Gig.U
The University Community Next Generation Innovation Project

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

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Let's start with a question.

Is the wireline network that serves your community good enough to meet your needs 10 years from now?

If the answer is "yes", you're in luck. Because we can guarantee you will be able to have that network.

If the answer is "no", then the question is: what are you going to do about it? Because if current trends continue, what your community has today might well be what it has a decade hence.

That question should be answered now. Upgrading or deploying a new network is not a next day event. Planning, permitting, constructing and all the other phases take years.

Several years ago some communities answered that question no and decided to do something about it. Those early plantings are beginning to sprout.

The purpose of this Gig.U Fall Update is to review the lessons from those pioneering communities that sought to be among the first with world-leading broadband networks. We'll start with a review of what prompted communities to act, a summary of where they are now, a review of common strategies Gig.U communities followed and conclude with an outline of lessons learned.

Genesis of the Gigabit Garden.

The roots of the current effort to upgrade wireline broadband networks lie in an analysis done as part of the 2010 National Broadband Plan. A review of the publicly announced broadband investments revealed that for the first time since the beginning of the commercial Internet, there was no national wireline provider with a plan to build a better network than the currently best available network. Further analysis suggested that as Cable's DOCSIS 3.0 architecture provided cable with both a faster network (excepting Verizon FiOS territories, which covers about 15% of the country) and a cheaper upgrade path, the current investment math was unlikely to lead to the deployment of world-leading networks in the United States.

In the short-term, lack of such networks may not be significant. But in the long-term, the analysis suggested it was important that the United States had the human capital that knows how to design, build, operate and innovate on top off, not just good, but the best networks in the world. Only with that kind of human capital would the United States retain the innovation leadership that will find ways to improve business services, health care, education and many other sectors.

At the same time, communities across the country who wish to lead in the development of the bandwidth delivered economy were coming to understand that they needed demand-leading networks; networks that supply the kind of bandwidth beyond that generally needed by most consumers today, networks that remove bandwidth as a constraint to innovation.

While the Plan did not lay out an effective strategy for deploying such networks, the goal of a critical mass of communities with world leading networks was embraced by Google and led to the Google Fiber project. Over 1,100 communities applied for the Google Fiber network, demonstrating a deep understanding of the benefit of a world-leading network for community economic and social development. A subset of those applicants, communities with major research universities, decided to organize the Gig.U project to determine if by working together, they could accelerate the deployment of such networks.

Pioneer Communities.

In the last two years, there have been several different efforts to create gigabit networks in the United States, including by Gig.U communities, Google Fiber, individual communities, and, more recently efforts by incumbent providers.

Figure 1. Status of Gig.U communities as of November 2013

Community	Status
Cleveland, Ohio	Pilots at Case, Senior Center, Shaker Heights
Orono and Old Town, Maine	Staged built out lead by local ISP
Gainesville, Florida	Utility offering in new development
East Lansing, Michigan	Local ISP building out
Champaign-Urbana, Illinois	Reviewing RFP responses
Chicago, Illinois	RFP Awarded; in engineering
Seattle, Washington	RFP Awarded; in engineering
Raleigh, North Carolina	Reviewing RFP responses
Durham, North Carolina	Reviewing RFP responses
Chapel Hill, North Carolina	Reviewing RFP responses
Cary, North Carolina	Reviewing RFP responses
Carrboro, North Carolina	Reviewing RFP responses
Winston-Salem, North Carolina	Reviewing RFP responses
Connecticut	Various cost lowering measures
Blacksburg, Virginia	Gigabit Wi-Fi Zone operational
College Station, Texas	RFI Pending
Louisville, Kentucky	RFI Pending
Morgantown, West Virginia	White Spaces Pilot Operational

Gig.U

Gig.U formed with a question: could research university communities—which have attractive characteristics of demand, density, demographics and innovative cultures—change the math for world-leading network deployments? Working collectively where appropriate and tailoring their answer to local circumstances, 18 communities believe the answer is yes and have announced plans to move forward:

