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## **From Books to Bandwidth: Connectivity and Innovation in California’s Public Libraries**

**By: John B. Horrigan**

### **Summary**

Public libraries have always been in the business of moving information and knowledge across networks. Checking out a book, taking it home on a bike or bus, and sharing its content in conversations with friends is the old-school way of networked information-sharing. Electronic networks are the currency of information-sharing today—a reality that libraries have understood for decades and that has prompted large investments by public libraries in digital infrastructure.

Libraries’ technology challenges never stand still. Digital access tools become more powerful, more portable, and more affordable, while networks become faster and more pervasive. Many libraries struggle to assemble the resources to upgrade network speeds. Some library facilities, especially in rural areas, are saddled with speeds that fall below the Federal Communications Commission’s 25 Megabits per second download threshold for consumer broadband. This is at a time when community anchor institutions such as libraries [need speeds of at least 100 Mbps](#), and often multi-gigabit networks.

What happens when libraries experience not just an incremental increase in network speeds, but network speeds that are orders of magnitude greater than they have had previously? The State of California offers insight into that question, as public libraries now are able to connect to a network called the California Research and Education Network (CalREN). CalREN is managed by the nonprofit Corporation for Education Network Initiatives in California – or CENIC. Over 80% of all library jurisdictions in California now have their internet connectivity and services through CENIC, which offers individual institutions speeds of 1 to 100 gigabits per second. This white paper explores the opportunities this connectivity offers, but also examines steps

stakeholders in California can take to get more out of gigabit connectivity for *all* libraries. The paper shows that:

**Libraries are using CENIC bandwidth for new digital programs for their patrons and communities.**

Many libraries using the CENIC network have launched educational programs for all ages using virtual reality (VR), gaming applications, and interactive video feeds with authors and experts in other places. Public libraries recognize, however, that bandwidth is not enough. They need new equipment, new kinds of educational content, and sometimes updates to internal wiring to fully take advantage of CENIC. In addressing those needs, funding from the state library has been crucial. Partnerships also help; many libraries have engaged with the private sector for VR gear and educational content that uses VR systems.

**The advent of CENIC connectivity has been a catalyst for greater engagement with the community.**

Community members come to programs that feature VR or gaming to learn something new in a group. It takes place at the library, rather than their homes, because many people do not have home internet speeds to support cutting-edge application and some have no home access at all. Libraries also report an uptick in foot traffic with more patrons using library computers or Wi-Fi networks. All this directly benefits the people who use them, but they also foster community as people gather together who might not otherwise come to know each other.

**Rural libraries face distinct connectivity challenges, but are often resourceful in overcoming them.**

The CENIC network extends to a library system's main branch and thereafter the local library, in partnership with CENIC, endeavor to find ways to connect branches—which can be distant in rural areas. The circuit connecting these branches can be expensive, as special construction is often necessary where there is little terrestrial infrastructure, resulting in additional costs and delays in connecting rural branches. Yet some rural areas have been able to leverage CENIC and other local networks to improve the connectivity proposition—and not just for libraries, but local government, health care, and also agricultural areas in critical need of access to sensor networks

for water use, soil conditions, and other critical factors, as well as access to global markets for sale of agricultural products.

**Looking to the future, public libraries in California could benefit from a forum to develop and disseminate library-specific innovations that depend on very high speed networks.**

Library officials in California report that annual events such as the CENIC conference help them learn about what other libraries are doing with increased bandwidth. At the same time, there is a concern that some libraries may focus too much on the administrative and productivity benefits of CENIC, and not enough on the new possibilities it offers for programs and services. This was characterized as the “bandwidth–imagination gap.” One way to address it: create a forum that develops library-specific applications that depend on gigabit-plus speeds and provides technology transfer services for public libraries. Libraries would also benefit from greater appreciation that they are now part of a network of research and educational institutions throughout the state. This gives them an opportunity to tap into digital content from California’s universities that, prior to CENIC, was less easily accessible. This sort of “thinking inside the network” could open up new opportunities for California’s public libraries.

