THE NEXT GENERATION NETWORK CONNECTIVITY HANDBOOK

A Guide for Community Leaders Seeking Affordable, Abundant Bandwidth

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Gig.U: The Next Generation Network Innovation Project

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Dedication

This Handbook is dedicated to the hundreds of city and university officials, particularly participants in Gig.U, who over the last five years, as we explored many routes, helped guide us to significant course corrections and created the map for community-led broadband.

It is also dedicated to the thousands of citizens who attended scores of meetings with us on community-led broadband, in cities large and small, in every part of the country, and who provided many insights we incorporated into our work and into this Handbook. Many of their words were wise, but none were wiser than those offered by a student at an event at the University of Maine, who, after noting all the specific reasons he was excited about having access to abundant bandwidth then said, **"But what is most exciting is what we don't yet know."**

It is further dedicated to the memory of Charles Benton, a wonderful friend and coach to the Gig.U project, and many others seeking to improve the capacity of communications networks to serve all. His energy and excitement about discovering 'what we don't yet know' served, and will continue to serve, as the most important type of fuel for the work of bringing affordable, abundant bandwidth to our communities.

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About this Handbook

This is a handbook for city officials seeking the affordable, abundant bandwidth their communities will need to thrive in the decades ahead. Designed for local decision makers, it reviews the current landscape of broadband networks, including next generation, gigabit capable networks, outlines best practices, summarizes existing models, and presents a framework through which community leaders might begin preliminary project steps given their city's specific strengths and circumstances. Our purpose is to lower the initial, daunting information barrier that exists between cities already immersed in these Internet infrastructure issues and those just beginning to navigate them.

The Handbook itself is an outgrowth of the many discussions between Gig.U and others deeply knowledgeable on municipal issues, in which it became clear that cities would benefit from a guide to stimulating new investments in 21st century information infrastructure. One of the key insights city officials provided concerned the importance of the many linkages between deploying such information networks and other municipal policies, including those affecting construction, transportation, housing, and economic development. As a result, at the heart of the Handbook are two critical and related tasks for the city: **understanding** how its practices affect the economics of deploying and operating next generation networks, and **organizing** its assets, practices and people to improve its ability to negotiate with third party providers or deploy a network itself.

Given the pace of change, this second edition of the Handbook provides a "snapshot" of information for city leaders as of the end of 2016. We anticipate future updates in response to new products, evolving technology, new lessons, and feedback from partners and readers. Our country is still early in its journey to assure that all have access to next generation bandwidth. While cities have led in the efforts to date, most still have not yet started down this path. As they do, we hope this Handbook helps them, and in turn, that their collective experiences will improve this resource, and ultimately bring all closer to affordable, abundant bandwidth now and for generations to come.

Gig.U is a coalition of research university communities seeking to accelerate the deployment of next generation broadband networks to support economic growth and educational innovation. Since Gig.U was formed in 2011, over two-dozen Gig.U communities have started or participated in next-generation network initiatives, in which over 50 additional cities have joined. **Information about the project can be found at gig-u.org/the-handbook/.**

Benton Foundation works to ensure that media and telecommunications serve the public interest and enhance our democracy. It pursues this mission by: 1) seeking policy solutions that support the values of access, diversity and equity; 2) demonstrating the value of media and telecommunications for improving the quality of life for all; and 3) providing information resources to policymakers and advocates to inform communications policy debates. **For more information, visit benton.org.**

Overview: The Underlying Equation

Our conversations with city officials and community leaders always begin with the same question, "Are the broadband networks in your city good enough for it to thrive ten years from now?"

The answer we always heard back was "no." And then the work would begin, with city staff asking us a series of questions designed to figure out how to accelerate the deployment of next generation networks and turn that "no" into a "yes."

What is Community-Led Broadband?

Many terms have been used to describe efforts by communities to improve the options their residents and enterprises have for broadband services. One common term is "municipal broadband," though that generally means the municipality deploying, operating, and offering a broadband service. We prefer the phrase **"community-led broadband"** to signify the community taking an active role in accelerating the deployment of next-generation networks, and consciously making choices about how those networks can best serve the public good, as illustrated by the many examples presented in this Handbook.

This Handbook is organized along the lines of the questions Gig.U heard most often as we worked with over 75 communities on about two dozen projects. (See the Gig.U communities Project Status Chart on page 8.) Not everyone is interested in the same questions. For example, city mayors might be most interested in the sections on why cities upgrade; their staff might focus on what's been done and first steps; and city lawyers might focus on the issues involving public-private partnerships.

While we hope all communities can benefit, the Handbook is primarily focused on community-led broadband. Such efforts are generally achieved though some kind of public-private partnership, meaning, at its most basic, an arrangement by which the city negotiates with a private party to achieve some public purpose. In our case, the purpose could include some or all of designing, deploying, maintaining, operating, and providing a retail service on the network. The private party can take many forms – including new entrants, incumbents, and nonprofits – and the relationship between the city and the private party can operate in many different ways. We acknowledge that some cities want to go it alone. While we describe some of these efforts, we acknowledge such efforts raise questions beyond the scope of this guide.

Whatever the nature of the partnership, and whatever the job of the person reading this, all readers should understand the underlying core question of economics. Specifically, why are current market forces not producing the affordable, abundant bandwidth that communities seek and that next generation networks can deliver?

In a way, the answer is simple. While the benefits to the community of constructing a gigabit or next generation network may be great, the benefits to private providers are generally less than the cost. We have found it helpful to break that simple cost-benefit idea into the following equation:

Figure 1: Broadband Cost-Benefit Equation

That is, for all the current and potential providers, the sum of new or incremental capital expenditures and operating expenses for a next generation network is greater than the new or incremental risk-adjusted revenues, plus system benefits (the benefits to the service provider's overall system beyond the local network), plus the threat of competitive losses.

That equation, however, can be and has been reversed by many cities, much in the way that cities often negotiate with private real estate developers and potential facilities locations to make an otherwise difficult investment possible. At the heart of these negotiations, and indeed every business negotiation between partners, is a search for asymmetric value creation. That is, the opening question is what can party A do that costs relatively little but creates a larger benefit to party B, so that party B will act in a way to benefit both party A and party B.

Here, both the city and a potential provider want to improve the investment opportunity in next generation broadband networks. The question is what can the city do, at a minimal cost to the city, that provides a larger benefit to the partner, that in aggregate reverses that equation by reducing capital expenditures, operating expenses and risk and increasing revenues, system benefits, and competition (Figure 2).

The first step, therefore, is for the city to understand how its policies and practices affect the economics of deployment and what actions it can take, at minimal cost, to improve those economics.

This leads to a second, and related, step. The city needs to organize itself in a way that improves those economics while also improving its own leverage in a negotiation. To attract any investment into next generation networks, the city has to do a certain minimum in terms of improving the economics for the network. To maximize its ability to negotiate certain terms, however, it has to have leverage in the negotiation. For example, many cities want commitments to serve certain areas or facilities. The more the city has done to lower the costs of deployment or organized demand for the new offerings, the more willing the private provider will be to agree to such requests. Further, the more the city does to attract competitive offerings, the more likely it is that the city will be able to further its own goals in the negotiation.

This Handbook provides numerous strategies and tactics that build on the economics and help create leverage. No two cities will walk the precise same path. But all can benefit from learning how other cities have traveled up this mountain. And all should understand this: actions taken today will affect what kind of broadband networks the city has in ten years, and in ten years; whether it has faster, cheaper, better broadband networks will affect everything that city does.

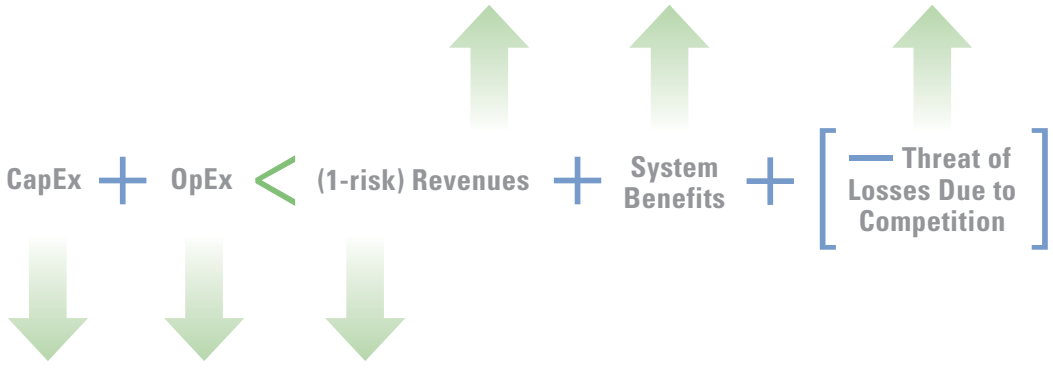

Figure 2: Revised Broadband Cost-Benefit Equation

Gig.U Status as of Spring 2015

UNIVERSITY	COMMUNITY	STATE	METHOD	STATUS
Virgina Tech	Blacksburg	VA	PPP	Downtown Gig Zone
Michigan State	East Lansing	MI	PPP	Local ISP Offering
U of Florida	Gainseville	FL	Local Utility	Innovation Zone Network Built
U of Louisville	Louisville	KY	RFP	3 New Entrants Building Gig Networks
U of Kentucky	Lexington	KY	RFP	Pending
Texas A&M	College Station	TX	RFP	Incumbent upgrade to Gig
U of NC	Chapel Hill	NC	NCNGN	AT&T and GF Deploying
NC State U	Raleigh	NC	NCNGN	AT&T and GF Deploying
Duke U	Durham	NC	NCNGN	AT&T, GF and Frontier Deploying
Wake U	Wake-Forest	NC	NCNGN	AT&T Deploying
ASU	Phoenix	AZ	GF	Negotiating with GF
Georgia Tech	Atlanta	GA	GF	AT&T and GF Deploying
U of Chicago	Chicago	IL	Legal Reform	Telco Upgrading Network
U of CT	Storrs, New Haven, 44 other cities	CT	State RFP	RFP in Process
U of Missouri	Columbia	MO	RFP	Developing RFP
U of Montana	Missoula	MT	Study	Study Complete; developing response
U of New Mexico	Albuquerque	NM	RFP	Developing RFP
U of Illinois	Cham/Urbana	IL	RFP	Local ISP Developing Network
Case Western	Shaker Heights	OH	PPP	Pilot Project with Non-profit
U of WV	Morgantown	WV	PPP	Spectrum Based Pilot Operational
U of Washington	Seattle	WA	Legal Reform	Telco Upgrading Network
U of Maine	Orono	ME	PPP	In Discussions, Spin Off Projects
Colorado State	Ft. Collins	CO	Study	Council Authorized Study of Options

GF: Google Fiber

NCNGN: North Carolina Next Generation Network

PPP: Public Private Partnership

RFP: Request for Proposal

Figure 3: Gig.U Status as of Spring 2015

Why Upgrade? Why Now?

The reasons to upgrade overlap multiple sectors and policy areas:

- Economic Development
- Public Safety
- Telemedicine
- Technology
- e-government
- Distance Learning and Education
- Job Training
- Improved Pricing and Competition-Driven Innovations

As noted earlier, the first question is always, "Does your city have the broadband network it needs to thrive ten years from now?"

If the answer is "Yes," stop reading. If you think you have everything you will need in the future, there is no need to act.

If the answer is "No," however, then the time to begin thinking about faster speeds, more competition, and better service is now. Network upgrades do not happen overnight. Many decisions your city will make over the next several years will affect what kind of network -- and city -- you have a decade hence.

When Google Fiber released its Request For Information (RFI) in 2010, over 1,100 municipalities stepped up and articulated their desire for next generation networks. In doing so, leaders at the local level started to think about how their community's infrastructure was a catalyst for economic, educational, and governmental innovation. Since 2010, growing numbers of communities have considered either investing in public networks or negotiating with companies like Google Fiber, AT&T, CenturyLink, and many smaller players to achieve desired high-speed access. Though these upgrades are happening city-by-city and slowly (for now), each new deployment pushes gigabit networks from novelty to competitive necessity. How will your city compete for, or retain, investment and human capital alongside Chattanooga, Kansas City, Austin, Leverett, Wilson, Nashville, Charlotte, Raleigh, Provo, Atlanta, and others with world-leading networks?

The Economic Case for Faster Speeds

There have been a number of studies linking broadband networks and new investments in such networks to improved economic performance. In September 2014, the Fiber to the Home Council released a study demonstrating higher per capita gross domestic product (GDP) in communities where gigabit Internet was available. Infrastructure investment, job creation, entrepreneurship, and companies relocating or expanding to your city are all manifestations of this growth.

The Quality of Life Case for Faster Speeds

According to RVA Market Research & Consulting, residents with fiber-to-the-home work an average of 1.3 extra days at home each month and about 14% have home-based businesses resulting in over $10,000 in extra income for the household. Given that the average consumer spends over five hours per day online at home and has multiple online devices, this infrastructure is only growing more valuable and more necessary. In fact, RVA found that high speed Internet capacity was often one of the highest or the highest consideration when residents evaluated neighborhoods, households, and multi-dwelling units (MDUs).

In terms of a community's quality of life, better, faster, cheaper networks also could mean great benefits for community anchor institutions. New possibilities for learning and efficient service delivery would open up to local schools and libraries, especially. The Schools, Health & Libraries Broadband (SHLB) Coalition is making this exact case in their recently launched Grow2Gig+ campaign and *Connecting Anchor Institutions: A Broadband Action Plan,* published by the Benton Foundation.

Why Not Wait for Google Fiber?

As proponents for communities having affordable, abundant broadband networks, we are happy for the eight metro areas where Google has deployed fiber. For the sake of other communities, we also hope that Google announces it will expand its fiber footprint both for the new option and the competitive response Google Fiber has stimulated.

Hope, however, is not a strategy. We don't know (and we suspect Google does not know) how extensive its deployment will be. (For more on Google Fiber and its evolving strategy, see Box on page 16.) It does not take inside knowledge (and we have none) to look at Google's deployments to realize that it, like its competitors, looks at a number of factors, including scale, regional growth rate, deployment costs, labor availability, density, pole attachment opportunities and others, to determine whether and where to expand. While some have speculated on 'if' and, if so, 'how' Google moves forward, even those communities that believe they fit the pattern, would, in our view, be making a mistake to rely on a future Google decision that may not happen.

Further, nothing in a community-led broadband effort is inconsistent with a future Google decision to invest in your city. We admire Google's transparency in telling communities how to make themselves "fiber ready" both with a technical guide and a check-list. Nothing in this Handbook is inconsistent with the approaches of those guides, and we have relied, both in Gig.U efforts and in writing this Handbook, on insights the guides have provided. Indeed, having a number of cities move ahead in the ways detailed here probably increases the odds of Google expanding as well as accelerating the competitive response. So our advice plays off the Talmudic wisdom to "pray as if everything depends on God; act as if everything depends on man." Hope for Google Fiber to continue its efforts, but act as if your fate is in your own hands.

The Bottom Line: If Not Now, When?

The bottom line is this: ten years from now, many critical things a city and its residents can do, and the attractiveness of the city from many perspectives, will be affected by the quality of its broadband networks. Every city will want the affordable, abundant bandwidth that does not constrain innovation, economic growth, or social progress.

It is also true that many things cities do today – in terms of zoning, construction, permitting, rights-of-way management, and other traditional municipal activities – will affect what kind of broadband networks it will have in ten years. In this light, the time to begin thinking about what a city can do to assure that all its residents and enterprises will have affordable, abundant bandwidth is now.

More Economic Studies on Broadband

The Broadband Bonus: Accounting for Broadband Internet's Impact on U.S. GDP
Shane Greenstein and Ryan McDevitt

The Substantial Consumer Benefits of Broadband Connectivity for U.S. Households
Mark Dutz, Jonathan Orszag and Robert Willig

Broadband Investment
US Telecom

Where the Jobs Are: The App Economy
TechNet

The Impact of High-Speed Broadband Availability on Real Estate Values: Evidence from the United States
Gabor Moinar, Scott Savage, Douglas Sicker

What's Been Done?

The following section summarizes the most notable work and trends in local next generation networks as of the end of 2016. The first step to considering an upgrade for your city begins with a general understanding of the best practices and wide variety of successful methods that can be replicated. Although there is no one-size-fits-all solution to attracting or deploying gigabit networks, becoming informed about the successes and failures in similar locations can illuminate potential paths for your city.

Community-Led Gigabit Fiber Success Stories

Google Fiber has been an exciting narrative, but it is not the only gigabit story holding promise for bandwidth-hungry communities. Many communities, rather than wait for an Internet service provider (ISP) to provide a solution, have become pro-active and succeeded in stimulating new, largely private, investment into broadband networks. The innovative, alternative models for building and operating gigabit networks are diverse in approach and strategy, but, as we've learned, encounter similar issues along the way.

Models: Trading Off Risk and Control

Every network deployment involves a number of components – design, constructing (which itself can be broken down into many subparts), operating, marketing, and financing, to name the major ones. And, while city efforts to date reflect elements unique to specific circumstances, all nonetheless face a fundamental question: what roles should the city play in the project?

As cities approach this question, the basic trade-off involves risk and control. The greater the roles, the greater the control, but also, generally, the greater the risk. What we have seen in community-led efforts are a variety of ways cities seek to balance the two factors, often reflecting local history and preferences, as well as opportunity.

But what is generally true may not be true for a specific city. For example, playing the primary role of designing and building out a network may be high-risk for some communities, but much lower for those with municipally-owned and -operated electrical utilities, or where a federal grant paid for an initial design and build. Similarly, some cities that are highly attractive to private sector ISPs can have a high level of control, even if they play none of the roles, by using various governmental levers in a competitive process. Others may have to give up all control to attract a private entity willing to deploy a gigabit network.

While we see a spectrum of how cities approach the fundamental trade-off question, their "answers" typically fall into one of three basic categories:

1. Primary: The city plays the primary role by using public facilities to invest in telecommunications as public infrastructure;
2. Partial: The city plays a partial role, but relies heavily on a private partner, particularly for operations, marketing, and financing; and
3. Facilitator: The city uses governmental and other levers to facilitate the ability by private sector partners to play all the roles.

Within each of these basic categories, there are other levels of common concern, the most significant of which are:

• Partnerships: With whom should the city partner – a local or national ISP or a nonprofit?
• Phasing: Should the city build-out incrementally or have a plan to build throughout the whole community from the beginning?
• Scale: Should the city scale the project on a local, regional, or statewide basis?

We describe some of the initiatives below, organized by degree of "city role level" (Primary, Partial or Facilitator). For additional analysis of these models, one can also read "Successful Strategies for Broadband Public-Private Partnerships," published by the Institute for Self-Reliance (available here), which provides a detailed explanation of some of the most important models for next generation broadband deployment. The Coalition for Local Choice wrote a report, *The Emerging World of Broadband Public-Private Partnerships: A Business Strategy and Legal Guide,* published by the Benton Foundation.

PRIMARY: The City Plays the Primary Role by Using Public Facilities to Invest in Telecommunications as Public Infrastructure

Some cities, particularly those with a municipal utility whose assets can be leveraged to build and operate a network, choose to play a primary role in deploying and offering broadband services.

Investing in the Entire Community: Chattanooga, TN

In 2010, Chattanooga became the first city in the U.S. to have a gigabit network available to its homes and businesses. The city did so by building its own fiber-to-the-premises network as part of a holistic smart grid strategy. Chattanooga has had its network, EPB, long enough that other cities can look to it for evidence of the qualitative and quantitative benefits of next generation speeds. Since service began, both Volkswagen and Amazon have moved into Chattanooga. Also, initiatives like GigTank have developed to foster the city's budding start-up community. In his 2012 New York Times op-ed "Obama's Moment," columnist Tom Friedman pointed to Chattanooga EPB's innovative ripple effect: "That network was fully completed thanks to $111 million in stimulus money. Imagine that we get a grand bargain in Washington that also includes a stimulus of just $20 billion to bring the 200 biggest urban areas in America up to Chattanooga's standard. You'd see a 'melt-up' in the U.S. economy."

Following Chattanooga's lead, other cities have also invested in a telecommunications utility model, such as in Leverett, MA, and Wilson, NC.

Ammon, ID

The small community of Ammon, Idaho, has joined the ranks of communities with the fastest broadband in the United States with a city-built fiber network. It follows in the Stockholm model of providing the underlying fiber, but offering residents the ability to choose and switch ISPs instantly on a city website. As is often the case with rural municipal projects, the community decided to go ahead with its own deployment when it could not get the commitment of the incumbent telco to upgrade its network. The city projected it would need a 50% market share to be economically viable and it has obtained a 70% share.

