadband and IT Funding Opportunities

Technology expenses are important budget considerations for all libraries. This section outlines several opportunities that may be available to help fund your library's broadband connectivity.

- Building a technology budget
- Identifying projects to fund
- Estimating required resources and costs
- Maximizing E-rate funding
- Grants and other funding sources

## 6. Estimate the required resources, cost, and timeframe required to reach each funding goal.

Write the required resources, cost, and timeframe for each goal in the "Resources Required and Cost Estimate" and "Timeframe to Complete" sections of the **Library Technology Budget Worksheet** in the Appendix.

To realize any funding goal, you need to know in advance how much it will cost in terms of money, time, and resources. For each funding goal, outline how much it will cost.

It is important to think about the *whole process* of realizing a goal. For example, if the library needs \$500 for new wiring, you also need to factor in the cost of installation.

### Estimating Resources

To research tech product pricing, consult the Purchasing Computers, Software, and Equipment section of this toolkit. This Computers in Libraries article, "Comprehensive cost planning yields successful tech projects," discusses how to consider all costs in your budget, including some you may not initially think about:

<https://librarytechnology.org/document/12054>.

### Estimating Cost

Next, identify potential funding sources for each goal. To do this, look to multiple sources of information:

- Library's existing technology budget
- Library's technology plan
- Library Grant Funding Opportunities Resources section below
- [Eligible equipment and services](#) that E-rate discounts
- Also review the Support and Advocacy and Technology Plan section of the toolkit—since the majority of library funds come from local sources, it is essential



# Additional Resources and Best Practices

The topics listed here are designed to provide you even more insight and resources to improve your library's broadband connectivity and services. You may find these items helpful in gaining a better understanding of your broadband connection, data network, and computers.

- E-rate
- Content filtering
- Broadband networking
- Data backup
- Digital inclusion and equity
- Free technology-related training opportunities & resources
- Grant funding opportunities and resources
- Internet use policies
- Purchasing computers, software, and equipment

## Data Backup

### [The Rule of 3-2-1](http://www.hanselman.com/blog/TheComputerBackupRuleOfThree.aspx)

(<http://www.hanselman.com/blog/TheComputerBackupRuleOfThree.aspx>)

This blog post suggests the “rule of three” best practice around data backup-- always have three digital copies of anything you really care about, use at least 2 types of backup media (hard drive, tape, cloud), and at least one copy should be stored offsite.

### [Your Organization's Backup Strategy](http://www.techsoup.org/support/articles-and-how-tos/your-organizations-backup-strategy)

(<http://www.techsoup.org/support/articles-and-how-tos/your-organizations-backup-strategy>)

Is your organization prepared for a disaster? A solid backup strategy is one of the key elements of being prepared. Get started developing your organization's backup strategy with these tips and best practices.

## Digital Inclusion and Equity

### **Digital Inclusion from BroadbandUSA**

<https://broadbandusa.ntia.doc.gov/resources/digital-inclusion>

The National In (NTIA's) BroadbandUSA convenes the Digital Equity Leaders Network (DELN), a group of state and local government leaders working to bridge the digital divide. The DELN meets regularly to share best practices, resources, and strategies. This page links to federal funding, federal digital inclusion resources, and a map with links to state and local government digital inclusion programs.

### **Digital Inclusion Coalition Guidebook**

<https://www.coalitions.digitalinclusion.org/>

The Digital Inclusion Coalition Guidebook shares lessons learned from six established community-wide digital inclusion coalitions composed of libraries, community-based organizations, local governments, housing authorities, and others to cooperatively address equitable access and use of communication technologies. The guidebook was developed by the National Digital Inclusion Alliance (NDIA) with support from the Media Democracy Fund and the Cleveland Foundation.

### **Digital Literacy Instruction Playbook**

<https://www.ala.org/pla/initiatives/digitallead/digital-lit-instruction-playbook>

The Public Library Association (PLA) has a comprehensive Digital Literacy Instruction Playbook, which has comprehensive resources to help your library implement a digital literacy instruction program to enhance your community's ability to find, evaluate, consume, create, communicate, and share digital content. This resource was developed

# Glossary

The glossary section explains all the terms used in the toolkit, including:

- Ethernet
- Firewall
- Latency
- Router
- WiFi Extender
- Wireless Access Point (WAP)

## Transmission Control Protocol/Internet Protocol (TCP/IP)

The suite of communications protocols used to connect hosts on the Internet. TCP/IP uses several protocols, the two main ones being TCP and IP. TCP/IP is built into the UNIX operating system and is used by the Internet, making it the de facto standard for transmitting data over networks.

## Voice over Internet Protocol (VoIP)

VoIP is technology that lets you make phone calls over your internet connection instead of a regular, analog phone line.

## Wide Area Network (WAN)

Most networks consist of two major zones—the local area network (LAN) and the wide area network (WAN). A LAN is the *internal* network, regardless of whether it is a house with two computers or a high-rise office building with thousands. The WAN is the network *outside* the LAN; this is both other internal networks and the full Internet. A WAN port is the portal by which information passes back and forth between the LAN and the WAN.