All this unfolds as public libraries face high expectations from the public for services that rely on quality broadband infrastructure. Library users today want their local public library to help prepare them for educational and work environments in which digital skills are paramount.

Higher speed networks are one crucial ingredient, but equipment, planning, and innovation will help libraries meet and exceed those expectations.

## **I. Background: The adoption of innovations**

By its very nature, innovation is uncertain. For every iPhone that takes hold of the public imagination, there is an Apple Newton that is launched to fanfare and flames out. In network industries, uncertainty is compounded by significant investment risks. High-speed broadband infrastructure is expensive to deploy and making money from broadband networks has not always been a sure bet. The dot-com bubble of 20 years is one example of the mismatch in the timing of network investment and society putting it to use.

Notwithstanding the current excitement about 5G wireless networks, there are serious questions about the investment case for deploying such networks. As scholars from Carlotta Perez to Paul David have documented, it can take years before society determines how to fully put to use innovations.

When people and organizations eventually do figure out what to do with worthwhile innovations, the process does not unfold automatically. It takes support from institutions in the public and private sectors. When rural American households were slow to adopt electricity, extension agents from the U.S. Department of Agriculture went door-to-door in some rural areas to promote adoption. In the industrial setting, electricity did not, by itself, improve productivity. Businesses had to completely redesign factories before firms could reap the benefits of having a new way to power production.

The other part of this dynamic is social. When early adopters try a new technology, they serve as models for others to emulate. In the internet's early commercial days, computer and online adoption reflected network effects, meaning there were higher rates of adoption in places where a lot of people were already using online services. This is hardly a surprise, but the research also showed that the effect was independent of factors one would expect to encourage online use, such as income and education. Internet adoption, in other words, was a phenomenon that depended on people's social ties and neighborhoods, not just wealth or educational attainment.

These two parts of the adoption process—organizational change and the social dimension—explain why realizing the fruit of innovations takes time. Levers that can shorten this timeframe include:

- Cost reduction: The new infrastructure to support many innovations is expensive, which may discourage even intrepid early adopting people and organizations. Defraying that cost can help spur uptake.
- Complementary investments: Electricity was not useful to homes until they had the wiring to run appliances; it did not help business productivity until companies invested in redesign.
- Information-sharing: This may unfold informally, as people see early adopters using the latest gadget or service. And it may proceed more formally through industry-wide forums aimed at disseminating best-practice and facilitating technology transfer.

Like any other institution, libraries confront the excitement of new innovations with the uncertainties of how to get the most out of them. They do this with tight resources and ongoing needs to serve communities in the ways they traditionally have. The library field is generally quick to embrace the future, but just how to do that is not always easy to see. In California, the availability of a high-speed broadband network that markedly increases library bandwidth offers a case study on how organizations adopt new innovations. This paper looks into how libraries adapt to more bandwidth, and also highlights actions that might improve how *all* libraries in California can benefit from enhanced connectivity.

## **II. Public Libraries in California: More bandwidth, new programs**

California's research and educational institutions have, since 1997, used the CalREN network managed by CENIC to meet their bandwidth needs. In 2013, the state legislature authorized libraries to use CENIC and set aside funds for libraries to defray a portion of the capital costs libraries must incur to connect to the network. Today, over 70% of the state's 1,100 library facilities (across 184 public library systems) use CENIC.

The upgrade in network speed is immense. In 2014, libraries nationwide reported a [median network speed](#) of 30 Megabits per second (Mbps) for wireline service. Given that network speeds tend to double every 21 months, median network speeds for libraries today nationally may be approaching 100 Mbps. CENIC network speeds can reach 100 Gigabits per second (Gbps); that is 1000 times faster than 100 Mbps. Not all libraries have 100 Mbps service and not all California library facilities can support 10 Gbps. But nearly all have or will receive at least 1 Gbps. CENIC finds that, of the [first one-third of California libraries](#) connected to the network, the average speed increased from an average 76 Mbps to an average of 2,001 Mbps.