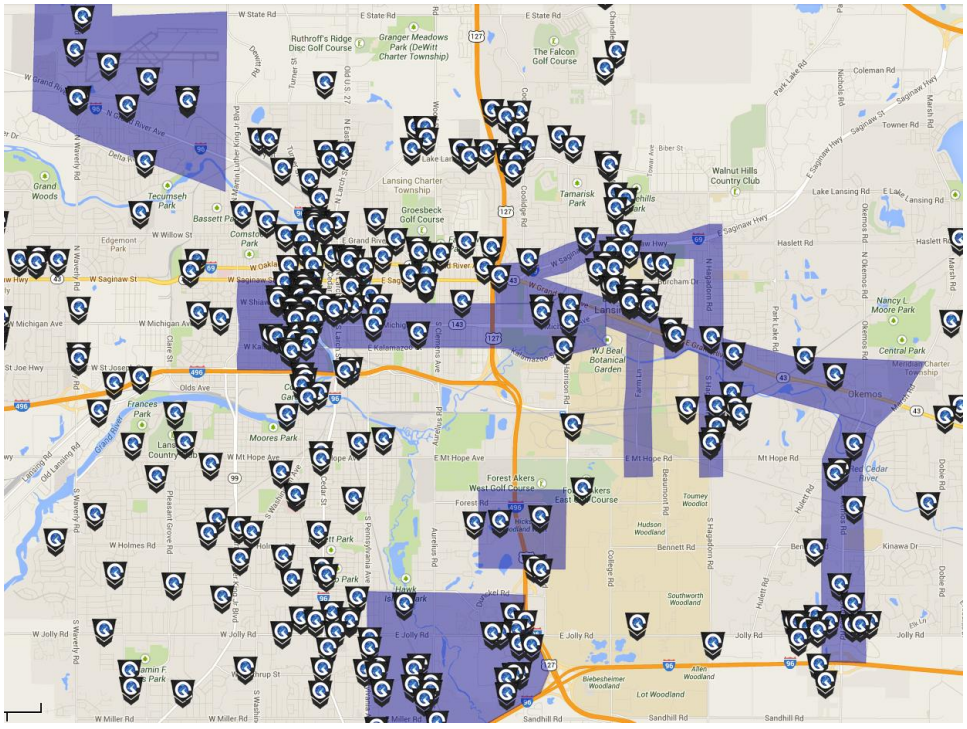
1. Cleveland, Ohio*:* Case Western Reserve University and OneCommunity, a nonprofit that owns and operates a high-speed all-fiber network in Northeast Ohio, built on the success of the Case Connection Zone—a gigabit beta block—by using gigabit connectivity to test how big bandwidth can be used to improve community wellness. Further, this September, the City of Shaker Heights (a part of the Cleveland metro area) and OneCommunity announced a partnership to bring Gigabit broadband to a neighborhood, creating the first Fiberhood in Northeast Ohio.

2. Orono and Old Town, Maine*:* A local ISP, GWI, is building mixed-use gigabit networks in a staged build out around the University of Maine. In July, the two municipalities jointly filed a grant application to the Northern Border Regional Commission for seed money to create a municipally owned, open access, FTTH network. A jointly owned entity will lease last mile fiber to ISPs, such as GWI, so they may provide retail services at gigabit speeds rather than the slower speeds supported by the currently leased copper local loops.

3. Gainesville, Florida*:* Gainesville Regional Utilities is building an Innovation Square surrounding the University of Florida with a gigabit service offering embedded in the development.

4. East Lansing, Michigan*:* Real estate owners and other public and private entities in the communities surrounding Michigan State University, are bringing gigabit networks to apartments—already serving over 12,000 subscribers-- and taking a multitude of steps to improve the economic environment for the deployment of a regional gigabit network.