Huntsville, AL

In February 2016, the city of Huntsville, Alabama, announced that its municipally-owned electric utility, after planning a fiber network for its own purposes, will lease its fiber lines to Google, and possibly other third parties. Huntsville could constitute the real deal and represent a new model for Google Fiber expansion and a potential model for other communities.

The Huntsville model changes Google's path to scale as it potentially decentralizes construction efforts to multiple cities. Further, it represents the first effort by a major company to decouple ownership of the fiber network from providing Internet services.

The model also provides cities a new tool to accelerate the delivery of abundant bandwidth to their residents. One can see a number of forces—cities, construction companies, finance companies—joining together to construct and, in many places, complete dark fiber networks far faster than Google Fiber has been doing with its current model. The new model also allows a city to address a number of city-specific policy objectives, such as establishing enterprise zones and closing the digital divide, along the way. This path resembles how America built out its electric grid; through local rather than national efforts.

Some may argue Huntsville is unwisely investing in a "municipal broadband" project in which public money is unfairly competing with private. That characterization misses the point. Whatever one's view of whether cities should be in any business that private sector players enter, as a practical matter, it is a rare city that can be successful, as successful broadband network enterprises usually have to take on financial and marketing risk, as well as attract human resources and scale, all undertakings outside the core competency of cities.

The Huntsville model, however, does not require the city to take on those risks and tasks. Rather, it requires the city to do something it does well: civil engineering. Building a dark fiber network is similar to building a water or sewer system. It is in adding electronics, and operating, marketing, and servicing a fiber network, however, where most cities' skills will be sorely tested.

Further, the Huntsville deal furnishes any provider with the ability to lease the fiber. By applying the utility's standard terms and rates to different provider types, the fairness test is met and barriers to competition are lowered. Finally, the economics are compelling as the incremental cost of the dark fiber to be leased to Google and others is very small, in the context of the larger and necessary utility deployment.

Investing Incrementally: Gainesville, FL and Santa Monica, CA

Even if a city explores a public option for gigabit service, it doesn't have to go all in right away. Gainesville Regional Utilities (GRU) has connected businesses, community anchor institutions, and large apartment complexes around the University of Florida to 1 gigabit, 100 Mbps, and 10 Mbps speeds. Recently GRU extended its gigabit offering to all of the student apartments (37 complexes – roughly 6,000 ethernet ports) that it provides service to throughout the Gainesville area.

Santa Monica's City Net is another example of this incremental approach. The city built-out a fiber network without a municipal electric department (as was used in Chattanooga) and without issuing debt. The project started by connecting public facilities and then slowly expanded through a citywide "dig once" policy, meaning that as other construction or capital projects occurred, the city would lay conduit and fiber. According to City Net's website, the network now covers downtown Santa Monica as well as a "majority of multiple tenant commercial buildings." For more about Santa Monica's fiber story, see the case study written by the Institute for Local Self-Reliance.

PARTIAL: The City Plays a Partial Role but Relies Heavily on a Private Partner, particularly for Operations, Marketing, and Financing

While all models carry some level of risk for all parties, some cities have pioneered new ways of sharing risk so that the city focuses on what it does well and the private party takes on the risks and responsibilities more consistent with its own skill set.

Developing, then Finding, a Partner: Champaign-Urbana, IL, Westminster, MD, and Santa Cruz, CA

At the end of May 2014, UC2B – a nonprofit consortium led by the university communities of Champaign and Urbana and the University of Illinois – announced a new model for gigabit connectivity through a public-private partnership with a local ISP, iTV-3. Several years earlier, UC2B leveraged various federal and state grants and local matching funds to construct a high-speed fiber network – first building out in low-income and low-adoption

areas. The new public-private partnership means that iTV-3 will now operate the existing UC2B network and extend its service to even more residents, institutions, and businesses. Although the cities will not have control over the network or collect the revenue, the partnership succeeded in its goal of eliminating ongoing operating risk to the cities. In August 2016, UC2B released a request for proposal expressing interest in working with a partner to expand the existing network.

Another example is in Westminster, Maryland, a rural community about equidistant from Washington, DC, and Baltimore, but not located on any major highway that connects to those major metropolitan areas. Years ago, the city identified a fiber broadband network as a key strategic initiative and last year funded two fiber-to-the-premises pilots. Building on that experience, in 2015, the city adopted a plan to install fiber that it will fund, own, and maintain throughout the city. It has also entered into an agreement with Ting, a small but innovative ISP, by which Ting will pay to lease the fiber, bring in its own equipment, and offer gigabit service to residents and business. The city essentially treats the fiber as it does roads and bridges—having the responsibility for building and maintaining—while Ting focuses on operations and customer service. The structure reduces the city's risk while increasing its control.

In December 2015, Santa Cruz, California, struck a deal with a local ISP, Cruzio, forming a partnership in which the city would provide some dark fiber that the ISP could use to offer a gigabit-to-the-home service. In less than six months, Cruzio lit up its network and began offering service. Cruzio was able to offer the service in far less time than other gigabit projects by virtue of utilizing a millimeter wave fixed wireless solution.

Serving as the Anchor Tenant and Limited Partner: South Portland, ME

South Portland, Maine, held a competition in 2014, in which it agreed to be an anchor tenant for a next generation gigabit capable network, in exchange for a private party agreeing to build, maintain, and operate the network throughout the city. Under the agreement, the company would receive almost half of the nearly $300,000 municipal investment in fiber and associated equipment through a $150,000 up-front payment by the city for 20 years of service. The city would also share about 5% of the revenues of the network. South Portland awarded the contract to GWI, a Maine ISP. As part of the contract, GWI committed to an open access model. GWI is working with other cities in Maine to build networks with a similar financial structure.

Using a Nonprofit: Cleveland, OH

Cleveland benefits from the existence of OneCommunity, a nonprofit fiber network spanning 2,460 miles and connecting about 1,800 facilities. Started in 2003 and now run by former Case Western University CIO Lev Gonick, OneCommunity services the key anchor institutions in northeastern Ohio (government offices, schools, universities, hospitals, etc.) and collaborates with the local community on broadband adoption projects and digital literacy trainings. Currently, city officials in Shaker Heights are considering a partnership with OneCommunity to extend fiber into the city's commercial districts and attract more economic development. OneCommunity has also formed a for-profit subsidiary, Everstream, which will provide high-speed Internet to businesses – the revenue from which will be available to support the organization's nonprofit programming. In November 2014, OneCommunity announced plans to build a gigabit network to connect a three-mile Health-Tech Corridor in Cleveland. Other cities should note that this expansion is partially supported by a U.S. Economic Development Administration (EDA) Grant – another federal resource that can be leveraged for these kinds of projects.

FACILITATOR: The City Uses Governmental and other Levers to Facilitate Interest by Private Sector Partners to Play All Roles

Other cities choose to adjust their policies in ways that change the economics of deployment, facilitating private actors who then undertake the deployment and operations of the network.

Adopting Best Practices that Assist Local ISPs: East Lansing, MI

Uniting a diverse group of stakeholders under its "Gigabit Ready" effort, Lansing created an attractive environment for its existing ISPs to upgrade. The Lansing Economic Area Partnership (LEAP), Michigan State University, nonprofits, and commercial property managers came together in 2012 to lower barriers to high-speed broadband deployment. To align incentives and capitalize on their unique partnership with local development companies, the Gigabit Ready Coalition created a Gigabit Certified Building Program operating similarly to the well-known LEED program. Now, local ISP Spartan-Net, and property manager DTN Management Co., have partnered to bring gigabit speeds to residences and apartment complexes in East Lansing.

Using the Competitive Process to Stimulate an Upgrade in a City: Louisville, KY, and College Station, Texas

Initial demand for faster speeds was fostered and articulated by Louisville's residents, academics, and the business community. To translate those voices into action, local advocates launched Louisville Fiber — a web-based tool that allowed residents who wanted a gigabit fiber network to input their address. The resulting heat map was informative for policymakers and also visualized demand for prospective vendors.

The city government released an RFI in November 2013 and received six responses. The RFI pushed Louisville to confront its fiber-readiness. It made adjustments to its plans in order to attract vendors, such as increasing the proposed franchise period from 15 to 20 years and reducing the bonding requirement, and issued an RFP. In July 2014, Louisville approved three new 20-year franchise agreements for fiber network build-outs — one with Louisville-based BGN Networks, one with London-based SiFi and another with New York-based FiberTech. It is also worth noting that Louisville has been flagged as a potential Google Fiber city as well, though, as discussed below in the sidebar on Google Fiber's Evolving Plans, there is some uncertainty as to how Google will proceed.

Similarly, College Station, Texas, home of Texas A&M, used a Request For Proposal (RFP) to test the market. In this case, the process stimulated an incumbent cable provider, Suddenlink, to respond by announcing it would spend $250 million to upgrade its company-wide network to make it gigabit capable. College Station will be the first Suddenlink market to see the upgrade, providing the community with what it believes it needs to keep, and attract, bandwidth-hungry businesses and residents.

Using the Competitive Process to Stimulate an Upgrade in a Region: North Carolina

The North Carolina Next Generation Network (NCNGN) project is a collection of four universities (Wake Forest, University of North Carolina-Chapel Hill, Duke, and North Carolina State) and six municipalities (Carrboro, Cary, Winston-Salem, Chapel Hill, Durham, and Raleigh) which shared knowledge and resources to release a single RFP. It articulated the region's objectives and sought vendors to build and operate a gigabit fiber network. The RFP was released in February 2013 and attracted eight responses. Since then, several of the NCNGN cities have caught the attention of major national providers. During the summer of 2014, Chapel Hill, Raleigh, Cary, Winston-Salem, Carrboro, and Durham finalized agreements with AT&T, which has begun to deploy. Further, Frontier Communications has launched a gigabit network in parts of Durham and a start-up, RST Fiber, has also announced plans to enter with a fiber offering. In January 2015, Google announced it would deploy fiber to the Research Triangle Park areas, which also prompted an announcement of additional hiring by AT&T to compete with Google and Time Warner Cable tripling its speeds.

Using the Competitive Process to Stimulate an Upgrade in a State: Connecticut

Connecticut is just beginning its upgrade journey, but the way it created a statewide conversation about faster speeds makes it a case worth following. In April 2014, the state hosted a conference on gigabit networks for municipal leaders. Then, in September, the mayors of West Hartford, New Haven, and Stamford announced the release of a joint RFQ ("Request for Qualifications"), inviting other cities to likewise express interest and share information. By December, 46 cities, constituting half the population of the state, had joined in the effort. In January 2015, the RFQ received 11 bids, which are now being reviewed. The intentional interaction between state and city-level officials is not only facilitating a conversation, it's creating a powerful network of stakeholders with a shared goal: that Connecticut be the first "gigabit state."

Google Fiber's Evolving Plans

Recently, Google Fiber announced it was postponing the deployment of fiber in some of its targeted cities as it explores opportunities to offer Gigabit services through a fixed-wireless alternative. (Google Fiber also announced some job cuts and a leadership change.) These announcements come on the heels of 1) the FCC approving a Google-supported plan to share spectrum in the 3.5 GHz band; 2) Google's announcement that it would offer a high-speed service to multiple dwelling unit buildings (MDUs) in some large cities -- including Chicago, San Francisco, and Los Angeles; and 3) its purchase of Webpass, an ISP that offers high-speed fixed wireless services in a number of communities, including San Francisco, Miami, and Chicago.

From this set of announcements, two different narratives have emerged. One view is that Google is slowly retreating from the access business and is looking for a face-saving way to provide some service to limited communities in a way that is significantly less expensive than a full fiber build-out. The other is that Google is putting a temporary pause on a limited number of communities but is, in fact, expanding the number of communities it can reach by developing a strategy that combines fiber with new wireless opportunities.

As of this writing, we cannot be sure which narrative is more accurate, though it is possible that both contain some truth. It is likely that the situation will clarify in 2017, as Google's testing in the 3.5 GHz band in 24 cities should be complete sometime in the middle of the year.

In either case, however, cities should still be proceeding with fiber-friendly policies, as such policies will be important for attracting affordable, abundant bandwidth, whether from Google, a telco upgrade, another fiber-based ISP, or a new generation of wireless providers. (See section on New Services that Benefit from Fiber, below.)

More to Come, and New Players Emerge

A few years ago, cities had limited, if any, models to consider if they wished to accelerate a next generation broadband network deployment. Now, they have many – and the age of experimentation is far from over. We are already in discussions with various communities who are considering tying together elements of different models to best meet their own needs.

Further, while Google Fiber and some large incumbent telephone companies are expanding their own fiber efforts, a number of smaller players are also experimenting with new ways to deploy next generation networks. As noted above, Ting, an innovative ISP with roots in both mobile and Internet services, is bringing gigabit networks to several smaller communities, including Westminster, Maryland, through a shared-risk model, and Charlottesville, Virginia, by buying an existing ISP and upgrading its network. Sonic.net, an ISP based in California, has plans to deploy gigabit-capable networks to ten communities in Northern California. C-Spire, a Mississippi-based Competitive Local Exchange Carrier (CLEC), ran a gigabit competition in that state and now is deploying to the six winners. Monkey Brains, an ISP in San Francisco, uses an advanced wireless radio, provided by a company named Siklu, to offer gigabit connectivity to residents in San Francisco. Brooklyn Fiber, a three-year-old startup, started rolling out a gigabit broadband service in early 2015 in Industry City, the Brooklyn complex of former warehouse buildings.

While cities should follow developments of community-led broadband, they should also note the private efforts of companies big and small, as they can provide insight into new technologies and business models to best address a city's future bandwidth needs.

What About Cable?

Most of the examples of community-led broadband in this Handbook involve the community working with a new provider, such as Google Fiber, a smaller ISP, or the incumbent telephone company. This raises an obvious, and important question: what about cable operators?

Cable provides a broadband service in all the communities discussed in this Handbook and Gig.U's philosophy was always to be business model and service provider agnostic. That is, we did not favor a particular model or type of provider; we simply wanted to create paths for communities to accelerate achieving the affordable, abundant bandwidth necessary to thrive. We approached all providers, including cable operators, about working with our communities to experiment with various paths forward.

Early on, we thought cable might be the most interested in such experiments as cable operators generally had the advantage of both faster networks and cheaper upgrade paths. In that light, we theorized, cable might welcome efforts that accelerated the demand for next generation bandwidth.

The theory proved to be wrong. Indeed, in a way we found ironic for enterprises that marketed a service based on the superior performance of its bandwidth, cable operators were generally dismissive of any need for more abundant bandwidth.

For example, in 2013, the Wall Street Journal reported that the then Time Warner Cable CEO said having fiber with gigabit speeds "ends up being more about publicity and bragging."

We don't question the sincerity of those views as stated at the time. But we also understood those views to reflect cable's comfort with a market structure in which it believed it had a clear advantage over its wireline broadband competition and that that advantage would allow cable to charge a premium for the scarcity value of abundant bandwidth. Given that comfort, we rethought our strategy to reflect the likelihood that cable would not move forward with deploying its own next generation networks until it faced competitive forces compelling it to do so. While we always welcomed cable's participation with our efforts, we focused on finding ways to either improve the position of the current bandwidth runner-up or bring in a new provider.

Subsequent events have reinforced that course correction. While cable has never been the first mover with a gigabit network, it has always responded to community-led efforts with significant speed increases. Comcast's emerging gigabit offerings across the U.S. have, through no coincidence, mirrored the geographic choices of Google Fiber's deployments and interest. Also, Comcast's more competitive gigabit pricing ($70 per month with a 3-year contract as of August 2016) has also mainly overlapped with Google Fiber's footprint.

We welcome this announcement and believe it confirms the fundamental equation and the role of the threat of competitive losses in improving the economics of next generation network deployments.

How Communities, Not Individuals, Buy Broadband

Cable's responsiveness also demonstrates something else at the core of community-led broadband efforts: **Broadband is bought as a community.** While individuals think they make a choice, the choice is bounded by choices the community makes.

To illustrate this, consider how at a Gig.U meeting several years ago, a cable company representative said the company could sell consumers in our communities a gigabit service for $7,000 a month, with a two year commitment. That company is now facing potential competition that will sell a similar product at $70 a month and what do you know? That cable provider now has announced it will soon sell a gigabit product at that price point now too.

What caused the difference? Was it some new technology or some other brilliant innovation by a company engineer? No. Rather, the difference lay in how a group of communities approached how they bought bandwidth by improving the math for the deployment of next generation networks. By making it possible for cable's competitors to deploy and operate a network more economically, it caused cable to respond, giving its residents faster, better, and cheaper options for broadband. Individual consumers may make the ultimate buying decision, but those choices are circumscribed by decisions made at the community level. Consumers in Durham, North Carolina, get the benefit of Durham's decision to participate in the NCNGN, but those options are not available to consumers in communities without such efforts.

That cable is now reacting to the efforts of Google Fiber, AT&T Gigapower, Century Link, and others with their own next-generation network offering is a welcome dynamic, putting communities in a stronger position to achieve affordable, abundant bandwidth. Still, we suspect to take advantage of that dynamic, communities will have to be proactive in changing the status quo.

City-Driven Wi-Fi Projects

Despite some high-profile failures in citywide municipal Wi-Fi several years ago (such as in Seattle and Philadelphia), recently, several smaller-scale projects have found their footing. Providing public Wi-Fi hotspots is not in any way equivalent to rolling out fiber-to-the-home gigabit service, but it can be part of any city's incremental connectivity plan – either as a stepping-stone to future, more robust offerings, or a complementary service to other offerings.

Partnering with Neighboring Cities: San Francisco and San Jose, CA

San Francisco and San Jose have partnered to allow citizens to securely access each city's public Wi-Fi networks. They jointly facilitated access to this seamless wireless access by using Hotspot 2.0 (also referred to as Passpoint), a technology that allows citizens to roam from one Wi-Fi hotspot to the other the same way cell phone users do with their mobile networks.

Leveraging City-Owned Fiber Assets: Boston, MA

In 2014, Boston launched the "Wicked Free Wi-Fi" project. The first site was the neighborhood of Grove Hall because of its concentration of low-income communities and its lack of Wi-Fi. The network spans 1.5 miles and serves about 10,000 individual users per day. Designed to supplement mobile use, rather than replace in-home broadband, the project connects users to the Web via the city's own high-speed fiber-optic network.

Creating a Pilot Innovation Zone: Blacksburg, VA

Blacksburg, home of the Virginia Tech Hokies, is also home to a free gigabit Wi-Fi network that covers about 40% of the downtown area. Initial funding to install the fiber at two locations was modest – just about $90,000 – and was collected through a crowdfunding campaign started by TechPad, a local co-working and hacking community. The network went live in the fall of 2013. The organizers intend to use the first few years of the project to gauge local demand for faster speeds and, with that knowledge, to transition to a sustainable funding model.

Using Advertising to Support Widespread Wi-Fi Deployments: New York, NY

In 2014, New York City announced an ambitious plan to erect 10,000 free public Wi-Fi hotspots on top of the city's old network of payphones. The LinkNYC kiosks, which started going live in January 2016, provide free high-speed Wi-Fi with a range of 150 feet (1); a touch screen for advertisements and local information (2); the ability to make free phone calls anywhere in the United States (3); a button to connect to 911 (4); and outlets for device charging (5). The kiosks design is Americans with Disabilities Act-compliant (6). The showcased advertisements are projected to subsidize LinkNYC (7) and bring in $500 million in revenue over the next 12-15 years. The initiative is a partnership between CityBridge (in which Google's city-oriented advisory business, Sidewalk, plays a major role) and the Mayor's Office of Technology and Innovation. Some questions have been raised about privacy, but design measures have been taken to address these concerns. For instance, the USB ports on LinkNYC kiosks can only be used for charging, not transferring data.

As of August 2016, LinkNYC had 300 kiosks in Manhattan and the Bronx, with Queens, Brooklyn, and Staten Island to follow. Generally, the project has been met with positive reviews and now other cities are exploring whether to follow this model with similar projects as both the economic and quality of life advantages of such an approach appear compelling.

New York City has a number of other broadband initiatives, including initiatives related to Wi-Fi in parks, Wi-Fi in Harlem, connectivity through community and senior centers, and the New York Public Library's Library HotSpot program, designed for patrons without home Internet. In a recent report on One New York City (pages 54-57) the City discusses these and other initiatives, such as investments in broadband in targeted broadband deserts.