Given that CENIC changes libraries' bandwidth by orders of magnitude, this opens the door to fundamental changes in how California libraries use digital tools to serve their communities.

What follows are just a few examples—and by no means a comprehensive survey—of what is happening with CENIC in some libraries around the state.

Virtual Reality: Bringing virtual reality (VR) technology into libraries is a prominent theme in several California libraries connected to CENIC. At the Marin County Free Library, interest in VR began in 2016 as a way to expand educational opportunities in the county.

Marin has a diverse population. Some homes have high incomes and an abundance of tech gear for family members; other households are low-income and have a dearth of tech devices and digital skills.

Although the bandwidth that the CENIC network brings was a necessary condition to get the ball rolling, it was not sufficient. For starters, the library needed funding for computing equipment and other peripherals that make VR systems work. The Marin library first sought a grant from

the Knight Foundation, but did not win the grant. The California State Library filled that void with a grant to help the library purchase computers with sufficient capacity to handle VR software.

The initiative also needed additional equipment and educational content for VR. For that, partnerships were paramount. The library entered into a relationship with Oculus, a maker of VR hardware and software, and HTC Vive, a VR equipment maker. As to content, the Marin library worked with New Media Learning, an initiative aimed at bringing project-based computational learning to schools. Those elements, in combination with an active youth tech program at the library, helped bring the VR project to life at the Marin County Free Library.

What started as a pilot project in the Marin County Free Library has become a statewide undertaking. In 2017, the California State Library [announced](#) a partnership with Oculus to bring virtual reality programs to nearly half of all California library jurisdictions. Roughly [100 library facilities](#) currently participate in this initiative.

Virtual reality is also a programming theme in the Los Angeles Public Library. At the LAPL, linking VR to education is part of the library's [Science, Technology, Engineering, Arts, and Mathematics](#) (STEAM) programming. Similar to Marin, LAPL uses Oculus and HTC Vive products for programming, with a particular interest in using the technology for immersive learning.

Another VR initiative at the Chula Vista Public Library has an intergenerational focus. The library's "[One Mile](#)" program refers to the familiar phrase of "walking a mile in another person's shoes" to convey the importance of understanding someone else's point of view. The project uses virtual reality, video, and story-telling to connect immigrants in the United States to

their countries of origin. One application has grandparents and grandchildren use virtual reality goggles to jointly take a walk through, say, Mexico City (where the grandparent grew up).

The interest in using virtual reality to help recent immigrants has taken hold in other libraries around the state. In northern California, the Sutter County Public Library has used VR to help different immigrant groups convey the realities of their homelands to fellow students. With twelve different languages spoken in the region, the VR program allows an immigrant from Afghanistan to show her home to one from, say, Central America—and vice versa. This program serves approximately 600 adult learners per year.

Gaming and Rural Libraries: Like many library systems in California, Sacramento Public Library has a diverse set of interests it has to serve—and rural areas come into play prominently.

Some two-thirds of its 28 libraries have CENIC connections with several rural ones still unconnected. However, one CENIC-connected library in the town of Galt shows how bandwidth can impact the community's library services. The CENIC bandwidth has enabled gaming programs for young students in Galt, many of whom come from low-income households. Some 12-14 kids at a time gather in the town's library to play Minecraft, using connectivity and hardware that they lack at home. Not only do they learn about technology while having fun, the program helps foster a sense of community in Galt, as many of the kids (and their parents who often accompany them) have met each other for the first time through this program.

The story is similar in the Sutter County Public Library, where teens gather for gaming competitions in the library, in part to take advantage of a fast network that they generally do not have at home. To make this an activity for the entire family, the Sutter County Public Library also makes “retro” games available (such as PacMan) so that kids and parents can experience the electronic games their parents did in the 1980s or 1990s.