## WAN (Wide Area Network) Port

A WAN port, sometimes called an “uplink,” is the portal by which information passes back and forth between the LAN and the WAN. Most users will find a WAN port on a network router. A common home router has one WAN port and four LAN ports. Some routers refer to them as an uplink (for the WAN port) and wired connections (for LAN ports). The WAN port takes in information from the outside network or the Internet. The information is filtered through the router’s internal firewall and routing system. Then the information is sent to the proper LAN port or out over a wireless connection to a wireless source.

## WiFi Extender

WiFi extenders communicate wirelessly with the primary WiFi system and receive the WiFi signal from the router and broadcast or “repeat” the signal into areas that need more WiFi coverage or signal.

# Common Issues

- Insufficient bandwidth
- Insufficient data wiring
- Inefficient network setups
- Old and/or obsolete equipment
- Poor WiFi coverage
- Not participating in E-rate (funding mechanism for U.S. libraries)

***Is your issue listed here? What issues do you suspect your library has when it comes to broadband and IT infrastructure?***

# Broadband Improvement Plan

## SHORT TERM ACTION PLAN (0-3 MONTHS)

Action	Intended Result	Resources Required	Timeline
Move WiFi router from back of library to central part	Improve throughput in library, reduce dead spots	Additional LAN cabling	One month
Obtain information on contract with broadband service provider, including speeds, SLAs, contract time, costs, etc.	Understand what speeds library should be seeing, calculate cost per Mbps, understand if there is recourse for missed speeds.	Name of service provider and billing name/information.	One week

## LONG TERM ACTION PLAN (3-12 MONTHS)

Action	Intended Result	Resources Required	Timeline
Contract with an additional area broadband service provider and bond/combine with existing broadband capacity	Increase broadband capacity at library	Additional broadband connection and equipment to combine connection	6 months
Install WiFi repeaters	Reduce dead spots, increase access to WiFi outside of library for off-hour use	WiFi repeaters	5 months
Participate in E-Rate program	Obtain a subsidy for the broadband connection and inside wiring to improve broadband connections and connectivity	Support from State Library, E-Rate consultant (possibly)	12 months

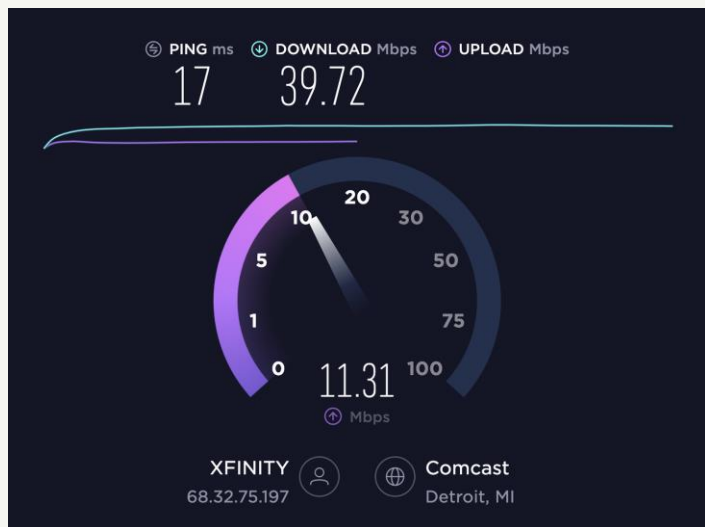


# **Tips and Takeaways**

# Conduct a Speedtest

## Ookla Speedtest






<https://www.speedtest.net/>



## M-LAB Speedtest

<https://speed.measurementlab.net/>

# Results

	Test Server	Chicago, US
	Download	49.31 Mb/s
	Upload	10.72 Mb/s
	Latency	17 ms
	Retransmission	1.68%

# Conduct a Speedtest

- Test at multiple times of day and on different days of the week
- Make sure to record all results
- Download and use this Speed Test Recording Worksheet:  
<https://bit.ly/2PIO8pu>

## Speed Test Recording Worksheet

Speed Test ( <https://speed.measurementlab.net/#/> <https://www.speedtest.net/> )

Date / Time	SPEED TEST RESULTS	Download	Upload		QUALITY TEST RESULTS	Notes
	Test #1 Measurement Lab			Mbps	Latency	Milliseconds (ms)
	Test #2 SpeedTest.net			Mbps	Ping	Milliseconds (ms)