Focusing on Tourist Areas Using Advanced Technology: Baltimore, MD

In February 2015, the City of Baltimore announced it would provide free Wi-Fi to the city's main tourist area, the Inner Harbor. While the City owns and operates its own fiber backbone, that network would not cover the entire area. Further, the City did not want to create any further construction disruption to the area so an additional fiber build-out was not an option. The City, working with a local ISP, turned to a high frequency radio solution built by an Israeli company named Siklu.

Turning Unused Spectrum into City Wi-Fi: Seattle, WA

In the Spring of 2015, Seattle's mayor announced a new Wi-Fi network in the city's site of the 1962 World's Fair. The network will use TV White Space technology to create a large, powerful wireless network for citizen use – reportedly capable of serving 25,000 users at once. The city is partnering with Microsoft to make this happen.

An Overview of Models

There is no silver bullet model when it comes to improving the infrastructure of your city to meet the demands of the Digital Age. Each approach comes with its own risks and rewards. **What will work for your city?**

CATEGORY	MODEL	BENEFITS TO CITY	RISKS TO CITY	RELEVANT CASES
Primary	1. Build and run a public network	• Local control • Universal coverage • Customer service and community accountability	• Financial return • Operational sustainability • Pushback from incumbents	• Wilson, NC • Chattanooga, TN • Bristol, VA • Lafayette, LA
Partial	2. Build and run a public network to businesses, innovation districts and/or community anchor institutions	• Local control • Leaves the door open for future expansion	• Financial risks • Operational sustainability • Pushback from incumbents	• Arlington, VA • Gainsville, FL • St. Louis, MO
Partial	3. Build and lease out public infrastructure to the private sector	• Potential increased competition	• Financial risks depending on vendor interest and city investment	• Huntsville, AL • Mesa, AZ • Santa Fe, NM • Westminister, MD
Facilitator	4. Facilitate a public-private partnership	• Little public investment or risk • Shared risk and reward across sectors and community stakeholders	• Uneven coverage • Lack of local control • Partnership conflicts going forward	• Kansas City, MO • Raleigh, Cary, Chapel Hill and Durham, NC (NCNGN) • Champaign-Urbana, IL • Louisville, KY • South Portland, ME
Facilitator	5. Adopt one, many or several incremental approaches to gigabit fiber-readiness	• Leaves options open for city unwilling to commit to public buildout or still seeking a private partner • Little public investment	• Incremental investment can be risky and unwise if it paves a path to nowhere– ex: a future private partner does not invest and the city has no plans to act alone	• Santa Monica, CA • San Francisco, CA • Boston, MA • NYC, NY • Los Angeles, CA • Bozeman, MT • Blacksburg, VA • Baltimore, MD
Preserve Status Quo	6. Do Nothing	• Zero public investment and financial risk	• Comparative disadvantage in the long-run	• Too many to count...

Figure 4: Overview of Network Models

Emerging Map, Including Cities to Watch

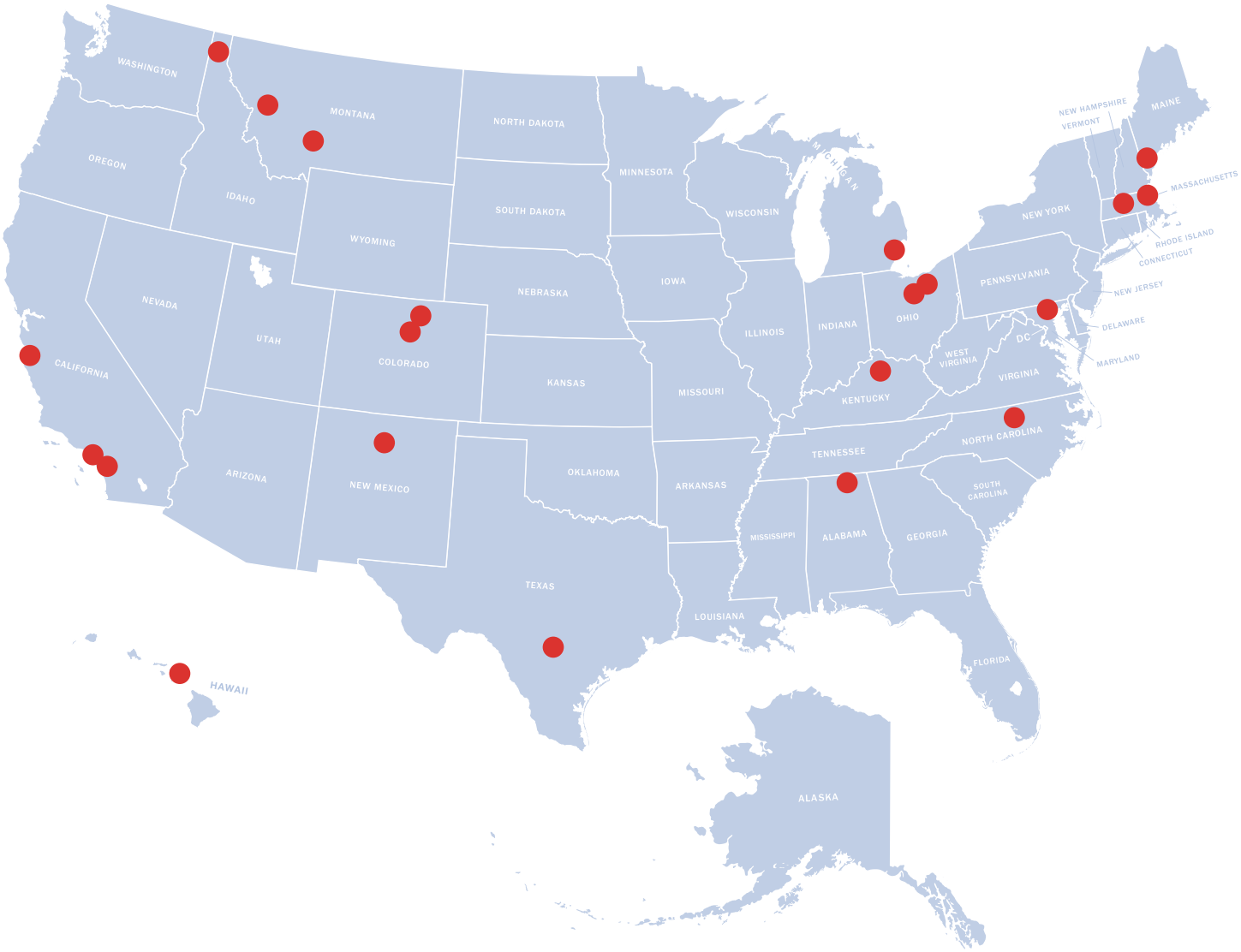

Figure 5: Maps of Cities to Watch

While the previous section summarized activities by cities fairly far along with their efforts, this section summarizes a variety of efforts that are at earlier stages, with the thought that communities using this Handbook can review the efforts of communities whose characteristics most closely match their own and benefit from learning how those efforts have progressed. We have also mapped those efforts with efforts already discussed to provide an overall view of community-led broadband efforts.

The cities in blue, listed in the chart on page 23, are just beginning their upgrade journey. All are in the preliminary phase – whether seeking a private vendor or planning to build their own municipal broadband system. In the coming months and years, it will be interesting to see the different methods, models, and partnerships unfold.

City	Details
Baltimore, MD	In 2013, Baltimore hired broadband consultant Magellan to explore the city's options for improving competition and speed. The city and community groups are still reviewing options.
Boston, MA	In July 2014, Boston released an RFI to expand its fiber network. The city is still reviewing responses. Neighboring Cambridge, MA, has also expressed interest in building public fiber infrastructure.
Boulder, CO	In 2014, 83% of Boulder voters voted to allow the city to pursue a municipal broadband network and the council is currently reviewing its options, including how best to leverage the 100 miles of fiber optic cables the city already owns and operates. In July 2015, Boulder released an RFP seeking a consultant to conduct a broadband feasibility study.
Bozeman, MT	Bozeman began the master planning phase of the Bozeman Broadband Initiative in 2014. At the beginning of 2015, Bozeman's Commissioners approved the city's master plan for the development of an open access fiber network.
Detroit, MI	The major player in the revitalization of Detroit, Dan Gilbert, has also backed a local ISP that is building out a gigabit service in downtown and midtown. The ISP is also "setting up line-of-site rooftop-based systems that would use antennas to deliver wireless gigabit-paced Internet to community centers and schools in the city in advance of any citywide rollout out of fiber-optic service."
Fairlawn, OH	The Ohio community announced in February 2015, and issued a RFP, that it was seeking partners to create and implement a new municipal broadband utility with the goal of the utility offering a gigabit connection throughout the community.
Fort Collins, CO	In early 2015, the city set aside $300,000 to create a strategic plan designed to deliver, among other benefits, a gigabit capable broadband network. The city hopes to have a recommended path by the end of the year.
Hudson, OH	Hudson is at the very beginning of its fiber journey. The city just released a RFP for the creation of a feasibility study for fiber-to-the-home Internet.
Huntsville, AL	In February 2016, the city of Huntsville, Alabama announcement that its municipally-owned electric utility will lease its fiber lines to Google. Huntsville could constitute the real deal and will be a city to watch, as it presents a new model for Google Fiber-city collaboration. Read more about this case on page 12.
Irvine, CA	This city, in addition to Huntsville, has been flagged as an "upcoming" Google Fiber city, but it is uncertain whether Google will proceed here.
Leverett, MA	Leverett, MA, released an RFP in June 2016 seeking a partner Internet service provider for its existing community network, LeverettNet.
Lexington, KY	After a six-month planning period, which included following the Google Checklist, the city in early 2015 put out an RFI, available here, to upgrade service throughout the city.
Los Angeles, CA	At the end of 2013, LA released an RFI for citywide gigabit connectivity. In response, Time Warner Cable (TWC), the incumbent provider, promised gigabit speeds by 2016, but it will be interesting to see to what extent TWC's vision aligns with the city's original RFI wish list. Other vendors, like Dutch start-up Angie Communications, have expressed interest in building-out as well. In June, Los Angeles released an RFP for a gigabit network.
Maui, HI	In February 2015, the Mayor's Economic Development Office hired the University of Hawaii to study how to upgrade the island's broadband network, with the aspiration of a gigabit throughout the island. The study should be completed by this summer.
Missoula, MT	The city released a broadband feasibility study with several key public policy recommendations regarding information sharing, streamlined permitting, increasing demand through education and adoption programs, and taking advantage of available loan and grant programs.
Raleigh-Durham, NC **San Antonio, TX** **San Francisco, CA**	These cities, in addition to Huntsville, have been flagged as "upcoming" Google Fiber cities but it is unclear how the pause in Google's plans will affect these communities.
Sandpoint, ID	In 2016, Sandpoint released an RFP seeking a partner to assist it in strategizing ways to leverage its existing dark fiber assets.
Sanford, ME	In the summer of 2014, Sanford completed a study concluding that fiber optic communications in the area would have economic potential.
Santa Fe, NM	In 2014, Santa Fe announced a $1 million municipal broadband project to increase local connectivity and competition and attract more technology companies to the region. The plan involves building a city-owned fiber network, "SF Fiber," and leasing it out to local ISP Cyber Mesa for its first four years of operation.

Figure 6: Cities Beginning Gigabit Fiber Journeys

Kansas City, Austin, Charlotte, Salt Lake City, Provo, Nashville, Atlanta, Wilson, Lafayette, Chattanooga and Sandy have already deployed residential gigabit service. With their residential service on or *almost* on (courtesy of Google Fiber, EPB Fiber, and LUS Fiber), all these cities are worth watching for how they identify and unlock the potential of gigabit connectivity. Prospective gigabit cities can analyze how these cities' economies expand, how their city governments change or improve online services, how their anchor institutions leverage improved connectivity, and how broadband adoption changes.

Cautionary Tales for Cities Seeking or Working with Private Partners

Gigabit Squared in Chicago and Seattle

In 2011, a new entrant, Gigabit Squared, reached agreements with Chicago and Seattle to build out gigabit networks. The company failed to do so and that failure suggests many lessons. The most important is that partnering with unproven new entrants is risky – especially when there is no existing stake in the local community. The importance of having "skin in the game" cannot be overestimated. When an additional incentive to deliver in that community, beyond the specific gigabit project, exists, then there is higher probability for the city that a partnership will be productive. This is why smaller but already operating ISPs in cities like Cleveland and Champaign-Urbana have proven successful so far, despite the fact that they were not large or had never provided gigabit service on the proposed scale before. Both OneCommunity and iTV-3 had preexisting relationships with the community (Cleveland and Champaign-Urbana respectively). They had a stake in the success of the communities in which they pledged to build. For established national providers like AT&T and Google, that extra assurance comes in the form of both their secure funding and their interest in promoting the brand. To these established companies, the cost of not meeting their obligations to the city, and thereby creating problems for their existing business lines, is greater than for new entrants.

Bottom Line? While new entrants always carry risk, it would also be a mistake to discount them completely. Instead, communities should be aware of the additional risks and protect themselves accordingly at the beginning of any agreement. Indeed, both Seattle and Chicago, prior to entering into agreements with Gigabit Squared, did due diligence and included contract provisions to minimize the communities' risk. As a result, the financial losses to each were relatively circumscribed, with the biggest loss being one of staff time and lost time to having a next generation network.

Public-Private Partnership Pushback in Utah

In 2014, Australia-based Macquaire Capital expressed interest in partnering with the partially built, financially struggling fiber network in Utah, UTOPIA. Macquarie is not a traditional ISP. Rather, it is a financing company, interested in assuming UTOPIA's existing operating deficit and then building out, upgrading, and managing the whole network over a 30-year term. Macquarie's build-out would be partially funded by a utility fee of about $18-20 per household per month. The utility fee would cover the cost of constructing, operating, and maintaining the network over the long-term. Payment of this utility fee would entitle consumers access to a basic level of connectivity, competitive with entry-level offerings of current providers. The deal also includes waivers in cases where customers cannot afford to pay the fee.

This effort is still progressing, but is in the midst of complications. Five of UTOPIA's eleven member cities voted not to continue to participate in the project, making it uncertain whether the utility fees will have to increase because of higher per capita project costs. Underlying this difficulty in securing regional buy-in is the ambitious nature of the per-household utility fee model – especially in a market where other providers still exist. Pushback has also been organized by the campaign "Unopia" launched by the Utah Taxpayers Association. Not surprisingly, Free Utopia, a Utah blog that favors municipal broadband, claims the Unopia campaign has spread misinformation about the deal.

Bottom Line? The developing Macquarie Capital/UTOPIA deal shows the uncertainty presented by regional, multi-city projects and models that, while having scale advantages, have coordination and financial hurdles.

Incumbent Push Back Against Cities Aiming to Own and Operate a Network

Incumbent Short-Term Pricing Strategies in Monticello, MN

Investing in a city-owned and operated service in areas with one or several existing providers comes with risks, as evidenced by the case of Monticello, Minnesota. In 2010, Monticello built its own fiber network, Fibernet, to spark increased competition in the area. The incumbent telephone and broadband provider, TDS, fought the city's network in court. When that proved unsuccessful, TDS built its own fiber network to compete with the city. The incumbent cable operator, Charter, did not build a new network but cut its prices dramatically, offering 30 Mbps speeds and cable television for just $60/month for two years – a package priced substantially below comparable service in its other nearby markets. Unlike Fibernet, Charter had the ability to take a temporary loss in Monticello to secure its customer base because revenue was coming in through other, less competitive, markets.

Bottom Line? You can expect incumbent competitors to a municipal broadband network to take a variety of legal, political and anti-competitive business steps to defend their customer base and revenues. The worst-case scenario? The public network will be run out of business and the incumbent raises prices to the level prior to the competition.

The Attacks on LUS in Lafayette, LA

Even after a community-owned network is built and fully operational, you can expect critics to attack. A primary tactic is to use private sector metrics, which, while probative on some issues, nonetheless cannot capture the public benefits that likely spurred the city to act. For example, the network finances of the Lafayette Utility System (LUS Fiber) in Lafayette, Louisiana, have been criticized by the Reason Foundation and defended by the Institute for Local Self Reliance. The critics point to the implicit subsidies while defenders note that LUS Fiber has brought Lafayette into the limelight, marking it as an innovative city. In 2013, Lafayette made Foreign Direct Investment Magazine's list of Top 10 Small American Cities of the Future, coming in at #7.

Bottom line? Any city looking to invest in a publicly-owned and run network for long-term change should be prepared to handle constant political and financial scrutiny both locally and nationally.

Other Problematic Initiatives

We don't mean to suggest these are the only cautionary tales. One notable failure was in Burlington, Vermont, for which there are thorough analyses of the lessons learned. As is often true in policy debates in which where you stand depends on where you sit, the analysis of such projects often depends on one's general view. Parties opposed find significant fatal flaws; parties in support acknowledge flaws but don't see them as fatal. The New York Law School wrote a critical report with lessons learned. The Institute for Local Self-Reliance was more supportive.

State Laws Inhibiting Public Networks

As cities consider how to proceed, they need to consider how state law may limit their options. Nineteen states have adopted laws constraining how cities may either operate their own networks or even partner with private entities in stimulating deployments. A list of the laws can be found at Broadbandnow.com.

State laws inhibiting public networks vary in scope. For example, the North Carolina law did not prohibit cities from partnering with Google Fiber, but the Colorado law kept Colorado cities from being considered for Google Fiber. In the last election, however, seven Colorado communities held a referendum on whether their community should be allowed to proceed with a municipal broadband initiative. Each passed with an overwhelmingly positive vote.

These laws are controversial. In February 2015, the Federal Communications Commission (FCC) acted on petitions by Chattanooga, Tennessee, and Wilson, North Carolina, and held that the laws in those states constraining municipal network expansion violated federal law. That ruling was challenged and, in 2016, the Sixth Circuit Court of Appeals overturned the FCC order, leaving the laws in place. The FCC is not appealing

the Court decision. In that light, while we think it will be difficult for the FCC to formally overturn such laws, we also think the FCC's advocacy about the problems with state's inhibiting local efforts has led to other states taking such laws off the agenda. Further, we think the more such efforts prove successful, the more pressure there will be in those states with such laws to repeal existing legal barriers.

Two groups have formed to advocate for municipal rights and provide resources for cities wishing to follow the policy and legal process. The Coalition For Local Internet Choice is organized to support the authority of local communities to make independent broadband Internet choices. Next Century Cities is an organization of municipalities helping all cities realize the full power of affordable and abundant broadband. Both have information about the current state of play of the litigation and legislative efforts and can assist cities in understanding the constraints they may face.

States with Limitations:

Alabama
Arkansas
California
Colorado
Florida
Louisiana
Michigan
Minnesota
Missouri
Nebraska
Nevada
North Carolina
Pennsylvania
South Carolina
Tennessee
Texas
Utah
Virginia
Washington
Wisconsin

For links to specific state laws, see page 65 in the Appendix.

How Should My City Approach the Challenge?

The previous section provided numerous examples of how other cities have been able to accelerate the deployment of a next generation broadband network. The section after this one details tactics that cities can use to begin the process. In between, however, we have found that it is helpful for cities to think about a general approach, and then course-correct as the process unfolds. The following section offers several tools and frameworks that cities can use when they begin forming their upgrade strategy. As mentioned before, there is no one-size-fits-all solution for next generation networks. What has worked for others might not work well in your city. It is important to consider the level of commitment city officials and community leaders are willing to undertake and define your city's short- and long-term goals in light of those levels of commitment.

High Level Local Strategy Framework

As an initial matter, we have found it helpful if a group of community leaders gathers to discuss how the city should proceed with its effort to upgrade its broadband options. In the chart below, we provide a set of questions and options that have guided such conversations and have been instrumental in building consensus for action.