Learning: This foundational part of the library's mission can take on new meaning when a library has abundant bandwidth. In Sacramento, the library has used the service Twitch to host author visits for book releases. The CENIC bandwidth makes this possible, as the Twitch.tv service offers dedicated channels for an author to deliver remarks. It also allows

the audience assembled at a library to have an interactive experience with the writer. At the Los Angeles Public Library, CENIC has enabled question and answer sessions for the public with officials at NASA's Jet Propulsion Laboratory about the Mars Rover. The Central Library also has a 28 foot video wall which the CENIC bandwidth makes possible.

Libraries could also, as they contemplate future uses for CENIC bandwidth, encourage citizen science on the network. Because California's public research institutions are on CENIC and conducting data-intensive research, library users could participate. Scientists at California universities have numerous research projects underway that place sensors on the ocean floor, collect data about weather, wildfires, and seismic activity. Libraries could provide tools for patrons to visualize the data, which in turn would enrich and enhance the learning experience for students.

Real-time cultural events are another use of CENIC bandwidth for libraries to consider, leveraging the symmetrical nature of the network. As one example, the San Mateo County Library, in 2015, let users to view [a live stream](#) of the Music of Michael Jackson event put on by the SFJAZZ Collective. In a state with a large variety of cultural institutions, such as the Getty Museum in Los Angeles, the Monterey Bay Aquarium, and more, there is ample opportunity to share those amenities with library users using the CENIC network.

In rural libraries, interactive learning programs may take more time to develop, in part because of scarce staff resources in smaller libraries. In Sutter County, there is a clear desire to roll out interactive learning programs, using content from places such as The Exploratorium in San Francisco or the Library of Congress. However, the capacity for more digital programs does not automatically translate into such programs if staff does not have the time to run them. If it is not possible to hire new staff, then library leadership has to consider shifting staff responsibilities from old functions to new ones. That is not always possible – or possible to do quickly even when new digitally-oriented programming ideas present themselves.

An example outside of California shows how a high-speed network can impact educational and learning services. Kansas City was the first beneficiary of the Google Fiber initiative, by which Google wired all premises in cities with a high-speed fiber optic network. Community anchor institutions received fiber drops under the Google Fiber initiative and the Kansas City Public Library (KCPL) was particularly aggressive in exploiting the network's potential.

With more bandwidth, which enabled more staff and patrons to be online in libraries at the same time, the library became more organized in thinking about digital programs. Using funds from an Institute for Museum and Libraries Services (IMLS) grant, the library used the [Peer 2 Peer University](#) model for developing learning circles in Kansas City.

It is worth noting that KCPL also provides these online learning resources in community centers, as a way to “meet people where they are” with an emphasis on workforce skills. The goal in Kansas City has been to provide learning services that will really take them someplace in their lives and careers – not just random classes. In this context, a robust city-wide network to homes and institutions has helped KCPL improve the reach of its programs.

Internal benefits: Beyond services to the public, the CENIC network offers libraries significant improvements in their operations. For Los Angeles, the CENIC network has allowed the library to have virtual desktops at all library computers which saves time and manpower in pushing out software updates. Several libraries in Marin found that the public could use the internet while staff could check out books, something that was sometimes a challenge pre-CENIC. In Sacramento, the rickety “plain old telephone service (POTS)” system from more than a generation ago has been replaced by a Voice over Internet Protocol (VOIP) system. Beyond now having modern telephone capabilities, the new phone system saves the library a lot of money.

The internal benefits can be especially acute in rural libraries. Sutter County’s library had a network whose speed was advertised at 10 Mbps, but speed tests showed much slower speeds in reality. This made it difficult for staff to do work, with some staff members choosing to work at home where they had better network speeds. CENIC’s bandwidth removed the bandwidth

constraints and has substantially improved staff productivity. It has also brought people back to the library. The slow network at the Sutter County library made it difficult for patrons to carry out tasks on the library’s public computers. As the library’s network has improved, people began to come back to the library to use public computers—and even gather after library hours to take advantage of the Wi-Fi connection.