Figure 2. East Lansing Gigabit Ready areas



5. Champaign-Urbana, Illinois: The University of Illinois and the cities of Champaign and Urbana collaborated to support the Urbana-Champaign Big Broadband (UC2B) project, initially supported by federal Broadband Technology Opportunity Program funds. Building off a successful deployment, the UC2B released a Request for Information seeking applications to extend the $29.4 million network to homes and businesses beyond the already-funded project area. The

coalition is reviewing those responses. In addition, the project has developed an aggressive community engagement strategy, signing up and pre-committing residents to ultra-high speed service to demonstrate demand. They are in the midst of converting the intergovernmental consortium to a 501(C)4 organization. More information is available here.

6. Chicago: In October 2012, the University of Chicago, in partnership with the State of Illinois and the City, announced a project to bring gigabit-speed fiber to over 4,825 residents, businesses, schools and healthcare institutions in the Chicago's Mid-South Side neighborhoods. As the project—called Gigabit Chicago—advances, based on neighborhood participation and adoption, next generation broadband access will be potentially available to as many as 210,000 residents who live in over 79,000 households as well as the 10,000 businesses in the area. Announcing the partnership, Illinois Governor Quinn noted, "Smart communities will foster the job engines of the future. To win in the information economy, we need information infrastructure that is second to none." In addition, the City of Chicago has released an RFI with its first goal being to "create an open-access gigabit fiber network in targeted commercial and industrial corridors to foster innovation, drive job creation, and drive economic growth.

7. Seattle, Washington: Following up on a Request for Interest issued in October 2012, in December, the City of Seattle, in partnership with the University of Washington announced the Gigabit Seattle project. A key component of the project is the city's ability to lease the excess capacity from the City's own extensive fiber network to private parties willing and able to provide the final element of connectivity.

The project includes three pieces:

- Fiber to the home and business
- Dedicated wireless gigabit to multi-family housing and offices
- Next generation mobile wireless Internet

While Seattle had a strongly contested mayor's race this fall, with the local cable provider, Comcast, contributing to the challenger, both the incumbent and the challenger—who won the election--supported the Gigabit Seattle effort, indicating that such projects have a broad base of public support.

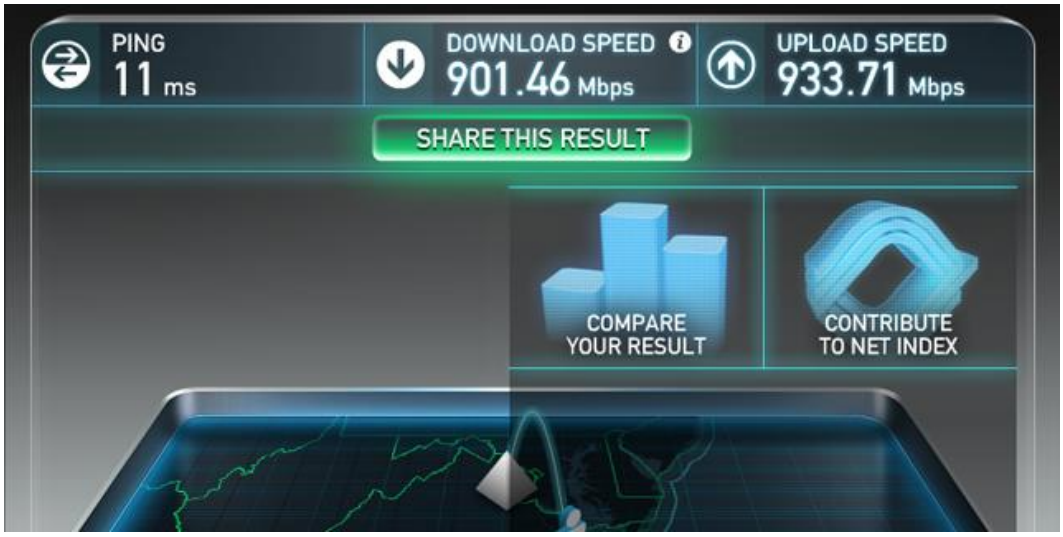
8-13. North Carolina Research Triangle/Winston-Salem: At the beginning of February 2013, a regional partnership, called NC Next Generation Network (NCNGN) composed of six communities (Cary, Chapel Hill, Carrboro, Durham, Raleigh and Winston-Salem) with the support of their Gig.U university partners (Duke University, NC State University, UNC Chapel Hill, and Wake Forest University/Wake Forest Baptist Medical Center) along with their associated Chambers of Commerce issued the nation's first regional Request for Proposals (RFP) for a next generation network deployment. Learning from and building upon the approaches taken by Chicago and Seattle, the RFP provides potential service providers with a clear statement of what the communities hope will be built, as well as commitments by the communities to improve the conditions for investment in the desired deployments. NCNGN received responses from eight different entities and is currently reviewing the proposals.