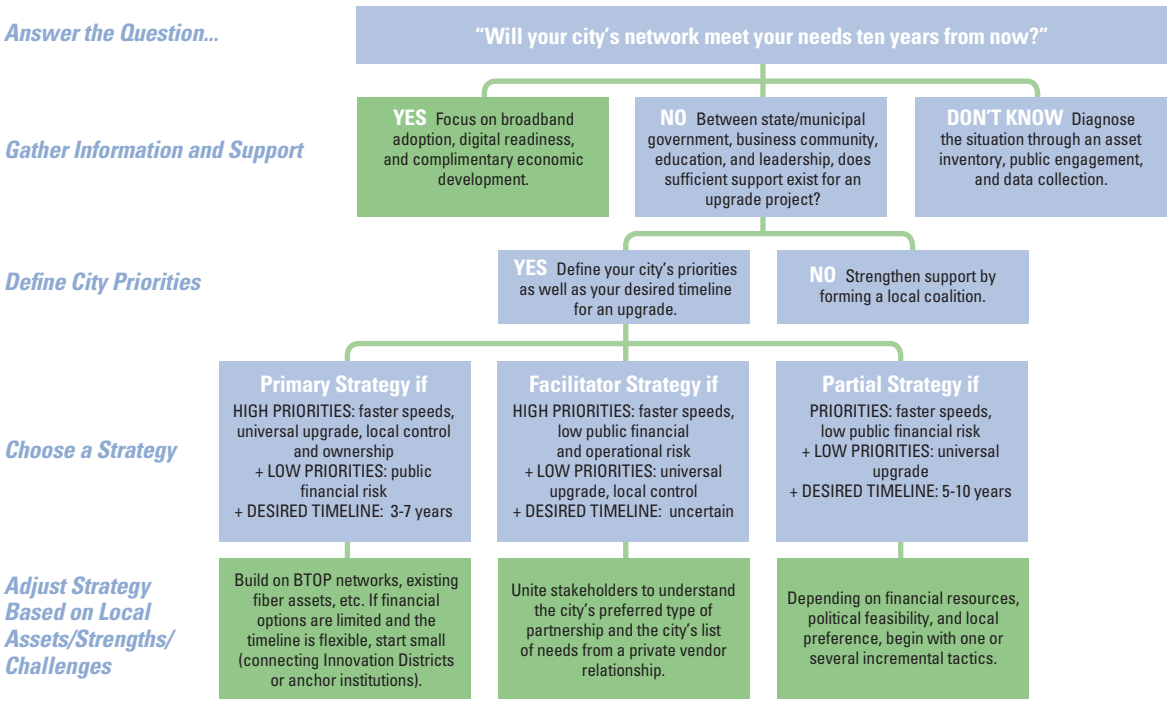

Figure 7: Local Strategy Formation Framework

The Spectrum of Strategies from Low to High Effort

Once the group has come to some initial agreement on a general framework for approaching the effort, we have found it useful for the same group to discuss how much the community wishes to commit to the effort. As described in the graph below, there is a spectrum of strategies, from a low level of effort, involving a variety of tactical steps to improve the economics of fiber deployment, to the highest level of effort, involving the city as the entity responsible for designing, deploying, maintaining, and operating a network.

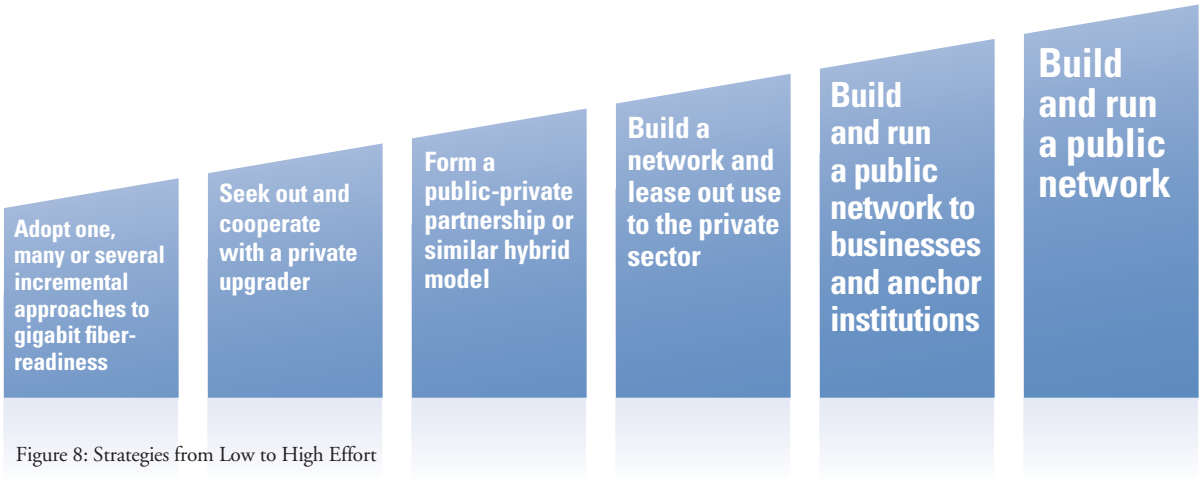

Figure 8: Strategies from Low to High Effort

Once the community leadership has developed a rough consensus on the framework and the level of effort for how it wishes to proceed, there are a series of incremental steps to be taken consistent with that general strategy. Again, as illustrated below, these steps represent a spectrum of efforts, from relatively simple and with minimal costs, such as having a committee or outside expert provide recommendations, to more difficult but with a significant return on investment. One such example is instituting a dark fiber strategy, in which the city installs unlit fiber whenever it engages in certain kinds of construction projects, such as those digging up streets, parking lots, or other activities, in which the incremental cost to the project of laying the fiber is very low. This creates a valuable asset that can then be lit by putting electronics at the edges and then used to provide a service, either by the city or by an entity to which the city leases the fiber. Some cities, such as Seattle, have used this approach for decades and, over time, have built out networks reaching a significant portion of the city, dramatically improving the economics of deploying a next generation network.

With these initial discussions, and with a consensus that hopefully develops from them, the city is ready to proceed with preliminary steps as discussed in the next section.

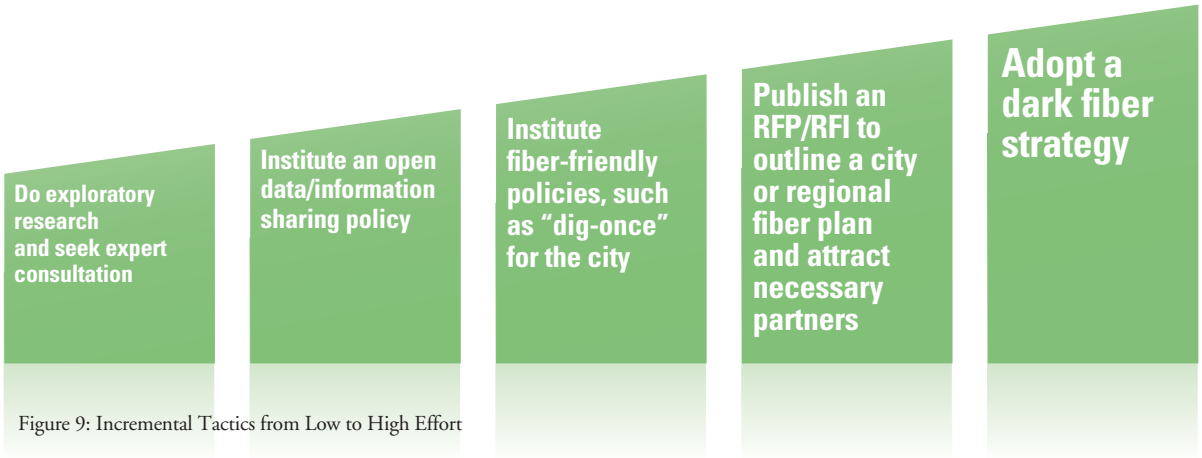

Figure 9: Incremental Tactics from Low to High Effort

Other Issues to Consider in the Process

As communities consider publishing an RFI and/or RFP to stimulate next generation network build-outs, they should also consider how such build-outs could also serve as the foundation for two other next generation communications initiatives, Fifth Generation (5G) Wireless and the Civic Internet of Things, discussed herein.

5G Wireless

While many Americans enjoy fourth generation (4G) wireless services, the wireless industry has suggested that the next generation (fifth generation or 5G) will provide a massive increase in performance and throughput. 5G holds great promise for basic communication needs, advanced new communication services like two-way 4K video, advanced security and privacy controls, and many other services.

While the promise of 5G is great, so are the challenges to deployment. While a number of technology advances have made 5G possible, 5G will also depend on a different network architecture than 4G. 4G customers received their data from a macro-cell, a large tower that serves a broad area and many customers. 5G customers will receive their data from many small cells that serve a smaller area and many fewer customers. 5G radio deployments will be exponentially larger in number and, more importantly, more densely distributed in order to support the 30 to 50 times faster bandwidth enabled by 5G in comparison to 4G. 5G service providers will need to be able to build or lease wireline networks that extend much closer to the customers than the wireline networks on which wireless customers currently depend.

This, however, leads to challenging economics. While 5G plans are still nascent, it appears likely that the network costs will be significantly higher than any previous wireless network deployment. Indeed, it may be cost prohibitive for the major carriers or any new carriers to overbuild end-to-end wireline networks.

Further, as was true in deploying all communications networks, state and local governments have to play a role in overseeing deployment through zoning, permitting, and other regulations. It is critical that government entities protect the public interest, but also embrace policies and processes that reduce delays and costs. Those policies will be similar to the fiber-friendly policies discussed in this Handbook, but will also include policies related to small cell siting.

The Civic Internet of Things

The Internet of Things itself refers to the ability of devices, equipped with far greater computing power and connected to the Cloud and each other through far greater bandwidth, to provide a greater awareness of a situation and to act to improve outcomes. These developments are already having a dramatic impact on how we manufacture goods, in what is generally referred to as the industrial Internet of Things.

The Civic Internet of Things is, at one level, simply adding intelligent devices to a number of infrastructure systems generally run by cities, including, but not limited to, water, sewer, power, and transportation. It also creates new opportunities to improve the data on which decisions are made in areas such as public safety, public health, and social services. For example, while numerous cities already have security cameras and gunshot recognition sensors, developing technologies are enabling such cameras and sensors to automatically detect unusual activities and to enable a rapid response, resulting in a 10% to 30% decrease in crime. The Civic Internet of Things can reduce electrical outages and water losses, improving resource management. Another big use is adaptive traffic management, which can improve traffic flow and dramatically reduce time spent in cars looking for parking spaces.

All in all, McKinsey estimates that the global economic impact of state and local government use of the Internet of Things would be between $930 billion and $1.7 trillion by 2025. Beyond the financial savings, cities are using such technology to better inform residents of the "state of the city" and thereby improve the public dialogue as to what a city should prioritize in terms of civic improvements. In short, the Civic Internet of Things represents an opportunity to do for the basic civic infrastructure of the early 20th Century what smart phones have done for communications compared to the standard black dial tone phones of fifty years ago.

Civic Internet of Things initiatives are emerging across the U.S. – in both gigabit and non-gigabit communities. Like 5G, the Civic Internet of Things will also depend on ubiquitous, fast, and affordable communications networks; the sheer amount of data and information collected by interconnected, smart sensors can only be strengthened by the presence of high-speed Internet infrastructure. Thus, communities contemplating how best to deploy a Civic Internet of Things initiative should integrate their plans with policies to attract next generation network deployments.

A Civic Internet of Things Case: A "Fit Bit" for Chicago

The Array of Things is perhaps one of the highest profile ongoing Civic Internet of Things initiatives in the country. Supported by a $3 million dollar grant from the National Science Foundation, and operated by the Urban Center for Computation and Data in partnership with the City of Chicago, the Array of Things will deploy 500 sensors across Chicago by the end of 2018. About 50 sensors are expected to go up in 2016. Network connectivity will be provided by AT&T. The model adopted for this project was collaborative, involving national partners in the crafting of privacy policies, and community partners in the design and manufacturing of the sensors and the civic engagement process.

The sensors themselves will measure environmental conditions in the city — congestion, air quality, temperature, standing water, and noise pollution. Information collected could have major implications for public health research and improve service delivery. Data will eventually be open and available to researchers and residents on the City's Open Data Portal. The resulting work and innovation from the open data will be worth following as the project progresses.

Federal Support for the Civic Internet of Things

As part of the larger White House Smart Cities Initiative, two federal agencies, the National Institute for Standards and Technology (NIST) and the National Telecommunications & Information Administration (NTIA), are hosting workshops and facilitating working groups for creating best practices for emerging IoT projects. In May 2016, NIST's Cyber-physical Systems (CPS) Public Working group has already published a framework inventorying the elements of IoT and articulating a shared understanding of the foundational concepts that shape the design of these types of projects. More resources from these ongoing efforts from NIST and NTIA will likely be future guiding lights for communities deploying sensors and connected devices.

What are the **Preliminary Steps?**

This section provides information about the preliminary organization of stakeholders and the process – who to rally within and outside of city government, ways to achieve quick wins and the low-risk "low-hanging fruit" that can be tackled first when setting the foundation for a larger scale upgrade project – no matter the model.

Unite Diverse Local Actors on a Common Mission

One of the hurdles that has arisen in nearly every project we have worked with is that the traditional organization of the city, as an enterprise, is not designed to take on the challenge of accelerating a next generation deployment. While there is often a department that works with the cable franchisee, cable regulation is not designed to facilitate competition or construction. While there is always a group that manages rights-of-way and construction permitting, the nature of citywide network construction is different than construction in discrete areas. While there is usually a group designated to do public outreach, the nature of this kind of project is quite different than the typical public outreach involving well-defined, ongoing constituency groups. Thus, the first job is organizing city officials to understand and adopt their role in the mission of accelerating next generation network deployment. This involves uniting a number of different players within the city's organization to work together for the common mission, as illustrated in Figure 10 below.

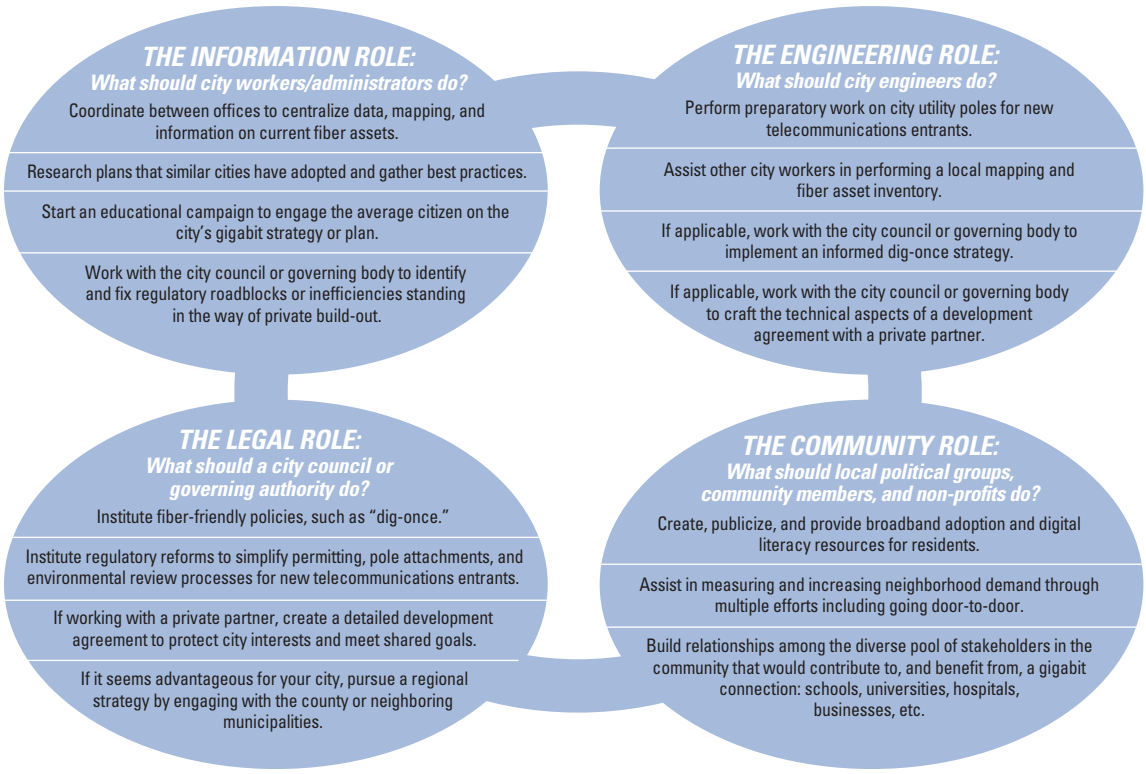

Figure 10: Uniting City Officials on a Common Mission

The next job is organizing the public to adopt the same mission. One important document that lays out how to do this is The Kansas City Playbook (published by the Mayors' Bi-state Innovation Team). An outgrowth of the cities' desire to take advantage of the Google Fiber network, it details plans for maximizing the opportunities by outlining pilot projects and strategies touching on digital inclusion, education, universal coverage, Wi-Fi hotspots, healthcare, arts and culture, and local government. While it was written after Google had committed to building a network, the Playbook provides a great blueprint for how to organize and excite the community about the opportunities such a network creates. Excitement in a community is also useful in creating leverage in negotiations with potential providers while providing community leadership with input into what community members believe would be the critical elements in any negotiation.

Take Inventory of Local Advantages, Strengths, and Barriers

A first step in evaluating how to proceed is to take an inventory of relevant assets. Gig.U has prepared "A Community Assessment Worksheet," primarily designed for city administrators, that provides a comprehensive list of assets and opportunities for cities to improve the conditions for investment in networks. We have condensed some of the tasks from the full worksheet in the graphic below.

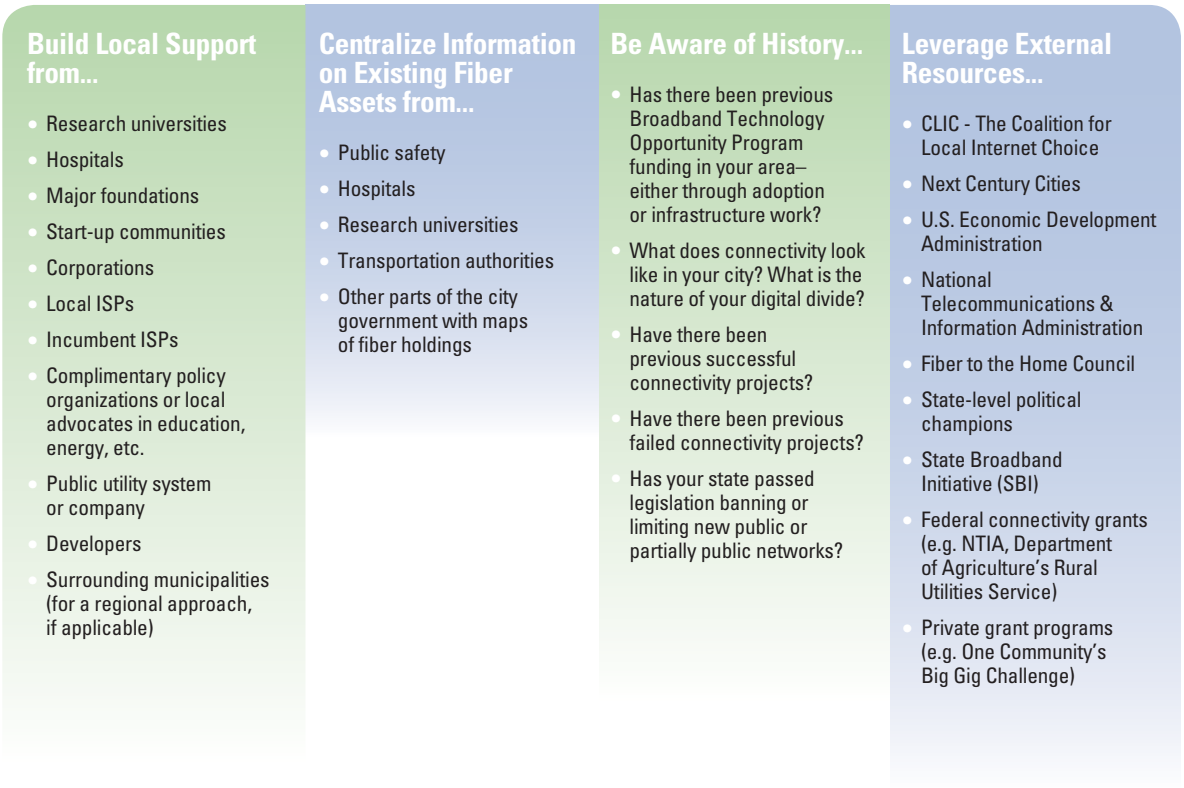

Figure 11: Inventory of Strengths, Weaknesses, and Assets

Tackle the "Low-Hanging Fruit"

If a gigabit connection is in the long-term strategic plan for your city, there are steps to take now to align you with private investment, public build-out, or the myriad of models in between.

Exploratory Research and Information Gathering

Look to cities that have succeeded or stumbled – especially cities of a similar size, geography, and political structure. Factors such as population density, existing competition, the cooperation of incumbents, politics, and the presence of local ISPs will also help determine which lessons are relevant to your city. It is important to remember that, though cases can be informative, no two cities are the same. At the same time, as noted in the Overview at the top of this Handbook and discussed further in the next section, the fundamental economics for all cities are the same.

Regulatory Reform

If you are looking to attract private investment from a local ISP, a nonprofit provider, or a project like Google Fiber, improving and streamlining regulatory processes will make your city a more attractive place to build. Specific changes can be found in the Google checklist; others may come to light during an RFI process.