External benefits: At its core, CENIC is about providing additional bandwidth to libraries so that they can provide new and better services to their communities. But beyond that essential bargain, libraries highlighted other ways in which CENIC bandwidth can benefit a

community.

- *The local network:* As one interviewee noted, once a library decides to connect to CENIC, it is a fourteen step process before the network is lit up at the library. That means the process is complicated, but also requires cooperation to successfully navigate it.

Libraries may have to engage with local officials or network providers for funds for the last mile connections. In rural areas in particular, where distance or topography may mean a last mile drop is very expensive, this can be no small problem. Yet libraries and local officials often find ways to overcome this. In Yolo County, for instance, a [county broadband plan](#) helped identify network assets in the region, including CENIC. This, in turn, has made it possible to alleviate some costs for the CENIC circuit to rural library branches. It has also improved network access for the agriculture industry, which increasingly relies on online access for data and natural resource management.

- *Home adoption issues:* Once libraries have CENIC connectivity, they may encounter other issues that spark community discussion. One interviewee noted that bringing CENIC's bandwidth into a community may shine a light on broader community technology issues, such as low levels of home broadband adoption. The gaming programming in Galt was popular in part because players did not have the home access or hardware to play at home.
- *Demonstration effect:* Without CENIC bandwidth, many people would not have any exposure to virtual reality or gaming applications. This may be especially true in rural areas where home broadband speeds may not be very fast. Given the novelty of VR, especially in the educational setting, it may be difficult for private sector developers to understand users' reaction to their products. This is where the advantage of libraries

partnering with HTC Vive and Oculus comes into play. Cutting-edge products often need lead adopters to demonstrate to others that the product is worthwhile. Exposure to VR at the library is, for many users, a way to evaluate VR products. The demonstration effect extends to library patrons using digital tools to create and share content. At the San Francisco Public Library, "The Mix" is a program by which teens use computers, creative maker equipment, audio/video devices, and other digital tools for a variety of creative

endeavors.

- *Security*: A final external benefit comes from the fact that CENIC brings a secure, public, and very high-speed network into a community anchor institution. In Sacramento (and other places around the state), the CENIC network makes the public library an attractive place to be a voter service center for California elections, which are moving to vote-by-mail by 2020. The library is a trusted place to drop off ballots and vote in-person using electronic voting machines. In Humboldt County, public officials see the CENIC network as one they can rely upon in case of an emergency or natural disaster.

### **III. Getting more out of CENIC**

The examples noted above demonstrate the exciting possibilities that a huge bandwidth boost offers to libraries. But integrating new technology into any organization takes far more than opening a box and turning on a switch. California public libraries are no exception and the challenges unfold in a number of ways.

*Equipment & internal wiring*: Libraries may have old computers running on operating systems that balk at applications that run on networks as fast as CENIC. Interactive gaming may run very well over a fast network such as CENIC, but then hit a bottleneck once the data arrives at a relatively antiquated computing device. Several libraries noted the State Library was indispensable with equipment grants (e.g., Chromebooks) that allowed libraries to put the CENIC network to work for patrons.

Internal wiring is another issue. As one interviewee noted, some libraries are old Carnegie buildings dating to the early 20<sup>th</sup> century. Some may not have upgraded their internal wiring to support the bandwidth that CENIC brings, although many libraries report that the State Library provided grants for necessary switches or circuits.

*Thinking inside the network*: Prior to joining CENIC, libraries were mainly consumers of commercial internet services for their connectivity needs. Upon joining CENIC, they have become part of a network of over 12,000 facilities with 20 million users in the state. This gives public libraries a new relationship to other institutions and the content they create. Library patrons have the potential to experience or access digital content from the state's university system. The capacity of the CENIC network allows for content caches of high

resolution images and video—in ways that enhance verisimilitude for patrons.