14. The State of Connecticut and the University of Connecticut System: Through a number of existing channels and new efforts, several interested policymakers have worked to make Connecticut's statutory and regulatory profile one that creates an open and competitive market based on easy and rapid access, with the statewide regulator engaged in reducing entry barriers. This includes:

- Relying on the state's 2007 video-provider statute that creates a Certified Competitive Video Service Provider, simplifying the process of becoming a video service provider;
- Offering access to the state's Nutmeg Network, which provides multiple fiber lines into each of the 169 towns and which is maintained by the state IT department from a data center in East Hartford. In addition to hundreds of libraries and schools across the state, since the BTOP build-out, the municipalities are beginning to lease access. Legislation was enacted to create a governance board to promote the Network to educational institutions, libraries, and all 169 towns, including requiring each town to file an application for interconnection, with $2mm in state funding made available to assist in connecting municipal buildings;
- Creating a Single Pole Administrator, which it is anticipated will be implemented this year, which will use a statewide database of all pole attachments to provide all attachers with scheduling support for work. The two electric companies have proposed performing the administrator role to begin managing access to the poles, with standardized attachment agreements; and
- Revising the Municipal Gain Statute, which allows all 169 towns and other entities (e.g., DOT) access to dedicated space at the top of the telecommunications stack without licensing fees, expanding its scope to include municipal use "for any purpose"—though municipalities are responsible for make ready costs.

15. Blacksburg, Virginia. In September 2013, the Town of Blacksburg, working with a local tech entrepreneur and Virginia Tech, announced a new broadband service in the downtown area consisting of a Wi-Fi offering connected to a Gigabit network. The Wi-Fi is open to the public and is free of charge. The service currently supports a local business incubator and adjacent restaurants, but plans are to expand to other high-traffic areas such as the library, schools and additional downtown restaurants, as well as other strategic locations in Blacksburg. The project is a result of the community successfully using crowd funding to raise funds for equipment and labor. The project has already enabled the development of next generation applications such as a gigabit-enabled fitness application.

Figure 3. Speed test result from the Blacksburg, VA Gigabit Wi-Fi project



16. College Station, Texas. In October 2013, the Research Valley Technology Council, an economic development organization for Bryan and College Station, Texas, released an RFI, inviting network operators to build a gigabit residential network and to offer 100 gigabit connections to local businesses. The Council recently held an information session, which was attended by a number of potential providers.

17. Louisville, Kentucky. In November 2013, the city of Louisville, Kentucky released an RFI similar to the College Station RFI. The request has three goals:

- Creating a world-leading gigabit-capable network across the city or in targeted commercial corridors, as well as in residential areas with demonstrated demand, to foster innovation, drive job creation and stimulate economic growth;
- Provide free or heavily-discounted gigabit 100MB (minimum) internet service over a wired or wireless network to underserved and disadvantaged residents across Louisville;
- Deliver gigabit internet service at prices comparable to other gigabit fiber communities across the nation.

In addition, some rural communities are using currently unused spectrum to accelerate a step function increase in bandwidth. These include:

18. Morgantown, West Virginia: The nation's first campus 'Super Wi-Fi' network launched in July, 3013 at West Virginia University. West Virginia University has partnered with AIR.U, the Advanced Internet Regions consortium (a project which has its own roots in the Gig.U effort and in which Gig.U is a founding member), to transform the "TV white spaces" frequencies left empty when television stations moved to digital broadcasting into much-needed connectivity for students and the surrounding community. The initial phase of the network provides free public Wi-Fi access for students and faculty at the Public Rapid Transit platforms, a 73-car tram system that transports more than 15,000 riders daily. More information can be found here.