Spotlight: Regulatory Reforms

Louisville lowered its bonding requirements and extended its franchise agreement period.

North Carolina cities involved with the NCNGN project agreed to allow ISPs to e-file their construction-related documents.

South Portland made it easier for telecommunications entrants to install utility cabinets along city sidewalks.

Information Sharing

Any existing mapping and data on the city's current fiber holdings can be either published online for anyone to view or shared with a private partner to ease the planning process and avoid creating duplicative infrastructure. As noted in the section below on challenges, there are security concerns that should be addressed before public dissemination of information.

Strategic Partnerships that Play to Local Strengths

Does your city have one or several large research institutions with their own networks? Does your city have existing broadband adoption/access nonprofits or projects that can be leveraged to increase public awareness and demand for faster speeds? Are there businesses or start-ups in the area that would benefit from gigabit speeds? Strengthening these key relationships and building trust between these institutions will maximize the city's leverage in negotiations with potential providers.

Be Firm in Declaring Your City's Interest in being on the Gigabit Map

Napoleon famously advised, "If you start to take Vienna, take Vienna." That is, don't undertake such a project with a half-hearted commitment. A statement of strong intent will both wake up the incumbent providers as well as attract non-incumbents. Be both loud and clear in your announcement to the world that you are interested in an upgrade, that there is demand in your area, and you are willing to work with those who can make it happen. All the cities that have used RFPs have depended on significant publicity to attract potential vendors. Further, every city that we have worked with has attracted new concessions by incumbents upon announcing their intent to consider new alternatives. In the case of College Park Station in Texas, for example, releasing an RFP led the incumbent cable provider to suddenly announce it would upgrade its old plant to make it gigabit capable.

CASES: Different Approaches to "Dig Once" Policies

BRENTWOOD, CA - Brentwood's Municipal Code contains provisions requiring all "utility distribution facilities," including communications systems, to be installed underground (waivers are permitted under extraordinary circumstances). Among these provisions, under the title "Advanced Technology Systems," is the following: "The developer shall design, install, test and dedicate to the city two advanced technology system conduits… within the public right-of-way." One of the conduits contains a fiber optic system for use by the city or one of its franchisees. The other conduit is to remain empty and available for future franchisees who prefer to run their own cables instead of using the city's. Under this policy, the city expands its own network incrementally while extra capacity is installed to facilitate future fiber deployments by private providers.

SANTA MONICA, CA - Santa Monica adds an important feature to its "dig once" policy - requiring all utility operators to submit maps of all "antennas, pipelines, conduits, cables, vaults, pedestals, and all other associated facilities" located in public rights-of-way (ROW). These maps must be submitted on a yearly basis, unless no changes have occurred. This reporting activity streamlines future uses of these ROW assets that, in turn, lower costs for future network builders.

MOUNT VERNON, WA - The city of Mount Vernon, Washington, has implemented a "dig once" conduit policy that specifically applies to "the construction of improvements such as buildings, homes, subdivisions, streets, and utilities." All such projects are required to "construct and install telecommunications conduit on all streets that are affected, disturbed, constructed and/or improved by development unless otherwise approved, pending a review by the city engineer." By spelling out a range of "improvements" covered, this policy appears to specify a highly incremental fashion for installing conduit which can help reduce overall costs in the long run.

POULSBO, WA - Poulsbo, Washington, adopted a policy that applies to all road construction, whether done by the city or any other entity. Poulsbo's policy further distinguishes between different types of roadways, requiring higher capacity conduit along "all new collector or arterial public streets serving or abutting residential development, and in all new public streets serving or abutting nonresidential development." This tailoring of conduit capacity to roadway capacity can lower overall "dig once" costs by allowing lower capacity conduit to be installed where appropriate.

SEATTLE, WA - Seattle has a similar "dig once" policy, but in contrast to all the others listed here, it specifies that the city will cover the incremental cost of the extra conduit. One can speculate this generous policy is due to the larger resources of a city the size of Seattle and a high prioritization by the city to ensure its conduit policy achieves its objective.

Understand the Economics: Orient First Steps Around Lowering Costs and Risks

As discussed in the Overview, while all cities face different challenges to success, all face a similar economic challenge. In other words, as we laid out in Figure 1, and again here, the current math doesn't work.

Figure 12: Broadband Cost-Benefit Equation (Revisited)

That is, the new or incremental capital and operating expenses of a next generation network are greater than the risk adjusted new or incremental revenues, plus the benefits to the system, plus the risk of lost revenues due to competition.

The path forward is to change that math, causing, where possible, cap ex, op ex and risk to go down and revenues, system benefits and competition to go up. What every successful project has in common is that the city has acted in a variety of ways to lower some or all of the first three factors and raise some or all of the last three factors:

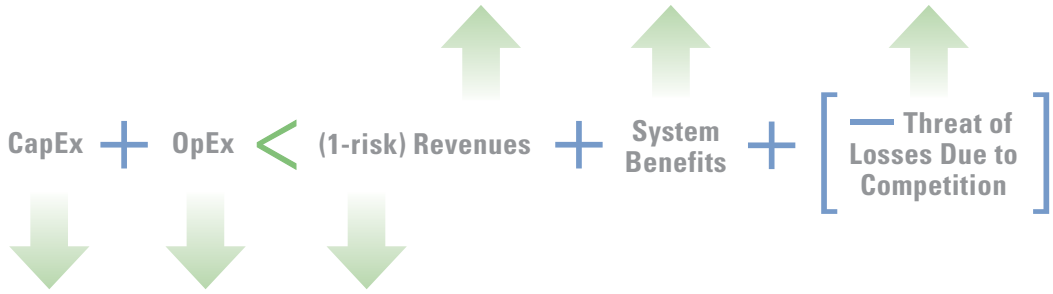

Figure 13: Revised Broadband Cost-Benefit Equation (Revisited)

Changing the equation does one of two things. It can make a public or public-private model more feasible to undertake or it can make your community more attractive to private partners.

Over the last several years, we have seen the equation changed by cities through three basic strategies. These are:

1. **Asset utilization and improvement.** The key inquiry is, 'What assets does the city have that can be provided at no or little incremental cost that improve the economics of deployment and operations?' This can include: physical assets, like rights-of-ways (ROWs), utility poles, conduit, buildings, etc.; information assets, like information regarding conduit, ducts, and other ROWs; and processes to improve current assets, such as ensuring that make-ready work is done expeditiously, coordinating with new providers to save costs or allowing them to perform work themselves through approved contractors.

2. **Regulatory flexibility to accommodate new business models.** The key inquiry here is what rules does the city have that may have made sense in a different time and with a different market structure that in today's market creates a barrier to an upgrade or new deployment. For example, all the projects with national ISPs, including

Google Fiber, have allowed neighborhood-by-neighborhood builds, which significantly reduces capital expenditures and risk through a pre-commitment strategy. This is not without controversy (see section below on "Addressing Equity, Broadband Adoption and Digital Readiness"), but nonetheless, has proven essential to facilitating new investment.

3. **Demand aggregation.** The key inquiry here is how to aggregate demand to demonstrate to existing players the value of an upgrade and to potential new entrants the opportunity in the community. This can be done on both the institutional and residential level. The greater the demand aggregation before the negotiation begins, the greater the leverage of the city in the negotiation.

These strategies lead to multiple tactics that have the desired effect on the core equation, as illustrated in the graph below, and discussed in more detail in the next section on forming public-private partnerships.

Figure 14: How to Change the Broadband Cost-Benefit Equation

Public Messaging Points: Better, Faster, Cheaper Broadband

At the beginning of every project, cities need to develop a message to the public about why the city is taking the initiative to improve something believed by some to be a private sector function. Developing a communications strategy becomes easier when city officials look at the project as one with the mission of providing fundamental infrastructure. After all, communications around infrastructure projects by city officials is a well-travelled path. Through campaigns around general obligation bonds to economic development efforts like sports or arts facilities,

we have found that there is a great deal of expertise within most communities about how to advocate for investing in infrastructure today to improve the community's prospects for tomorrow.

Several years ago, the novelty of gigabit networks made the task more difficult for broadband projects. Now, we have found (and the record of popular referenda on the issue confirms) that the necessary messages already have significant wind in the sails. While all politics is local, and the precise messaging should reflect local context and concerns, in our experience, there are three, primary, public messaging points that support the initiative for city broadband adoption that will resonate with the public. These are:

1. **A world-leading broadband network is necessary for a community to thrive in the future.** No matter what the community's major economic forces or demographics, we have found a broad and deep understanding that better broadband has both specific benefits for economic sectors and broad benefits for all. McKinsey, in a paper on "Making the Consumer Case for Major Infrastructure," urges leaders to think big by focusing on the "catalytic" benefits to the economy. That message applies here. As noted in the earlier section on "The Economic Case for Faster Speeds," there is substantial evidence supporting the argument that faster broadband leads to economic gains throughout the community. Moreover, the public, having experienced the impact of broadband in their own lives, is predisposed to understand the value of next generation broadband in their lives and throughout the community.

2. **The broadband status quo is unacceptable.** We have visited many communities in the last four years but have yet to find one satisfied with its broadband choices. This is confirmed by consumer feedback. The University of Michigan Consumer Satisfaction Index ranks Time Warner Cable and Comcast as the lowest ranking companies in their survey. Telephone broadband providers do better but are far from loved. One can argue about whether the companies deserve those rankings, but from a messaging perspective, advocating for the city to ensure its citizens have faster, better, and cheaper broadband has proven consistently attractive.

3. **Our community needs to have the kind of broadband that other communities have.** Several years ago, many communities seemed resigned to a static fate of incumbents providing broadband over existing networks, built decades earlier for voice and video services, without a hope of a world-leading network. That has begun to change. With each new announcement from a Google Fiber, AT&T Gigapower, Century Link and others, support for efforts to bring one's own community into the club of gigabit cities has grown and is likely to grow even more. Of course, no public policy debate moves in a straight line. There are likely to be moments where the movement hits some setbacks, but the overall trend is likely to be that such networks will go from novelty, to "good to have" to "must have."

Potential Pushback

Two issues generally prove more complicated in terms of communications. One is, what is the role of the city in the project? As noted in the sections on models, cities can play a number of roles or limit their roles and risk. From a messaging perspective, the greater the role, particularly in terms of financial liability, the greater the controversy, and the more important it will be to tailor messages that justify the city's effort.

The second is the issue of whether the project will deepen the digital divide. That issue is discussed in greater detail in a later section of this handbook: "Addressing Equity, Broadband Adoption, and Digital Readiness." The bottom line, however, is that such concerns have never derailed a project; every city we have evaluated has worked out a path to accommodate the interested parties, by, for example, negotiating for free or low-cost connections to relevant anchor institutions.

What are the Key Issues in Developing a Public-Private Partnership?

For cities that have chosen a public-private partnership model, this section provides an introduction to the diverse issues that are likely to arise in network negotiations. Gig.U has also prepared links to public documents, RFPs, RFIs, development agreements and feasibility studies that can be found in the Appendix. This summary is not exhaustive, as every municipality will have unique challenges to sort through, but much can be gained by knowing how others have approached these arrangements. The Coalition for Local Choice, in partnership with the Benton Foundation, collaborated on a publication providing a business strategy and legal guide for the emerging world of broadband public-private partnerships.

Negotiating with Partners

The Kansas City/Google Fiber negotiations created a new model for how cities can facilitate an upgrade to next generation networks -- a model that has now been advanced by further Google Fiber negotiations, as well as by negotiations involving other cities and providers. These negotiations can become very complex, with provisions affecting city operations, personnel, property, and, most importantly, finances. The key to these negotiations is for the parties to recognize the relative costs and values of trade-offs, for the cities to maximize the asymmetric value creation discussed in the Overview, and for the cities to build on that recognition to obtain greater leverage in the negotiation. There are assets and levers city officials can use at little or no cost to improve network construction economics for the provider. Understanding these negotiating positions helps parties reach win-win positions more efficiently.

In this section, we discuss how different cities have approached some of the key negotiating points. But first, we provide examples of levers and requests that can be found in the agreements.

Where to Build

One primary concern of all parties when planning a network deployment is what geographic areas the network will cover. The competing factors are construction costs and risk of recouping those costs for the network builder against economic development and spillovers for the community. The builder will naturally lean towards deploying first (or exclusively if the municipality will allow that) to areas where risk of recovering upfront costs is lowest (and potential for profitability is highest). The municipality likely will want to bring access to as many residents and businesses as possible, perhaps even prioritizing certain areas where the city believes the economic and social benefits to the entire city are the greatest. The parties can resolve these divergent interests in a number of ways as discussed below.

Cities have requested from ISPs...	This can be seen in...
Universal coverage	Los Angeles RFI
Open access, wholesale network	Macquarie-UTOPIA, iTV3-UC2B, Los Angeles RFI
Connected anchor institutions	Los Angeles RFI
A free tier of basic service	Los Angeles RFI, Google Fiber in Kansas City, Macquarie-UTOPIA, NCNGN RFP, Portland-Google franchise agreement
Free public Wi-Fi hotspots	Portland-Google franchise agreement, Los Angeles RFI
Subsidized connections to public housing	Austin, TX
Ownership of the network	Macquarie-UTOPIA, SiFi-Louisville franchise agreement
A designated franchise fee	Portland-Google franchise agreement
Funding/program support for digital literacy	Google Fiber in Kansas City
Geographic priorities/schedules for build-out	NCNGN RFP
A flexible menu of service options	NCNGN RFP
Connection to existing state or regional fiber	Egremont, MA RFP (MassBroadband 123)
Increased funding/support for public, educational, and government access programs	Philadelphia, PA Comcast franchise agreement
Technology upgrades in city buildings at no cost	Philadelphia, PA Comcast franchise agreement
Specific, agreed upon customer service improvements and standards	Philadelphia, PA Comcast franchise agreement
ISP compliance with local living-wage ordinances	Philadelphia, PA Comcast franchise agreement
ISP will provide career and technical training & entry-level opportunities to youth	Philadelphia, PA Comcast franchise agreement

Figure 15: Key Development Agreement Negotiating Points 1

Cities have offered to...	This can be seen in...
Be an "anchor tenant" of the service	Los Angeles RFI
Provide space and power	Google Fiber in Kansas City, Los Angeles RFI, NCNGN RFP
Provide their partner with data and asset inventory	Los Angeles RFI , NCNGN RFP
House fiber huts on city property	San Antonio-AT&T lease agreement, San Antonio-Google fiber lease agreement
Provide a single point of contact (SPOC)	Google Fiber in Kansas City, NCNGN RFP
Streamline communication/permitting	Google Fiber in Kansas City, Los Angeles RFI, NCNGN RFP
Give the partner access to city dark fiber and/or conduit	Los Angeles RFI
Designate a team within the local government to work specifically with the partner	Google Fiber in Kansas City
Conduct a consumer outreach/marketing campaign	Google Fiber in Kansas City
Provide funding through a utility fee	Macquarie-UTOPIA
Give the partner sole discretion over build out plan and schedule	Google Fiber in Kansas City, Portland-Google franchise agreement
Designate the ISP as the exclusive partner	Leverett, MA RFP

Figure 16: Key Development Agreement Negotiating Points 2

Where to Build: Key Considerations

- Are there areas of the city we insist on connecting to the new network and, if so, on what timetable?
- Are there public facilities we insist on connecting to the new network? How many and on what timetable?
- Is there a minimum coverage area that a provider must commit to as part of the agreement?

Mutual Consultation

Google and Kansas City dealt with this issue by leaving the question of initial build sites open to continuing negotiation, with Google retaining the right to base future build locations on purely economic calculations. As a matter of practice, Google agrees to build-out in the entire city but the actual construction obligation only kicks in when a certain percentage of a "fiberhood" (with the boundaries of the fiberhood and the minimum percentage set at Google's sole discretion) signs up for the service. This approach can be viewed as a win-win from the perspective that the city has a voice in negotiating initial build locations and the ISP retains control over expansion locations thereafter. However, if the city falls short of getting agreement on its planned network sites during initial negotiations, turning over control of expansion planning to the ISP can end up resulting in a build-out to fewer areas than the city may have wished.

Need-based Quotas

In contrast to the negotiation model above, Raleigh agreed upfront to let AT&T base its build locations purely on cost-recovery calculations in return for a quota of additional locations that the city could choose based on need. The trade-off here is that the city may not get the network to reach all of its need-based sites initially, but it can ensure the network eventually expands to cover some of its highest priority areas.

Competitive Response

In addressing this issue of where to build, the city should consider the likely response from competitive network providers. So long as the new network reaches a critical mass of the city, it is likely to drive a competitive response. For example, the deployment of fiber by the incumbent telco or a new entrant with significant resources, like Google, will likely compel responses by the cable provider. The cable upgrade will be done system-by-system, rather than the fiber build-out neighborhood-by-neighborhood. In that way, facilitating an upgrade or new entrant can result in a broader geographic upgrade through third party providers who are not involved in the initial agreement. Further, as pricing is generally consistent throughout the entire jurisdiction, the competitive response will likely mean that all residents receive the benefits of price competition, even if the new network does not extend to every area.

How to Build

Network construction methods are largely standardized, so the primary decision is whether to build above- or below-ground (or whether to use a combination of both approaches). Making this determination can involve considerable cost calculations and complex policy issues, such as pole attachment rights and equipment placement.

Above-ground vs. Underground Construction

Above-ground network construction tends to be less expensive from a labor and equipment cost perspective, so it is most commonly used. Above-ground construction also minimizes digging up roadways and the consequent impact on traffic.

On the other hand, the main benefit of underground construction is weatherproofing the network, protecting it from wind and ice, which are known to topple utility lines and poles. So it is in the city's interest to assess these costs and risks while planning and negotiating a network construction partnership.

Pole Attachment Access and Costs

Labor and equipment costs are not the only costs to consider when deciding between above- and below-ground construction. Pole attachment costs can potentially dominate the calculation. For municipalities that lack a public utility or other means for easily accessing poles, the costs of negotiating and accessing privately-owned poles can quickly make above-ground construction more costly than running fiber underground. This was the situation with Champaign-Urbana, which decided to build completely underground to avoid pole attachment costs and headaches.

How to Build: Key Considerations

- If there is no municipal pole ownership, are the private pole owners supportive of the project?
- How many different parties must your city negotiate with to gain access to the pole space needed for this project? Does the city have a history of negotiating with them?

Next Battlefield in the Game of Gigs: Cities and Poles

One of the biggest costs to deploying a fiber network is preparing utility poles to carry a new fiber line. This process, known as "Make Ready," has become the next policy battleground in the fiber-dependant Game of Gigs.

In early 2016, for example, the City of Louisville/Jefferson County adopted a "One Touch Make Ready" proposal that would allow new providers to perform all the required work in the Make Ready process themselves — meaning they would be moving equipment owned by competitors — provided they use a skilled contractor. Shortly thereafter, AT&T, which has its wires on poles -- and controls a number of the poles -- in Louisville, sued the city, alleging the city has no jurisdiction under federal or state law to regulate pole attachments. Not surprisingly, Google, which is a new entrant and could be among the first to benefit from faster pole access fiber deployment, stood up in support of the city. AT&T countered that the proposal raised safety concerns and that Google could have access under terms it has agreed to in other locations.

The question, however, is not just about access, but how to balance legitimate safety, cost, and competitive concerns. In that effort, Louisville is at the vanguard of a growing movement. San Antonio's municipal utility, CPS Energy, has put in place a similar policy. North Carolina's state broadband plan noted that "'[O]ne touch' policy . . . promotes safety and limits disruptions to the ROW [rights-of-way]." And the Tennessee Department of Economic and Community Development's recent broadband report called out 'one touch' as a best practice.

Subsequently, Nashville introduced an ordinance similar to Louisville's. As in Louisville, Google Fiber is seen as the primary beneficiary and incumbent providers have opposed the measure, in this case arguing "(j)ust because you spell your name with eight different colors doesn't mean you can't play by the rules that everybody else has to f*****g play by." The FCC has weighed in on the side of the city, saying that federal law did not pre-empt the city. The FCC did not weigh in on whether state law pre-empts the city effort.

As noted throughout this Handbook, for communities to obtain next generation broadband, they will have to change the math of deployment, taking a number of steps to lower the costs and risks of deployment in a way that enables capital to flow to new fiber. One Touch Make Ready proposals fit right into that effort. If implemented, it would cut both the time and cost for deployments, translating into more affordable, abundant bandwidth. What's more, it reduces disruption and improves safety on city streets, reducing the number of times that people need to drive a truck down a street and climb up a pole.