Data and its growing role in society is another way in which libraries—situated in a broader range of CENIC institutions—can leverage new bandwidth. For example, CENIC-connected universities in California have created [WIFIRE](#)—a sophisticated tool to analyze wildfires and predict their paths. The main customers for WIFIRE analysis are government agencies, but libraries could be the vehicle to disseminate it to the general public. CENIC bandwidth would enable that, which could also have public safety benefits in communicating emergency response information to citizens.

Government data offers another way for libraries to extend the reach of CENIC institutions. Local governments collect large quantities of data about how a city or county runs. Many make this data open to the public, but citizens may not always be aware of that or have the skills to make the data usable to them. CENIC research institutions might create apps or visualization tools to help the public better understand what “open government data” means. Libraries, as trusted institutions, could use their CENIC-enabled networks to convey this to the public so that their understanding of these data tools improves – with greater civic engagement as a possible bonus.

Any discussion of data quickly goes to its security and the privacy of the people who use it. Libraries care deeply about users’ privacy, while perhaps lacking the staff capacity to stay current on a rapidly changing data security landscape. Here libraries’ membership in the CENIC community can be mutually beneficial. Libraries could benefit from the sophistication many research and educational institutions bring to data security, while those institutions could tap into the library field’s sensibilities about privacy.

*Staff and support:* VR, and other cutting-edge tech applications such as artificial intelligence and machine learning programs, are very “high touch,” as one interviewee pointed out. This means even libraries sophisticated enough to have such programming must have staff on hand to guide patrons through its use. In general terms, a large urban library may have the resources for a dedicated staffer for digital programs, but rural libraries may not.

Constrained staffing resources may also result in libraries new to CENIC focusing more on the internal benefits to library operation CENIC brings and less on new programming opportunities for the public. In any event, staff training is a necessity as new bandwidth-driven library programs emerge in light of CENIC connectivity.

The nature of information technology (IT) support also comes into play. Some libraries – usually the larger ones—have their own IT departments. This can improve how strategic planning unfolds for putting CENIC to work, as library personnel (both programmatic and technical) can work together on pursuing new opportunities that CENIC enables. In many smaller jurisdictions, IT support for the library is a municipal function. This can present problems to libraries if a city or county IT department does not place much priority on the library’s technology needs.

Yet it is not always an insurmountable problem. The Sutter County Public Library relies on county IT services, and the county staff did exhibit a learning curve as they responded to new tech needs at the library. But Sutter County’s IT department eventually became engaged supporters of library IT needs. In fact, with a fast network, new programs and equipment in areas such as virtual reality, the library often presented county IT staff “interesting problems” that they eagerly addressed.

*Last mile & network silos:* The CalREN network is about 8,000 miles of broadband infrastructure in California. This covers a lot of ground, but not all corners of the state. The backbone has to be connected to the facilities it serves in order to deliver its bandwidth. This “last mile” connection can be a logistical challenge and expensive proposition. This is especially the case in rural areas. Even if libraries have a willingness to foot the bill, there have been instances where no vendor steps forward to bid on last mile connections. That is because the amount a library has budgeted for the task does not cover the cost of deployment.

This means that rural libraries often have to be very resourceful in knitting the network resources together to get the most out of CENIC. In a rural area, the distance between the central branch, where the CENIC network connects, and other branches can be significant and “last mile” broadband links scarce. But it is not always the case that a rural library branch is in a network desert. Over the years, the state of California has built dedicated communications for a variety of initiatives, such as telehealth. As one interviewee noted, however, there is usually no way for these networks to connect to CENIC or to be leveraged to help a rural library branch connect to CENIC. This “siloed network” problem can attenuate the value of the CENIC network, especially in rural areas.