Date / Time	SPEED TEST RESULTS	Download	Upload		QUALITY TEST RESULTS	Notes
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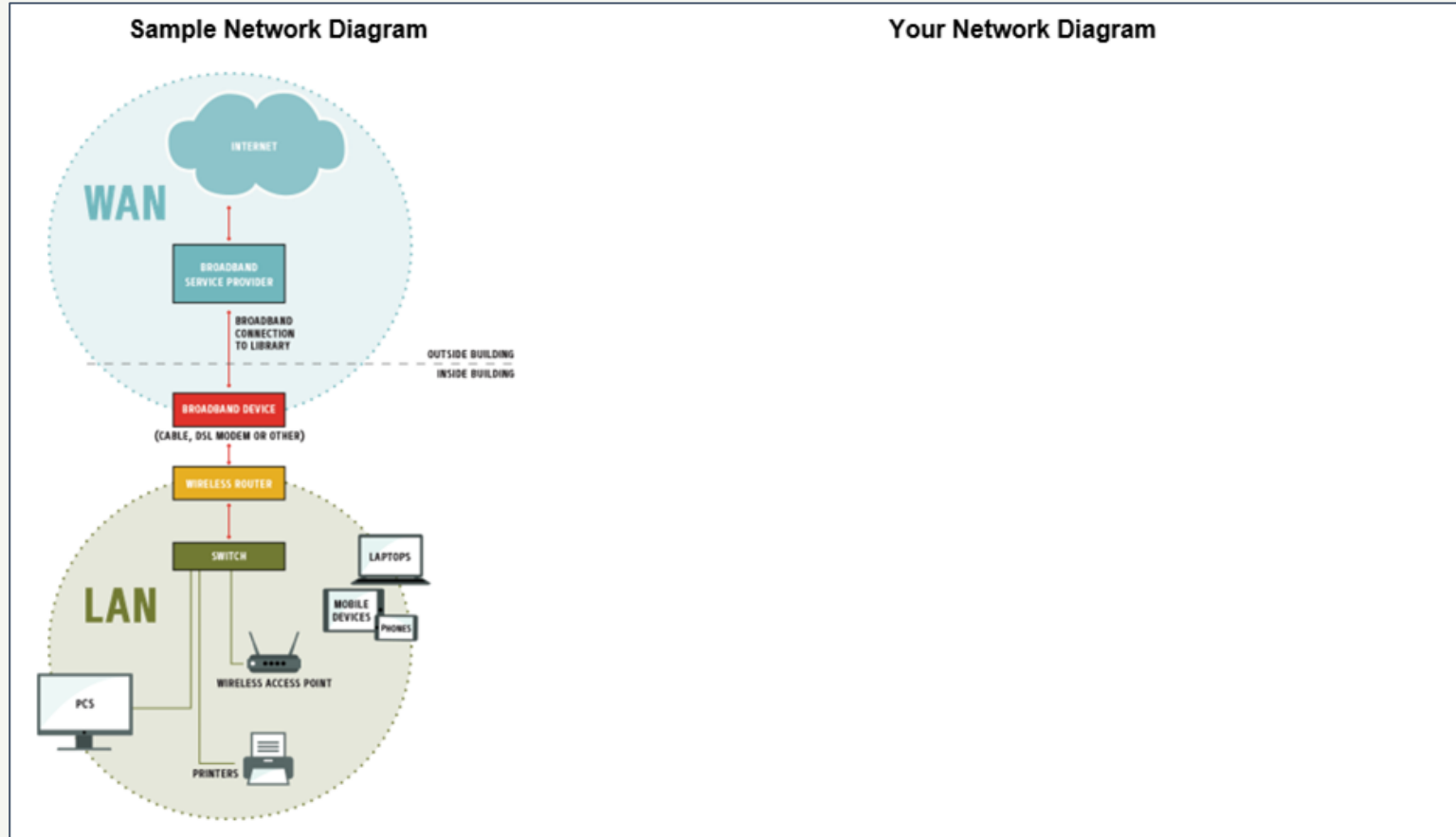




**GLB**  
GIGABIT LIBRARIES  
AND BEYOND



# Network Diagram



# Gigabit Libraries and Beyond: Next Steps

- Further refine and supplement the toolkit draft version 1.5
- Working with the Gigabit Libraries and Beyond Advisory Board and toolkit users to identify toolkit improvements
- Working with tribal and rural libraries to improve outreach
- Working with urban libraries to address their needs and conduct outreach
- Building partnerships between research and education networks and state libraries
- Developing “Train the Trainer” seminars to support libraries interested in completing the toolkit

# How to Stay Connected



- Follow us on Twitter: [@TGLtoolkit](https://twitter.com/TGLtoolkit)
- Download the exclusive Version 1.5 Draft of the Toward Gigabit Libraries Toolkit:  
<https://bit.ly/TGL1-5WebJunction>
- Email Stephanie [sstenberg@internet2.edu](mailto:sstenberg@internet2.edu) to provide toolkit feedback and/or join our email list



# Questions or Comments?

Toward Gigabit Libraries toolkit and materials:

[internet2.edu/tgl](http://internet2.edu/tgl)

Gigabit Libraries and Beyond grant project page:

[internet2.edu/glb](http://internet2.edu/glb)

***Feel free to reach out with any additional questions or ideas, we'd love to hear from you!***

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