The opposition is not without merit, but it is important to break down different kinds of opposition. Of course, incumbents always have an incentive to delay new competitors and regulators and legislators should always question such efforts. The jurisdictional question, however, is a valid one, but that does not go to the core economic benefit of more efficient make-ready work. Safety is also a critical issue. There are a number of ways to address it -- such as with bonding, certification, and notice -- without giving competitors tools for delay.

The fairness issue is important as well, but the ordinance would apply to anyone building a new network or improving an existing one, not just Google Fiber. Further, cities that have granted Google Fiber certain rights have generally granted those same rights to incumbent telecom players, like AT&T, to lower the costs of upgrading their cooper networks to fiber.

Access to certain private facilities to encourage network deployment is nothing new. Without the 1978 pole attachment law, we would not have had a robust cable infrastructure, just as without the 1992 program access rules, we would not have had a viable cable competitor in direct-broadcast satellite. Cities do not need to wait to revisit the relationship between access to poles and multiple dwelling units and the deployment of next generation networks. They should carefully follow the pioneering efforts of Louisville and Nashville to enable more efficient pole access. Moreover, to the extent they have jurisdiction, all cities should be exploring all methods that can lower the cost of deploying and operating future-proof broadband networks.

This issue was addressed in part through the FCC's recent order on the classification of broadband. The Commission held that ISPs should be entitled to fair access to poles and conduits under Section 224 of the Telecommunications Act of 1996. The long-term value of that decision depends, in part, on how court challenges and potential congressional legislation plays out. Another way of addressing this issue is having a single pole administrator. Connecticut recently implemented a single administrator through state legislation. Google addressed the issue in its first project by initially going to Kansas City, Kansas, which had a municipal electric company, and then leveraging the public reaction to strike a deal with private pole providers in Kansas City, Missouri, who did not want to be seen as obstacles to Google Fiber expansion in their city.

Access to Infrastructure and Rights-of-Way (ROW)

Infrastructure and ROW Acess: Key Considerations

- What parts of the fees reflect actual costs to the city and what parts reflect an implicit charge for scarcity value of the use?
- What is the impact on prior agreements with others of changing the fee schedule for one provider?

Infrastructure and ROW access is a big lever for a city during negotiations. Great care and diplomacy, however, must be used in order to not scare potential partners away. While cities have the economic leverage to charge fees beyond their costs for the use of the ROWs, as well as existing ducting or conduit, the value of such fees must be compared to the value of the economic benefits that a next generation network is likely to bring. Again, there are multiple ways to address this issue.

Use a Fee Schedule

Google's contract with Kansas City includes a separate "Fee Schedule" detailing which infrastructure and ROW activities require a fee. The activities that do not require a fee include: collocation space, office space, pole attachments (in utility/power space), conduit use, existing fiber, access to Geographic Information Systems (GIS) data, access to computer tools, permit processing, and inspections. The activities that do require a fee are: pole attachments (in telecom space), traffic control, and access to city rights-of-way for construction and installation of outdoor network equipment. While the city has considerable discretion to impose, or forbear from imposing, a fee, the key consideration is whether the reduction in fees can lead to a network that will increase the economic activity within, and attractiveness of, the city. Further, the city should distinguish between those fees that reflect an incremental cost to the city and those that reflect the ability of the city to charge a fee for use of the rights-of-way or other municipal assets, which by their nature are both scarce and essential to certain kinds of projects.

Ensure Equal Treatment of All Providers

AT&T's contract with Raleigh contains language that generally ensures AT&T is treated like any other third party seeking access to such infrastructure and rights-of-way. It states: "Such access will be provided in accordance with all applicable regulations and ordinances and the City's standard processes and practices generally made available to all third parties. . . ." In addition, the contract contains a "Most Favored Nation" ("MFN") clause providing "the City will… license AT&T to utilize such space for those purposes at rates or fees and other terms no less favorable than those granted to any other similar commercial service provider." Such MFN clauses are frequently requested by incumbents, and new entrants alike, to guarantee a level playing field on fees and rates.

Permit Approvals

Any network builder will need to obtain permits for construction tasks as the project progresses (which can take months and even years). Cities should work with network partners to ensure these permits are processed as efficiently and quickly as possible to reduce construction costs and time.

Setting Timelines

While permitting approval timelines benefit the network builder by providing certainty and expediency, the city should retain flexibility so it is not on the hook for every permitting delay. For example, the AT&T/Raleigh contract reads:

"The City will provide diligent and expeditious review and determinations of all applications for permits submitted by AT&T and will attempt…to approve or respond within one week from the date of the submission of the request."

Permit Approvals: Key Considerations

- Has your city internally reviewed its permitting process?
- Can the city's permitting be improved or streamlined through digital processing?

Similarly, Google's contract in Kansas City called for "quick, diligent review of all applications for permits" followed by "a commitment to review and respond to any subsequent modifications or similar documents that may require approval by City within five (5) working days of submission by Google."

Waiving Permit Fees

Another way to streamline the permitting process is to waive fees, although the obvious financial implications of this tactic should not be overlooked. The Google contract reflects this approach, as seen in the Fee Schedule that sets a fee of "none" for "permits." Before adopting this approach, city officials should review internally how its payment processing affects permit process timing. If the effect is negligible, so too will be the benefit.

Personnel Commitments

Another way to streamline the permitting process and network deployment, more generally, is identifying specific city personnel who can focus partially or primarily on network-related issues. Having such a dedicated team will speed up not only permit processing, but also the resolution of the numerous diverse issues that inevitably come up throughout long and complex construction projects. The level of specificity in personnel provisions can vary.

The contract between AT&T and Raleigh uses general language:
"The City shall designate staff that will facilitate communications between AT&T and City staff and officials, and will coordinate between municipal departments…City will designate inspectors and supervisors with the collective authority to inspect all construction for the Network, maintenance, and related work in connection with each applicable permit to be issued by the City to AT&T."

Personnel Commitments: Key Consideration

- How will dedicating such a team affect city resources and other high priority construction processes?

In contrast, Google's contract with Kansas City spells out personnel requirements in more detail, going as far as creating new job roles. For example, Google's contract requires the creation of an "Executive Sponsor for the Project at the most senior level of City" and a "Single Point of Contact (SPOC)... responsible for addressing all issues related to the Project." The Google contract further requires "a City team dedicated to the Project… the full cooperation of all City departments…[the City] participate in regular status meetings (at least weekly)... a dedicated inspection team as part of the City Project team… [and] consulting assistance to Google on planning and build of the Project."

Open Access

The term "open access" refers to a network management policy by which multiple service providers can offer services over the same physical network. This objective is reached by requiring the network owner to offer access to its physical network on non-discriminatory terms to any requesting service provider who can plug their own equipment into the network and begin offering services to customers. Stockholm, Sweden, is the most notable example of an open access fiber network. The South Portland, Maine, and Champaign-Urbana, Illinois, efforts include open access requirements.

From the city's perspective, an open access policy has the advantage of promoting competition at the service level because it prevents the owner of the physical network from dominating the market for network services. From the network builder/owner's perspective, open access may reduce profits because competition will likely lower market prices for network services. This means it will take the network owner longer to recover its costs and turn a profit, which could mean no new build-out ever occurs. But if a party is willing to invest in a next generation network even with an open access requirement, such a policy could, in the long run, result in more innovative services, lower prices, and greater access for residents and businesses.

Open Access: Key Considerations

- Does the city want to try an open access model?
- Have ISPs expressed initial interest in working with the city to implement an open access network policy?

When Google announced its Kansas City fiber deployment, it initially suggested the network would be open access. Later, however, it reversed its position, saying that as the company had studied the economics of deployment and consumer behavior, the advantages of open access were not sufficient to justify the increased costs and risks of that business model. Google has talked about how the costs of obtaining traditional programming packages, and the need to offer a multi-channel video package, make an open access model non-viable from an economic perspective. In contrast, Champaign-Urbana's fiber network embraces the open access ideal. This distinction stems from the fact that Champaign-Urbana's network originated under a federal BTOP grant that came with an open access requirement. As the network operator evolved into a nonprofit (UC2B), and then a partnership between UC2B and private service provider, iTV-3, open access remained a core principle throughout. The BTOP grant made open access a precondition to negotiation with private ISPs when UC2B went looking for an expansion partner.

While still untested, one potential compromise is to allow the network builder a limited grace period during which it can be the sole service provider, allowing it to recoup upfront costs more quickly. This grace period can be followed by an open access policy thereafter and can be negotiated as a number of years or pegged directly to cost recoupment. Currently, a theoretical approach, some cities have debated whether to try to obtain such a commitment.

Free Network Services for the City

All the contracts we analyzed contain provisions by which the ISP provides some form of free service for the city and/or other public facilities. This is often an important negotiating point for city officials because free network services can add up to major cost savings for the city or can otherwise serve some other policy objective. City officials should examine their existing IT costs and either try to minimize them by procuring as many free services as possible through the negotiations, as discussed below in the Kansas City and Raleigh cases, or leverage them to stimulate the build-out of the network, as was done in South Portland, Maine, also addressed here.

Google's contract with Kansas City allots free Internet connection service, of the same kind offered to the general public, through a quota of 130 locations within the city including city facilities, public utility sites, and school districts. One caveat is that such free service facilities will only be connected as they are passed by the natural progression of the network's construction. Another caveat is that Google will cover the cost of connection, but only if it is "commercially reasonable." Otherwise, "Google and Kansas City will discuss options to address that issue." Most importantly, following such connection, these locations will receive Internet connection services free of charge.

AT&T's contract with Raleigh similarly uses a quota to provide "Community Broadband Service" to "public or non-profit facilities that provide access and services directly to citizens." The agreement specifies that 100 sites can be chosen collectively across all six municipalities that form the North Carolina Next Generation Network. The agreement also stipulates that the relevant city must pay for the cost of connection (estimated in the contract to be $300-$500) and that schools and libraries would not be included unless they qualify for funding through E-rate, the federal program administered by the FCC, which subsidizes broadband connections for low-income schools and libraries.

Another type of free service which can be negotiated, particularly in the case of a dark fiber network, such as GWI is providing in South Portland, Maine, is an Internet point of presence. Without this, the city could still end up paying a significant sum of money to connect its facilities to the Internet despite having high-speed fiber connections internally. GWI's contract stipulates that it will provide an Internet connection at a termination point designated by the city, capable of at least 100Mb/sec symmetrical, free of charge for the remainder of the contract term. Thus, while the South Portland model does not focus on free services, it does enable the city to enjoy lower costs over time while accelerating the deployment of a next generation network.

Revenue Sharing

Depending on the financial model or models under consideration, revenue sharing is another topic worth exploring during negotiations. Some network models do not make room for such provisions (e.g., Google/Kansas City; AT&T/Raleigh). Other models make revenue sharing a central provision, such as the deal between South Portland and GWI. In return for becoming an anchor tenant of the new network and paying for 20 years of service upfront (approximately $150,000), South Portland is entitled to a share of revenues generated from retail services provided by GWI.

The important note here is how to define the profits from which to calculate the city's share, because the network provider must account for numerous costs. Accordingly, the GWI contract starts by defining "Retail Revenues" as "revenues received by GWI from retail business or residential customers for Internet and data transport services connected directly to the Fiber Optic Cable Network, exclusive of any applicable taxes or surcharges." From there, the contract specifically defines the "Connection Costs" which must be recouped by GWI from each retail customer's revenue stream before the city begins to receive a 5% share of all future revenues from that customer.

Other Provisions

Not surprisingly, there are a number of other topics that have been the subject of negotiations. A quick summary includes:

ACCESS TO CITY FACILITIES FOR NETWORK NODE EQUIPMENT: The network builder will want access to city facilities for locating network equipment. This is particularly valuable in areas where appropriate facilities are scarce.

CUSTOMER SERVICE: Cities have asked service providers to hold to specific standards of responsiveness for outages and issues.

DIGITAL LITERACY: Cities have asked for assistance with digital literacy efforts.

EDUCATION/MARKETING: Service providers have asked for certain kinds of assistance in making educational and marketing materials available to relevant segments of the public.

INTERCONNECTIONS: Service providers have requested settlement-free interconnections with anchor institutions within cities that have existing fiber connections.

MAKE-READY WORK: The network builder will want the city to commit to doing most or all of the make-ready work on city facilities (such as on poles) in order to lower the cost of the build-out.

PUBLIC WI-FI: The fiber build-out also improves the economics for deploying a robust, cost-effective Wi-Fi network. Cities can negotiate for some of the Wi-Fi hotspots to be available for public consumption, instead of just for service providers.

SERVICE TO LOW-INCOME HOUSING: Cities can ask for a minimum number of connections to low-income housing facilities.

SERVICES TO CITY, SCHOOLS, AND OTHER ANCHOR INSTITUTIONS: In both the Kansas City Google Fiber and North Carolina AT&T agreements, the cities were able to negotiate for fiber connections to certain public facilities.

SERVING SMALL/MEDIUM BUSINESSES: In the same way, cities can ask for a minimum number of connections, or geographic coverage, in areas with small and medium-sized businesses.

SMART GRID SUPPORT: Cities have asked service providers to make efforts to ensure that the new network supports the city's "Smart Grid" program. Additional provisions might request that the parties negotiate an agreement in which the city agrees to reinvest any resulting cost savings back into the network.

UPGRADING TECHNOLOGY IN CITY BUILDINGS: Cities have asked service providers to update equipment and technology at a certain number of public or government buildings.

What are the Funding Issues and Opportunities that Affect How the City Proceeds?

This section summarizes funding issues and resources for cities seeking private partnerships or public funding.

An Overview

If a city obtains a national partner like Google, AT&T, CenturyLink, or Cox, it does not have to "worry" significantly about funding issues. In the deals to date, these kinds of large private parties have carried the financial risk. If, at the opposite end of the spectrum, cities decide to proceed without a private partner, there are a myriad of financing issues beyond the scope of this Handbook. For cities pursuing some type of public-private model with more public control and more public risk, they should consider a number of financial questions addressed here.

Like traditional municipal projects, there are numerous financing options available for a public broadband initiative. However, it's best to recognize upfront that this is not a conventional publicly funded endeavor, nor one that a municipality and its traditional lending partners will be familiar with, or experienced in, utilizing. Nonetheless, as demonstrated in successful community-led broadband projects, there are numerous funding models available to support various network deployment strategies.

Whichever path a municipality chooses to pursue, it is imperative to ensure the financial inputs and outputs are fully understood and properly presented to any potential private partner and/or source of financing.

Any public or private proposal must have a credible strategy that addresses standard questions:

- Return on Investment (ROI)?
- Internal Rate of Return (IRR)?
- Point of Breakeven?
- Point of Profitability?
- Point of Positive Cash Flow?
- Is this a 5 year lifespan? 10 year? 30 year?
- Preferred funding source – public or private? Debt or equity? Corporate or municipal?

As financing methods are considered, municipalities must have an understanding of, and answers to, the questions and financial return metrics any sources of financing will consider when evaluating the project. There are both financial and legal mechanics that can be designed to protect everyone involved and that, if properly presented, could generate significant interest from investment sources.

The technical design, construction, and operating complexities of the telecommunications business must be fully grasped by any municipality pursuing sources of funds. It is often the case that a traditional lending institution, while acknowledging the intangible economic development benefits of a community broadband network, will likely focus on how funds will specifically be used, how they flow, and how debt will be serviced, while ultimately testing the metrics to ensure returns. In that light, here are some key questions cities and their partners must evaluate.

Key Considerations: Financing

Who will ultimately take the risk when financing the network?

There are a number of different risks to consider, such as the risk that deployment costs will be greater than anticipated, or revenues will be less than expected. In many community-led broadband projects, the municipality has moved all financial risk to the private party (as is true in the Google Fiber and fiber by incumbent projects), but that generally leads to less control by the municipality on a number of issues, such as the extent of the build-out. This raises a host of related questions, including: What does the current competitive landscape look like? What is the anticipated reaction from incumbents? Will this present a formidable hurdle related to network returns? Again, while the answers cannot be known with certainty, the question of who bears the risk has to be addressed before any actual deployment can proceed.

Would the municipality support the network with other internal sources of revenue, such as legacy utility service fees, or existing or new taxes? Will this be purely a stand-alone revenue pledge?

These questions are always core to the analysis if the city intends to operate the network. They may also be relevant if the city wishes to control certain outcomes as well, as we saw in the South Portland and Westminster examples.

Is the municipality willing to pledge resources or collateral or offer concessions to mitigate risks for a funding partner?

Again, the city can, as we're seeing in Utah with the Macquarie initiative, facilitate both a build-out and a preferred business model for the operation.

What are the long-term costs/benefits of pursuing a public broadband network in deference to future or alternative uses of funds and resources?

If city officials wish to participate, they will have to justify expenses with projections demonstrating benefits like cost savings (such as in Santa Monica and South Portland), or new economic growth (such as the Westminster project).

What are the legal requirements, limits, or barriers to entry in pursuing a public broadband network?

As noted in an earlier section in this Handbook, many states have constraints on cities participating in broadband networks, particularly in terms of financial support. In short, a firm grasp of the initiatives' financial inputs will go hand-in-hand with the development of a defined network architecture and management planning for the project. A thorough understanding of the financial inputs and outcomes demonstrates a foundational understanding and coordination between the financing, technology, and operational imperatives paramount to the long-term success of any community-led broadband project.

Funding Methods and Case Examples

There are a wide variety of funding approaches that communities have adopted to support the phases of network deployment – whether **exploratory work** (writing a request for information, taking an asset inventory, measuring demand, etc.), **capital expenditures** (the cost of actually building the network), or ongoing **operating expenses** (the cost of maintaining service over time). See below for common and sometimes creative takes on funding.

CATEGORY	RISKS TO CITY	RELEVANT CASES
Federal Grants	To partially off-set costs of a network or lay middle mile or dark fiber for future expansion (either public or private).	Chattanooga, TN Georgia
State Grants	To partially off-set costs of a network or lay middle mile or dark fiber for future expansion (either public or private).	Minnesota Illinois
Municipal Bonds	For full-scale, ambitious city-wide deployment where there is projected revenue from a public model or there are private parties interested in leasing the project infrastructure.	Lafayette, LA
Private Funding	For full-scale, ambitious city-wide deployment.	Cities with Google Fiber, AT&T Gigapower, CenturyLink, and other such efforts
Cooperative Funding Model	When residential service is demanded, but there is little to no private investment interest.	Sibley County, MN
Crowdfunding	For incremental, scalable projects with visible effects for civic investors (public Wi-Fi, Innovation Zones/Districts); or for exploratory costs in cases of widespread citizen demand and slow government action.	Blacksburg, VA
Utility Fee	For full-scale citywide deployment funded publicly or through a partnership in an area without competition. Caveat: given the sensitivity of public funding, high levels of political and public support are needed.	Macquarie in Utah
Infrastructure Financing Districts (IFD) or Tax Incremental Financing Districts (TIF)	In states where such districts are set up or politically supported and where projected future gains/value from infrastructure projects are reliable.	Wabash County, Indiana California

Figure 17: Financing Methods

Note that these methods are not mutually exclusive. For example, the original network in Champaign-Urbana was built using a NTIA Broadband Technology Opportunity Program infrastructure grant. While the original plan called for the network to be expanded through a public-private agreement between the cities of Champaign-Urbana and a local ISP, ITV-3, ITV-3 was recently purchased by another private company. The cities are now considering their options for completing and continuing to operate the network.

Innovative Financing: Westfield, Indiana

This section does not exhaust the innovative ways cities and private parties can work together to meet both their needs and provide the capital necessary to deploy a new network. The opportunities vary according to state law. One of the best examples of an innovative way to finance a network was that employed by Westfield, Indiana. The city employed an innovative form of Tax Increment Financing (TIF) in its effort to have a private ISP bring gigabit broadband to town. TIF is a public financing model which aims to capture future gains in property taxes from a specified "tax district" to subsidize current improvements; improvements which the city and bondholders expect to be the main cause of the subsequent tax gains. Because Indiana state law allows TIFs to be defined narrowly, Westfield is able to offer a TIF bond based on specific assets as opposed to an entire geographic area.

With Indiana's unique TIF flexibility, Westfield was able to offer a private provider, Metronet, a TIF bond based solely on the network assets to be built. This bond effectively acts as a 25-year tax abatement instrument, where state law would normally limit tax abatement plans at 10 years.