#### **IV. Jumpstarting the Future: Bridging the “bandwidth – imagination” gap**

When libraries experience the boost in network speeds that comes along with CENIC, two things generally happen in sequence. First, most herald the productivity benefits that result from speed boosts of one hundred times or more. After that, many libraries start to plan for a future with a wider range of services for the public that the faster speeds enable. Yet, there can be a time lag between the two events – a lag that might be considerable if a library focuses more on the productivity benefits of CENIC than planning for new programs and services. This dynamic is what one interviewee termed the “bandwidth-imagination” gap.

The preceding discussion suggests that there are steps that can ease the path from libraries getting a CENIC connection to using it to better serve their communities. From talking with a selection of libraries, here are a few ideas:

**Planning:** Libraries committed to integrating technology into how they serve their communities must undertake deliberate planning to make that happen effectively. Five years ago, the library in Marin County had little in the way of a technology plan to envision a future with pervasive and fast connectivity. Recognizing the diverse economic profile of the county, the library embarked on a strategic planning process that deepened how the library thought about technology in programming and service provision. A similar process unfolded in Sacramento, in which library leadership began to see the opportunities CENIC offered and moved to try to maximize what the library could get out of the higher speed network. In Kansas City, the dynamic was a little different. The leadership there was already fairly well attuned to digital services, but the deployment of Google Fiber prompted them to think more expansively and systematically about the services they could provide—particularly in the areas of learning and workforce development.

**Mechanisms for information-exchange:** Although CENIC offers libraries a huge improvement in network speed and capacity, the network does not come with a blueprint on how to use it. In California, given that CENIC has been rolled out to libraries in stages, there are early adopters with experiences to share with others. Interviews with library officials in California indicate that there is some informal information-sharing that has unfolded around CENIC network deployment. The CENIC annual conference was cited as a place to find ideas on how to use the increase in bandwidth for programs. However, a more formal process might be worthwhile, especially as smaller libraries come online with

CENIC. Since early CENIC adopters tend to be larger libraries, having peer-to-peer sharing about CENIC among libraries of similar sizes may be helpful.

**Innovation for libraries:** Spurring libraries' imaginations about how to embrace the abundant bandwidth also requires content and programs that inspire. One interviewee suggested that there needs to be a [CineGrid](#) for libraries. CineGrid is a non-profit organization that serves essentially as a lab to engage in "research, development, and demonstration of networked collaborative tools to enable the production, use, preservation, and exchange of very high-quality digital media over photonic networks."

Although precisely how such an innovation lab would work for libraries is an open question, it is a mechanism that is familiar in other contexts. [US Ignite](#) is a non-profit organization that supports the emerging apps ecosystem for smart cities. It receives funding from the National Science Foundation and grants from private foundation. In addition to partnering with universities for technology development, U.S. Ignite seeks to [match city technology needs](#) to the ecosystem of developers working on smart city technologies. The [Manufacturing Extension Partnership](#) (MEP) program is another example of an initiative to disseminate innovations. This is a federal-state program, with a \$140 million FY 2018 budget from the U.S. Commerce Department. MEP facilitates technology transfer to small and medium-sized manufacturing businesses so they can stay current on new manufacturing techniques.

Planning, sharing information, spurring and disseminating innovation all work together. Planning with an orientation toward the use of high-speed networks will inevitably benefit from understanding the experiences of other libraries. And understanding the digital tools—the software and hardware—available for libraries is something an innovation lab can help facilitate. Initiatives such as US Ignite also bring all parties in the ecosystem into the innovation process. This gives California library users, potentially, a central role in innovation for VR and other bandwidth-intensive educational applications.

"The future is already here—it's just not evenly distributed." This memorable phrase uttered by the writer William Gibson captures the excitement of the new, while begging the question of how and *how fast* the future eventually arrives to everyone. This exploration of public libraries in California shines light on the steps the library community is undertaking to

accelerate widespread dissemination of CENIC's benefits. They include: complementary investments funded by the State Library, partnerships, sharing information, and local library planning. These are the ingredients that can help libraries use the CENIC network to be the underpinning for next-generation library services for Californians.