Here's how it works: Westfield offers TIF bonds that cover the very assets Metronet plans to install for its Westfield fiber-to-the-premises network. Metronet then purchases those bonds from the city, which entitles Metronet to the future property taxes that will be assessed on its network assets going forward. Westfield then releases the bond sale proceeds back to Metronet to build out the network. As a result, Metronet has effectively abated its property taxes due on the new network in a way that does not affect the pre-existing tax base of the city. It's a true win-win: Westfield gets a new high-speed fiber network and Metronet gets long-term tax abatement without impacting Westfield's existing tax base.

Most states have a different law on tax abatements and TIF financings, but we believe there are similar opportunities in most states for the parties to share the upside of the benefits such networks bring and, thereby, improve the economics of deployment.

Challenges to Expect Along the Way

In this section, we outline the expected roadblocks, trade-offs, and criticisms a city will likely encounter, both during the preliminary decision-making process and after it has chosen, and begun to pursue, a specific upgrade strategy.

Challenges During the Exploratory Phase

Assessing a City's Current Status and Demand for Next Generation Speeds

Depending on the city, taking an inventory of existing local fiber assets can be a complicated undertaking involving coordination on many fronts. Does your city have a public safety network? Between private industry, public entities, universities, and hospitals, what does the existing fiber infrastructure look like? To the extent possible, information about existing fiber assets should be centralized by a single local government agency charged with freeing this information from silos and then mapping it.

Measuring local demand for higher speeds is another challenge. Do you have anecdotal or quantitative information about dissatisfaction with current service offerings in your community? Do you have the resources to survey residents, schools, and businesses to capture and express this level of demand? A number of resources are available to capture community demand, including this Demand Identification Website created by Gig.U. These tools are designed to assist those in charge of local outreach efforts by making it easy to assess interest in upgraded networks.

Finding Champions, Creating Accountability

Ensuring "better, faster, cheaper" broadband is not explicitly written in anyone's job description. As a result, many of the successful or developing cases have come about because local leaders took the initiative to step out of their traditional or expected duties to adopt this cause. The need for champions creates a local governance challenge. Who in City Hall is accountable? Who is in charge? Who is pushing the project ahead? The answer depends on the particulars of each city, but if the answer is, "We don't know," the project is unlikely to succeed.

Recently, we've seen cities explicitly create and embed positions that would be the local "champion" for broadband access and upgrades. One example of this was Boston's new "Broadband & Digital Equity Advocate" position in city government, created in early 2016 and presently held by Anne Schwieger.

Pushback from Incumbents

If an incumbent ISP is not involved in the local gigabit project as a partner, it could become a major obstacle – even before the network has been built. If a local broadband plan threatens existing revenue streams, as it inevitably will, incumbent companies will react to protect the status quo. They might use a combination of political, public relations, and legal tools to challenge any action they believe hurts their interests. Pushback could come in the form of misinformation campaigns, "astroturf" organizations, legal barriers, and lobbying on the city or state level. Almost all of these tactics were used to try to block the network in Longmont, Colorado, so it provides a comprehensive case study for city officials.

While all the communities discussed in this Handbook have experienced some form of pushback, to a remarkable degree that pushback has been muted by the desire of communities for improved broadband. What we have

found is that if communities run an open process, with a clear statement of goals, and gain the support of key community and economic interests early on, the incumbents generally decide that overt opposition hurts their brand. They instead focus on improving their product and price, which benefits the community and its citizens.

Challenges during the Decision-Making Phase

Understanding the Trade-Offs

As your city moves forward with its gigabit strategy, there are important trade-offs that need to be understood and addressed in choosing the most appropriate network model. Is it more important for the city to have a quick roll out to certain locations, like business districts, innovation zones, and anchor institutions, or a slower, but potentially more comprehensive, roll-out? Is it more important to have as broad a coverage as economically viable, or to have less coverage but potentially lower prices that may trigger a competitive response by incumbents? Is the aggregated demand and scale of a regional approach worth the extra time and coordination? Embracing a private partner means reducing financial burdens for the city, but it also means sacrificing future operational control. An incremental approach means less immediate risk, but also likely means a longer wait for the benefits from widespread availability of gigabit speeds. Some of the key trade-offs are illustrated in the figure below.

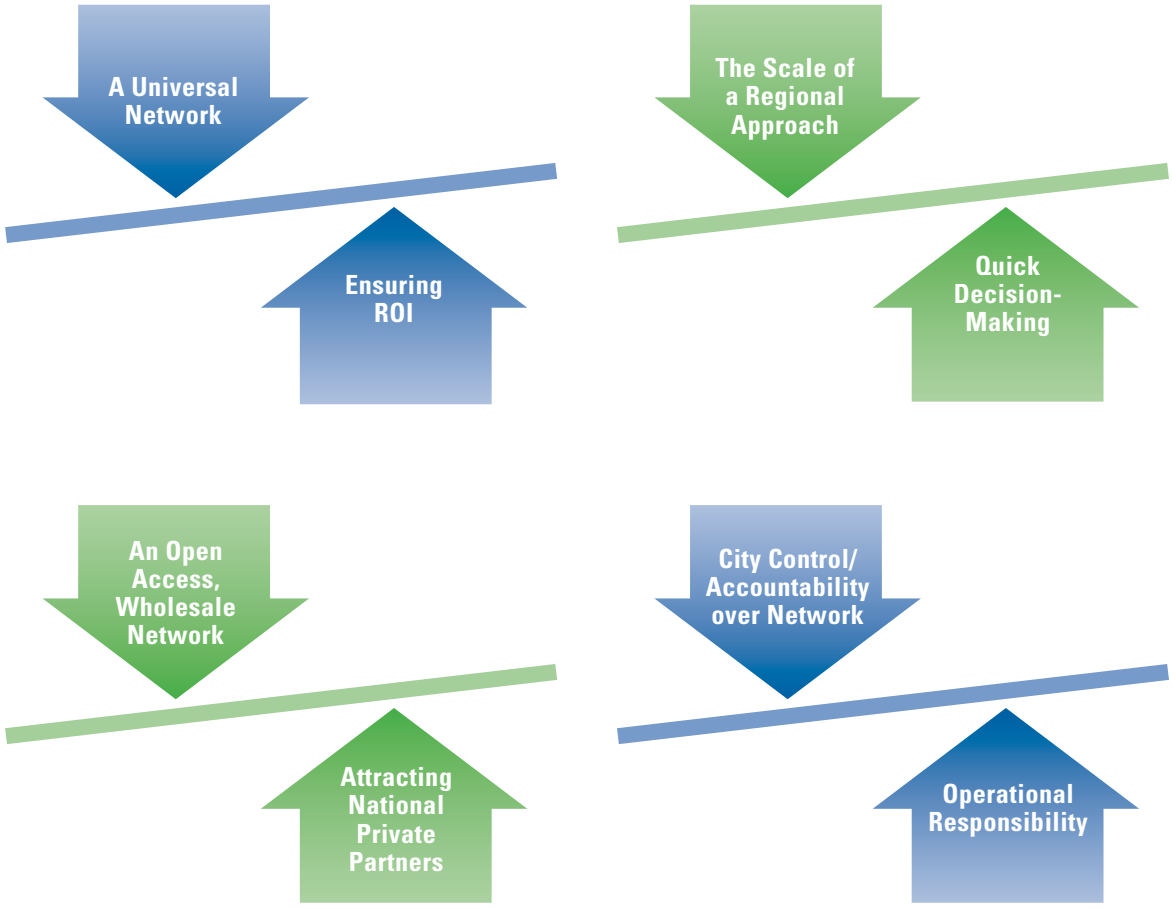

Figure 18: Trade-Offs

Challenges during Implementation and Build-Out

Managing Community Expectations

While educating the community on the project will be a challenge, so will managing expectations. This will be important to do in regard to the project's timing and construction – especially since this is an investment with mostly long-term benefits. To retain momentum, cities must create and meet public milestones (sign-up deadlines, announcements of institutional support, etc.) that translate into quick wins.

Addressing Equity, Broadband Adoption, and Digital Readiness

The economic and educational benefits of higher speeds are undeniable, but they do not solve the "Digital Divide." While the rewards of a gigabit network might cause multiplier effects in the city and possibly impact the lives of those not directly connected, many residents will not directly benefit from gigabit connectivity without complimentary community adoption, digital literacy programs, and access to hardware. The challenge for any prospective gigabit city will be to understand the nature of the local digital divide and to create tailored, targeted solutions to roll out alongside the gigabit upgrade. For instance, future gigabit city Austin, Texas, just announced that Google Fiber would be connecting residents of 18 HACA properties (public properties operated by the Housing Authority of the City of Austin) with free 5 Mpbs service for a $10 pre-registration fee.

Getting over barriers to adoption – whether those of access, cost, or relevance – is arguably just the start. Achieving a certain threshold of digital and technical know-how is becoming a de facto requirement as more job applications, government services, and informational resources shift exclusively online. Cities can no longer be thinking of broadband adoption as a binary question of whether someone is online or not. There is a compelling case that the new framework should be what Pew Research Center researcher and leading expert on these issues, Dr. John Horrigan, calls "Digital Readiness," which measures how skilled and prepared new adopters are for next generation applications and online services.

While broadband adoption or digital readiness is a problem most cities share, those pursuing gigabit upgrades will have added pressure to address and correct them. In 2014, a *Wall Street Journal* article surveyed how some argue that gigabit efforts contribute to the digital divide. On further examination, however, most of those arguments fall apart, as can be seen in a report by Aaron Deacon, one of the community leaders involved with the Kansas City gigabit deployments. The report provides six arguments for how Google Fiber has narrowed the digital divide in Kansas City. *Wired* also ran a piece providing a further discussion of how digital divide-based attacks on next generation deployments are factually and logically flawed. This analysis from co-author Denise Linn begins to explore the question of how the digital divide in high-speed Internet cities might look inherently different than in other municipalities.

Winners of the National Digital Inclusion Leaderships Awards

Philadelphia, PA **Seattle, WA** **Davidson, NC** **Austin, TX** **Chattanooga, TN** **Washington, D.C.**

Fortunately, the list of national resources available to communities seeking to increase speeds *and* bridge divides is growing. The new national mayoral coalition, Next Century Cities, exists at the nexus of digital inclusion and city upgrades, compiling resources and incentivizing cities through digital inclusion and civic technology awards. The National Telecommunication & Information Administration also has an emerging Community Connectivity Initiative that will feature an assessment and recommendation tool for cities seeking to improve their community information ecosystem.

Recognizing that a Good Network is Only Part of a Successful Digital City

Asking, "How do we get a gigabit network in my city?" is not the same as asking, "How do we become a gigabit city?"

While a gigabit network is the starting point for many innovative possibilities, it is important to keep in mind that it is just that – a starting point. For example, Mayor Andy Berke of Chattanooga leads a city with gigabit connectivity, but is also still seeking ways to unlock the potential of those high speeds. Recently, Mayor Berke was at the Brookings Institute discussing ways to foster the creation of Innovation Districts, geographic areas described by Brookings urban experts as "where leading-edge anchor institutions and companies cluster and connect with start-ups, business incubators and accelerators. They are also physically compact, transit-accessible, and technically-wired and offer mixed-use housing, office, and retail. Such areas have the unique potential to spur productive, inclusive and sustainable economic development." Such areas also depend on robust broadband networks.

In addition, initiatives like US Ignite and the Mozilla Gigabit Community Fund have encouraged the development of applications and projects for next generation, high-speed networks. Even cities that lack the infrastructure right now are taking steps to bolster civic technology and e-government. The Boston Mayor's Office of New Urban Mechanics is a model government project when it comes to leveraging technological tools and city data to make citizen services more efficient. As noted earlier, The Kansas City Playbook (published by the Mayors' Bi-state Innovation Team) details the cities' plans for maximizing the opportunities created by their gigabit network. It outlines pilot projects and strategies touching on digital inclusion, education, universal coverage, Wi-Fi hotspots, healthcare, arts and culture, and local government.

Agendas and Issues to Watch in the Next Administration

Although Donald Trump will be our next President, we are not sure who will occupy key positions in broadband policy. We can, however, know what some of the agendas and issues will be and their potential direction. As discussed below, several can impact the economics and options related to network deployments.

Municipal Broadband

As noted earlier, the FCC lost its effort to pre-empt state laws restricting municipal broadband efforts. The FCC declined to appeal the case to the Supreme Court. So the FCC's ability to legally undercut such laws is likely to remain limited. We note that a number of efforts have proceeded in states with such laws, and as more communities obtain next generation broadband through their own efforts, and as such broadband becomes more important from an economic development perspective, the ability for incumbents to convince legislatures to pass such laws will likely weaken.

An Access Agenda

As we look back at the history of communications networks, the deployment of networks capable of offering faster, better, and cheaper services always requires a new capital allocation decision. This is generally done by a private-sector party, but often follows government decisions that lower the cost of deployment or operations and/or increase potential revenue and competition. The 1978 Pole Attachment Act, for example, sparked an investment wave into cable systems by allowing cable to attach to utility poles. More recently, the fiber network

deployments and upgrades by Google, AT&T, and CenturyLink were stimulated by a variety of agreements between cities and the providers, as discussed in this Handbook, that improve the economics of the investments.

A continuing challenge, however, lies in assuring access to essential facilities. There are three basic categories: government-controlled inputs, such as spectrum at the federal level and rights of way at the local level; quasi-public essential facilities, such as utility poles and certain kinds of intellectual property developed through standards-setting bodies; and private assets that have become essential. Examples of these include the cable programming regulated under the 1992 Cable Act, the unbundled network elements at the heart of the Telecommunications Act of 1996, and the business data services facilities currently being debated by the Federal Communications Commission.

This is not a simple task. Nonetheless, Congress specifically told the FCC that it was responsible for the deployment of advanced communications networks and that it should "take immediate action to accelerate deployment of such capability by removing barriers to infrastructure investment." In other words, if the FCC thinks such deployment is too slow—and the current commission clearly believes it is—it ought to inquire whether there are barriers that ought to be removed.

As competitors try to deploy next generation networks, they have pointed to two places where they see significant barriers: utility poles and entry to multiple-dwelling units (MDUs).

As to poles, there is some existing federal regulation and, as discussed on page 39, new efforts by cities to lower the cost of pole access. Depending on the outcome of those local efforts, but particularly if the courts determine jurisdiction for regulation lies at the state and federal level, we could see the federal government ask why the current rules often require multiple construction crews to do what one crew could do. Just as both national and local governments are wisely adopting "dig once" policies for deploying below streets, we would expect the FCC and some states to explore a similar vision of "climb once" or "one touch" policies.

With MDUs, the law already bans exclusive access agreements, but there are still many MDUs where, as a practical matter, the residents cannot exercise free choice. We might expect the FCC to consider whether the failure to provide residents choice creates a barrier to broadband deployment, in violation of Congress' mandate. This would affect how cities approach their own plans, as cities often have a high percentage of their residents living in MDUs.

An Infrastructure Agenda

One of the few areas of agreement between the Democratic candidate, Hillary Clinton, and the President-elect, Donald Trump, is that both agreed there was a need for the country to spend more on infrastructure. While Trump has not yet laid out his technology-related agenda, cities making plans for upgrading their networks should pay close attention to policy debates in the first part of 2017 to determine if there are new resources to be utilized in upgrading networks for these future needs.

A Digital Inclusion Agenda

The FCC recently reformed its Lifeline program, which provides support for low-income individuals to stay on critical information networks. But this was not just about helping low-income people. It helps everyone. As a group of 44 mayors and city officials wrote in support of the reforms, "Getting more low-income households online will help modernize delivery of public services—facilitating more responsive and effective governance while lowering overheads for local government." The same would be true for federal government. A high-tech CEO group estimated the savings of transitioning the federal government to a more efficient digital platform to be $1 trillion over ten years. In short, many in government understand moving to the digital platform can save billions but that movement requires all to be on that digital platform. As an initial policy question, the government will have to consider whether the Lifeline reforms are sufficient to make complete the transition to digital delivery of public services.

But this is not just a function of traditional government services. When the mass market Internet emerged 20 years ago, many hoped it would lead to increased social equity. It was not irrational for us to believe that a medium in which the cost of distribution is zero could lead to a world in which the best products become available to all. After all, the Silicon Valley billionaire and any impoverished child with Internet access probably use the same search engine and same apps. As *Wired* magazine noted, refugees fleeing Syria often have the same smartphone as those in the 1 percent.

But we would have to be blind to believe social equity has improved in the last 20 years. As others have noted, venture capital has largely focused on addressing the pain points of the most well off, not the least well off. Further, as the White House has noted, algorithm-based services may lead to new forms of exclusion and discrimination.

In the last few years, there have been increasing calls for the government to adopt policies that enable all to participate in what we might think of as digital life, particularly for such services as health care, education, job training, and public safety. Again, we cannot know what the precise policies will be for improving inclusion in digital life. We can know that greater efforts at inclusion increase the value of, and the percentage of, adoption in traditionally low-adoption communities. Both have the impact of improving the economics of new deployments, as they bring new customers, and a greater willingness to pay, to the platform.

Top Ten Overall Lessons

Throughout this Handbook, we have identified the most important considerations for cities seeking to accelerate the deployment of next generation networks in their communities. This section distills these even further to a "Top Ten" list that provides lessons for all communities—regardless of size, density, or demographics—pursuing improved bandwidth for their businesses and residents.

Lesson 1: Organizing community resources and stakeholders is essential for making gigabit projects economically viable.

While different cities have different demographics, construction costs, and other variable factors that affect the feasibility of a gigabit capable network, communities that have moved forward share one driving force: a commitment to improving broadband availability. Any community has the ability to organize its resources and regulatory processes to lower capital expenditures, operating expenditures and risk, and raise revenues – the key to making gigabit projects economically viable. Also, any community with a vibrant tech or start-up community can leverage that energy to produce project support. These stakeholders are first adopters and already understand the "why" of gigabit speeds.

Lesson 2: Start with a clear understanding of how your city's rules and assets affect deployment costs.

The organizing effort starts with a detailed understanding of how communities' policies and assets affect the economics of network deployments. Gig.U, the Fiber to the Home Council, and others have developed tools for this exercise and public documents from the Google Fiber project also provide a roadmap for how cities should think about the impact of their rules and assets on network economics.

Lesson 3: Because it takes a long time to plan and deploy a network – and it always takes longer than you think – the right time to start thinking about how to improve the economics is today.

Every day, cities make decisions that can affect the cost of deployment. Every time a street is dug up, every time an area is developed or redeveloped, there is an opportunity to lower the cost of future deployment. Every time such actions occur without an eye toward lowering the cost of next generation broadband facilities, the future cost of such a network increases.

Lesson 4: Incumbents only respond to a potential change in the status quo. Inaction by a city leads to inertia in the market.

In every community we have worked with, action by the city has always led to a response by incumbent providers. Generally, that response is in the nature of an incremental bandwidth increase or some other kind of improvement designed to forestall a broader, community-led broadband upgrade. This is not to criticize the incumbents; it is simply to suggest that when it comes to cities and their broadband networks, the old saying, "The squeaky wheel gets the grease," turns out to be true. For example, without its RFP, it is doubtful that Los Angeles would have received a proposal by Time Warner Cable to accelerate its upgrade throughout the city. Similarly, Time Warner Cable's upgrade in North Carolina only occurred after the community-led efforts in that state.

Lesson 5: Cities who act will have to choose between the quick, short-term win and the harder, longer-term win.

When cities become "the squeaky wheel," they often have an opportunity to obtain some quick concessions from incumbents in exchange for stopping a process that opens the door to new providers. There is no general rule for responding. Some cities may best be served by taking what is in front of them, while others have the potential for far greater gains. What is certain is that cities should be prepared to analyze the short-term and long-term risks and opportunities so as not to be pressured into making a decision based solely on a desire for a "quick win." Rather, they should be looking toward the "art of the possible" by maximizing the long-term prospects for broadband abundance.

Lesson 6: While success depends upon broad support, it also depends on nimble decision-making.

One reason Google chose Kansas City as its initial project site was that the existing unified government structure gave Google confidence it would receive decisive responses on a variety of issues as the project proceeded. Other projects have not gone as smoothly because decision-making was diffuse across a number of constituencies. For a project to be successful, there must be a broad coalition of interests supporting it. At the same time, that coalition must have confidence local leadership will act quickly on behalf of all. Otherwise, there will be delays that ultimately raise costs and could injure the project's long-term prospects. Further, it is often difficult, within the existing local government structure, to find a high-level executive to "own" the project and assure its completion. Empowering such a person, and making sure the project is not an orphan, has been critical to the success of projects to date.

Lesson 7: There is no one-size-fits-all solution. There are multiple solutions to multiple community needs with multiple trade-offs. But all efforts improve the situation relative to the status quo.

As evidenced by the multiple ways in which Gig.U communities have approached the opportunities, there are many different ways to accelerate the deployment of a next generation network. Each has advantages and disadvantages. What is common to all, however, is that the cost to the community of such efforts is negligible and the benefits are significant. There is no cost to asking questions. Indeed, simply asking the right questions can cause incumbent providers to become more interested in how the city is thinking and more responsive to future needs. Competition – even the threat of competition – tends to improve the performance and the offerings of incumbents.

Lesson 8: Experiments don't always work the first time. That's why they are called experiments. Make sure the community leadership understands this and uses "lessons learned" to improve performance in successive iterations.

Pioneers don't have the advantage of a clear and certain map. In each of the efforts to date, mistakes were made. The key is not to let the mistake determine the fate of the project, but rather to figure out how to correct the error and continue to move forward. A good example of the right way to approach the long-term objective is the work of the Seattle Citizens Telecommunications and Technology Advisory Board. As a letter from the organization notes, the disappointment in the inability of Gigabit Squared to deliver on its promises did not diminish the centrality of world-class broadband to the economic future of the city, nor the citizens' interest in accelerating the deployment of a gigabit network. Indeed, as the Board stated, "Though we are disappointed in light of recent news that the Gigabit Squared initiative with Seattle no longer seems viable, the Citizens Telecommunications and Technology Advisory Board (CTTAB) wants to be clear in reaffirming our earlier position on broadband for the City… the Board (CTTAB) urges the Mayor and the Council to move forward without further delay to bring a Fiber-to-the-Premise network to Seattle… State-of-the-art Internet access is essential to Seattle's ability to compete and lead in the 21st Century global economy." The city continues to explore other options, with a recent study that provides a thorough review of the costs of deploying a next generation network.

Lesson 9: Scale matters.

As these projects are not cookie-cutters, there are significant start-up costs. In that light, scale is an advantage. The larger the ultimate addressable market, the more a provider is willing to risk those start-up costs. It is unlikely, for example, the eight respondents to the NCNGN project would have been willing to respond to six different RFPs. While the regional approach appears to be working there, it is important to remember the prior rule that quick decision-making also matters. So leaders of multi-community efforts must make sure the desire for scale does not result in complicated and lengthy decision-making.

Lesson 10: Above all, local leadership is the single most important ingredient for success. If there are local leaders who put this at the top of their agenda, it can happen. If not, it won't.

Gig.U is proud of how it created a national platform for communities to help each other chart a path whereby every member community benefits from the efforts of others. But the single most critical variable for success is not in Gig.U or any national organization. It has been, and always will be, local leadership. In every community where an effort has moved forward, there has been strong local political, business, and civic leadership that has made it a priority.

Conclusion – Eliminating Bandwidth Constraints

Each city brings its own set of challenges and advantages to this issue, but all cities serve to benefit from the presence of future-proof, next generation connections and the multiplier effects that come with them – distance learning, innovation districts, telemedicine opportunities, and a tech-friendly environment for business development (to name a few).

As costs, business models, norms, average speeds, and prices evolve, this Handbook will evolve with them. The fundamental idea of Gig.U, as well as this Handbook, is to create a roadmap of different approaches, so that all cities can benefit from what those communities, and others, have done. As Nassim Nicholas Taleb reminds us in his book, Antifragile, "Like Britain in the Industrial Revolution, America's asset is, simply, risk-taking and the use of optionality, this remarkable ability to engage in rational forms of trial and error, with no comparative shame in failing, starting again, and repeating failure." At its core, this Handbook is a recounting of the many ways communities have capitalized on that asset to engage in thoughtful risk-taking and trial and error for the sake of developing new models for creating bandwidth abundance.

With fiber deployments in 2016 on pace to have their highest level of year-over-year growth since 2008, we are optimistic that the next edition of this Handbook will showcase additional best practices and new innovative models, as well as more cautionary tales in the wake of new roll-outs and major market changes. Our prediction? More companies will announce city projects and more cities will experiment with community-led, innovative models. Then, as gigabit speed is pushed further from "exception" to "norm" through the next few years, the U.S. will see even more cities step up to publicly announce their interest in a network upgrade to stay competitive in the global information economy.

We began this Handbook by suggesting that all communities should want the kind of affordable, abundant bandwidth that insures that bandwidth is never a constraint on innovation, economic growth, or social progress. When we began several years ago, companies suggested they could provide abundant bandwidth, but at prices few, if any, could afford. Further, because of the huge incremental cost of building new, or upgrading old, networks, there was no pricing pressure on offerings of abundant bandwidth. What we have begun to see, however, is that if two or more providers deploy networks where the marginal cost of additional bandwidth is basically zero, the price for next generation services drops dramatically and bandwidth constraints become a thing of the past.

In that light, we encourage all prospective gigabit cities to take advantage of the variety of tools, resources, and institutions at their disposal (see Appendix) and to think creatively about how best to accelerate the deployment of a gigabit capable network. Smart experimentation benefits your own city and the lessons learned will benefit others. In the long run, this will improve how all communities can best take advantage of affordable, abundant bandwidth.

Appendix: Tools, Resources, and Links for Your Next Steps

Previous Reports from the Gig.U Project

"Upgrading America: The One Year Anniversary of Gig.U" July 2012

"Upgrading America: The Semi-Annual Report of Gig.U" February 2013

"Gig.U Y2" July 2013

"A Gigabit Garden Begins to Grow: Lessons from the First Planting" December 2013

"From Gigabit Testbeds to the Game of Gigs" August 2014

Glossary

"Astroturf" Organizations – Fake grassroots organizations that present themselves as non-profit or ground-up public interest organizations, but are primarily funded by private corporations.

Broadband Technology Opportunity Program (BTOP) – A grant program run by the National Telecommunications and Information Association (NTIA). BTOP was created in response to the American Reinvestment and Recovery Act (ARRA) as a way of boosting broadband adoption, improving infrastructure, and creating jobs.

Competitive Local Exchange Carrier (CLEC) – Telecommunications providers competing with existing established providers aka "incumbent local exchange carriers" (ILECs).

Dark Fiber – Fiber that is in place (aka in the ground), but not being used. Communities and business often deploy dark fiber during a construction project for other purposes, such as fixing sewer lines, as the incremental cost of such deployment is low, compared to the significant cost of construction solely for the sake of deploying the fiber. The fiber can be "lit" at such time as the demand justifies providing a service over the fiber.

Digital Divide – The gap that exists between people that have access to broadband services and know how to use the Internet and those that do not have such access or knowledge.

Digital Equity – According to the National Digital Inclusion Alliance, "Digital Equity ensures all individuals and communities have the information technology capacity needed for full participation in society, democracy, and economy. Digital equity is necesssary for civic and cultural participation, employment, lifelong learning, and access to essential services."

Digital Inclusion – According to the National Digital Inclusion Alliance, "Digital Inclusion is the activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to, and use of, information and communication technologies (ICTs). This includes 5 elements: 1) affordable, robust broadband Internet service; 2) Internet-enabled devices that meet the needs of the user; 3) access to digital literacy training; 4) quality technical support; and 5) applications and online content designed to enable and encourage self-sufficiency, participation, and collaboration. Digital inclusion must evolve as technology advances and recognizes that access to, and use of, ICTs are an essential element for participation in our society, democracy, and economy."

Fiber-Ready – When a community has fiber-friendly conditions including, but not limited to: a willing/interested local government, an engaged local community, streamlined permitting, measured broadband demand, and a dig once policy.

Fiber-to-the-Premises (FTTP)/Fiber-to-the-Home (FTTH) – High-speed Internet infrastructure that connects directly to residents' homes. By comparison, some communities have fiber infrastructure that connects business districts or community anchor institutions such as schools and hospitals.

Geographic Information System (GIS) – Mapping and data visualization tool to assist planners and policymakers in taking inventory of infrastructure assets, including assets essential to broadband deployment, and in analyzing local demographics – among other things.

Gigabit - Gigabit speeds are roughly 100x faster than average residential Internet download speeds in the U.S. today (approximately 10 Mpbs).

Google Fiber – Google's recent gigabit-capable Internet service business first launched in Kansas City (MO and KS), Provo, and Austin. Google Fiber is now expanding into Nashville, Atlanta, Charlotte, the Research Triangle Park communities in North Carolina, and Salt Lake City.

Infrastructure Financing District – A local policy lever allowing cities to use property tax increment financing in a district to support public infrastructure projects.

Innovation Zones/Districts – An innovation zone or district is a designated area in a city for start-ups, economic development, and/or civic technology. They can come about through bottom-up business activity or through top-down policies from the city governments to incentivize investment, new research, or new industries in a neighborhood.

Internet of Things (IoT) – The network of physical devices, vehicles, buildings, and other items—embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data.

Middle Mile – The wire line infrastructure that runs between the Internet service provider central office and Internet point of presence. Middle mile infrastructure connects places or communities to infrastructure, but doesn't connect individual homes or buildings.

Open Access Network – When the Internet service provision and infrastructure functions of a telecommunications network can operate separately. In other words – the company (or companies) who provide the Internet service do not own the infrastructure. Instead, the infrastructure can be used on a wholesale basis amongst several providers.

Point of Presence – A physical location that serves as an access point to the Internet. The location will usually have servers and routers.

Public-Private Partnership (PPP) – A term referring to any agreement or project jointly pursued by a public entity (i.e.: a city government) and a private entity.

Request for Information (RFI) – A public information gathering process – usually preceding an RFP. The purpose of an RFI is to collect information about the capabilities of potential project vendors/suppliers.

Request for Proposal (RFP) – A public bidding mechanism. When funding is available for a project, an RFP document is released to specify project goals. Then, vendors put forth bids in response to the RFP and one vendor is ultimately chosen to get the funding and complete the project.

Request for Qualifications (RFQ) – A public information gathering process similar to an RFI – usually preceding an RFP.

Right-of-Way – This term refers to the legal right that telecommunications providers need to set up their infrastructure. Rights-of-way can refer to the right for infrastructure to be connected to publically owned utility poles or cabinets.

Single Point of Contact – A consistent liaison between the public and private partners in a project. For instance, this means that, if the private company needs to know something quickly from a partnered city government, they can always contact the same person or office.

Smart Grid – An updated electrical grid that has a capability – either through analog or digital communications – to gather data and respond to it for cost saving or efficiency purposes.

Tax Incremental Financing (TIF) Districts – A public financing method that allows a city or county to use future gains in taxes projected from an improvement project to fund that improvement project.

Related Cases, Studies, and Tools for Gigabit Cities and Municipal Broadband

Resources	Summary
Benton Foundation, Digital Inclusion Initiatives Study	"Digital Inclusion and Meaningful Broadband Adoption Initiatives," written by Dr. Colin Rhinesmith, presents findings from a national study of digital inclusion organizations that help low-income individuals and families adopt high-speed Internet service.
Berkman Center Case Studies: Leverett, MA, Washington D.C., San Francisco, CA, and Seattle, WA	Detailed narratives of successes, challenges, and lessons learned from each fiber project.
CTC Technology & Energy, Broadband Strategies Checklist	A resource outlining preparatory work for communities pursuing gigabit strategies.
CTC Technology & Energy, Dark Fiber Lease Considerations	An overview of dark fiber pricing, pricing models, and customer identification.
CTC Technology & Energy, Facilitating Broadband Construction	A guide to fiber readiness.
CTC Technology & Energy, Gigabit Communities Report	"Technical Strategies for Facilitating Public or Private Broadband Construction in Your Community."
CTC Technology & Energy and New America's Open Technology Institute, The Art of the Possible: Overview of Public Broadband Options	An overview of different network ownership and governance models, and broadband technologies to help potential stakeholders understand the advantages and disadvantages of each technology.
Coalition for Local Internet Choice, Broadband Public-Private Partnership Guide	"The Emerging World of Broadband Public-Private Parnerships: A Business Strategy and Legal Guide" explores how emerging models present an alternative for communities that lack the capital or expertise to deploy and operate fiber networks, or to act as ISPs, on their own. Published by Benton Foundation.
Dallas Federal Reserve Bank, Closing the Digital Divide: A Framework for Meeting CRA Obligations	A report for the banking community outlining why and how banks can invest in improved Internet access and adoption projects in the communities they serve.
FTTH Council, Early Evidence Suggests Gigabit Broadband Drives GDP	A study found that gigabit cities had per capita GDPs 1.1% higher than non-adopters.
FTTH Council, Federal Resource Listing	A centralized list of federal grants, agencies, and programs that might assist a community's upgrade.
FTTH Council, Glossary	A useful reference for non-expert decision-makers seeking to understand the policies behind fiber upgrades.
FTTH Council, State Resource Listing	A centralized list of state grants, agencies, and programs that might assist a community's upgrade.
FTTH Council and Broadband Communities, What Fiber Can Do for Your Community - 2013	From the 2013 Broadband Summit, a great report answering the "why?" of gigabit fiber networks.
FTTH Council and Gig.U, Asset Inventory Worksheet	Downloadable Excel Workbook assisting with initial community assessment.
FTTH Council and Gig.U, RFP Templates	Downloadable, generic templates for different network models.
Gigabit Nation	An online radio show hosted by Craig Settles featuring municipal broadband projects and community leaders.
Google Fiber City Checklist	A collection of best practices to assist cities and fiber providers – whether they are future Google cities or not.

Figure 19: Cases, Studies, and Tools *(continued on page 62)*

Resources	Summary
Harvard Kennedy School study by Denise K. Linn	A mixed-method study, "A Data-Driven Digital Inclusion Strategy for Gigabit Cities," examines how the digital divide looks systemically different in gigabit cities and how gigabit cities and aspiring gigabit cities can move forward to address equity.
Institute for Local Self-Reliance, SandyNet case	In "SandyNet Goes Gig: A Model for Anytown USA," ILSR outlines the case of a community network which pioneered a low-risk incremental strategy to build its telecommunications utility.
Institute for Local Self-Reliance and Benton Foundation, Broadband at the Speed of Light	Case studies of Chattanooga, TN, Lafayette, LA, and Bristol, VA, and how they built next-generation networks.
Kansas Cities' Mayors' Bi-state Innovation Team, Playing to Win in America's Digital Crossroads	A publication by Kansas City, KS, and Kansas City, MO, about capitalizing on their newly-acquired next generation speeds.
Living Cities, City Accelerator Guide for Embedding Innovation in Local Government	A centralized, practical guide for fostering innovation in local government workers, projects and services.
MuniNetworks.org	A website with articles, reports, podcasts, maps, and other resources to assist communities seeking to build public broadband networks.
NTEN, Digital Inclusion Toolkit	NTEN, which runs the National Digital Inclusion Fellowship in partnership with Google Fiber, provides a toolkit of resources and case studies that build on knowledge of that fellowship program.
New America, Building Broadband Commons	A resource for local network planners – includes both U.S. and international cases.
New America, The Philadelphia Story: Learning from a Municipal Wireless Pioneer	A case study on Philadelphia's wireless network – how it was developed and the lessons to glean.
NTIA, Broadband Adoption Toolkit 2013	Best practices and lessons learned from the Broadband Technology Opportunities Program.
NTIA, Broadband USA	More tools, information, and news on broadband access and federal support.
NTIA, Broadband USA: An Introduction to Effective Public-Private Partnerships in Broadband Investments	A summary of cases and lessons gleaned from BTOP infrastructure grantees.
NTIA, BTOP Map	This map shows Broadband Technology Opportunity Project funded middle mile networks that communities can leverage or expand.
NTIA, Community Connectivity Toolkit	An overview of steps and tools for communities interested in pursuing a publicly built and run network.
SHLB Coalition, Anchor Institution Broadband Action Plan	"Connecting Anchor Institutions: A Broadband Action Plan," developed by the SHLB Coalition and published by Benton Foundation, provides ideas and actionable policy recommendations for government leaders to address anchor institutions' broadband needs.
State Broadband Initiative	A list of SBI-funded projects and studies by state.

Figure 19: Cases, Studies, and Tools *(continued from page 61)*

Public Documents of Interest

City / State	Agreement
Kansas City	Development Agreement – Google Fiber
Louisville	Franchise Agreement – SiFi Networks
Oregon	Franchise Agreement – Google Fiber Oregon, LLC
Philadelphia	Comcast Franchise Agreement
Raleigh	Master Network Development Agreement with AT&T
South Portland	Dark Fiber Use Agreement with GWI

Figure 20: Agreements Between Cities and ISPs

City / State	RFP / RFI / RFQ
Boston	RFI – Expansion of Boston Fiber Network
Chicago	RFQ – Broadband Infrastructure Expansion
Commonwealth of Kentucky	RFI – Statewide Middle Mile Fiber Optic Infrastructure
Los Angeles	RFI – Los Angeles Community Broadband Network
North Carolina – NCNGN	RFP – Next Generation Network
South Portland	Invitation to Bid – City Dark Fiber Infrastructure

Figure 21: RFIs, RFPs, and RFQs

City / State	City Report, Study, or Memo
City of Missoula, Missoula County	Next-Generation Broadband Feasibility Study for the BitterRoot Economic Development District
Palo Alto	Memorandum to Utility Advisory Commission Re: Feedback on the Development of a Business Plan for the Citywide Ultra High-Speed Broadband System Project
Salt Lake City	Google Fiber Feasibility Study
San Jose	Memo – Status of Google Fiber in San Jose as of May 2014
Seattle	Benefits Beyond the Balance Sheet: Quantifying the Business Case for Fiber-to-the-Premises in Seattle – City of Seattle Broadband Study
Utah	Utopia Network PPP: Milestone One Report

Figure 22: Misc. Public Reports and Studies

Organizations to Know and Follow

Organization	Website	Twitter
Benton Foundation	benton.org	@benton_fdn
Berkman Center	cyber.law.harvard.edu	@berkmancenter
Broadband Communities	bbcmag.com	@bbcmag
Coalition for Local Internet Choice (CLIC)	localnetchoice.org	@localnetchoice
CTC Technology & Energy	Ctcnet.us	@ctc_technology
Fiber to the Home Council	ftthcouncil.org	@FTTHCouncil
Google Fiber	Google.com/fiber	@googlefiber
Harvard Ash Center's Project on Municipal Innovation	Ash.harvard.edu	@HarvardAsh
Institute for Local Self-Reliance Community Broadband Networks	muninetworks.org	@communitynets
Living Cities	Livingcities.org	@LivingCities
Mozilla Gigabit Fund	Blog.mozilla.org/gigabit	@MozillaGigabit
National Association of Telecommunications Officers and Advisors (NATOA)	natoa.org	@NATOA
National Telecommunications & Information Administration (NTIA)	ntia.doc.gov	@NTIAgov
New America's Open Technology Institute	Newamerica.org/oti	@oti
New America's Wireless Future Project	wirelessfuture.newamerica.net	
Next Century Cities	Nextcenturycities.org	@NextCentCities
RVA Market Research & Consulting	Rvallc.com	
Schools, Health & Libraries Broadband (SHLB) Coalition	Shlb.org	@SHLBCoalition
U.S. Economic Development Administration Grants	eda.gov/grants/	@US_EDA
US Ignite	Us-ignite.org	@US_Ignite

Figure 23: Organizations to Know and Follow

List of State Laws Inhibiting Public Broadband

States	Law(s)
Alabama	Alabama Code § 11-50B-1 et seq.
Arkansas	Arkansas Code § 23-17-409
California	California Government Code § 61100 (af)
Colorado	Colorado Revised Statutes Annotated 29-27-201 et seq.
Florida	Florida Statutes § 350.81
Louisiana	Louisiana Revised Statutes Annotated § 45:484.41 et seq.
Michigan	Michigan Compiled Laws Annotated § 484.2252
Minnesota	Minnesota Statutes Annotated § 429.021
Missouri	Missouri Revised Statutes § 392.410 (7)
Nebraska	Nebraska Revised Statute Annotated § 86-575 and § 86-594
Nevada	Nevada Statutes § 268.086 and § 710.147
North Carolina	North Carolina Statutes Chapter 160A, Article 16A
Pennsylvania	66 Pennsylvania Consolidated Statute Annotated § 3014(h)
South Carolina	South Carolina Code Annotated § 58-9-2600 et seq.
Tennessee	Tennessee Code Annotated § 7-52-601 et seq.
Texas	Texas Utilities Code, § 54.201 et seq.
Utah	Utah Code Annotated § 10-18-201 et seq. and § 11-14-103 (4)
Virginia	Virginia Code § 15.2-2108.6 and Virginia Codes § § 56-265.4:4, 56-484.7:1
Washington	Washington Revised Code Annotated § 54.16.330
Wisconsin	Wisconsin Statute Annotated § 66.0422

Figure 24: State Laws Inhibiting Public Broadband

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