The University of New Hampshire is also working on a similar white spaces test bed project.

On November 14, the team that is coordinating the AIR.U project announced a "Quick Start" program to enable all AIR.U participating institutions to run projects similar to the West Virginia project.

Google Fiber and Other New Entrants.

Google has announced gigabit network projects in Kansas City, Austin and Provo. While we have no knowledge of Google's plans for expanding beyond those three communities, we note that Google has suggested that it has found a way that such projects can be a "money maker."

It should be noted that Google is not the only non-incumbent service provider to offer world-leading networks. Sonic.net offers services to several communities in Northern California and just announced it would be offering gigabit service in Santa Rosa. Mississippi-based C Spire recently announced the community finalists in its contest to build a Gigabit network in a community in the state.

Individual community efforts.

There are a number of communities that have charted their own individual paths to obtain a network upgrade. In contrast with the Gig.U and Google Fiber projects, several of these projects are premised on municipally-owned operations. Chattanooga has a gigabit service offered by the municipally-owned electric utility. Lafayette, Louisiana, Longmont, Colorado, and Wilson, North Carolina involve municipal operations. In addition, there are a number of small communities that have been able to build fiber to the home networks. Some of these projects, being in high-cost areas, are supported by the federal Universal Service funds. The Institute for Self-Reliance, which provides the most extensive resources about such efforts, has a map that identifies over 40 communities in 13 states with a publicly owned network offering 1 gigabit services, while the Fiber to the Home Council has compiled a list of 22 known gigabit fiber to the home providers.

Recently, other communities have looked to build out gigabit networks by focusing on high-demand areas, generally involving universities, such as St. Louis' effort adjacent to Washington University. Other communities have hired consultants to lay out options for obtaining next generation networks, including Baltimore and Missoula, Montana. The City of Los Angeles just announced a Request for Proposals to bring the city both a gigabit network and a free Wi-Fi service.

Incumbent providers.

Initially, incumbent ISPs responded to efforts to build gigabit networks by suggesting that there was no demand for such networks. Recently, however, incumbents have looked more favorably about such networks. CenturyLink announced projects in sections of Omaha and Las Vegas, with indications that it is considering upgrading other of its networks. Time Warner Cable announced its intention to respond to the RFP in North Carolina, while also improving their offerings in Kansas City and Austin, in response to Google Fiber's offerings. Comcast has similarly responded to Google's efforts in Provo.

AT&T has announced a plan to offer a gigabit service in Austin and suggested it would offer the service in other communities as well. AT&T's CEO Randall Stephenson recently noted two reasons why the company is looking more seriously at fiber to the premise upgrades. First, he said that "(c)ities and municipalities are beginning to hold up their hands and say we would like you come in and invest. And they're actually beginning to accommodate and tailor terms and conditions that makes it feasible and attractive for us to invest. That being the case, you will see us do more and more cities around the country. I fully expect that to happen." Second, he said that "(t)he cost dynamics for deploying fiber have radically changed. And it's just the interfaces at the homes, the wiring requirements, how you get it dropped to a pole and splice it. It's just totally changed the cost dynamics of deploying fiber."

International efforts

Other countries have been leading the charge with gigabit to the home networks. Prior to the recent round of deployments in the United States, gigabit fiber networks were deployed in Korea, Japan, Hong Kong and Sweden. More recently, projects have been announced in Taiwan, in Vancouver, Canada, in Israel—which will provide gigabit connectivity to the entire country—and in New Zealand, which involves a contest in which 50 towns registered to compete. Last week, the British fiber provider CityFibre announced the first partnership, with the city of Peterborough, as an initial step in its "vision of creating Gigabit cities throughout the UK."

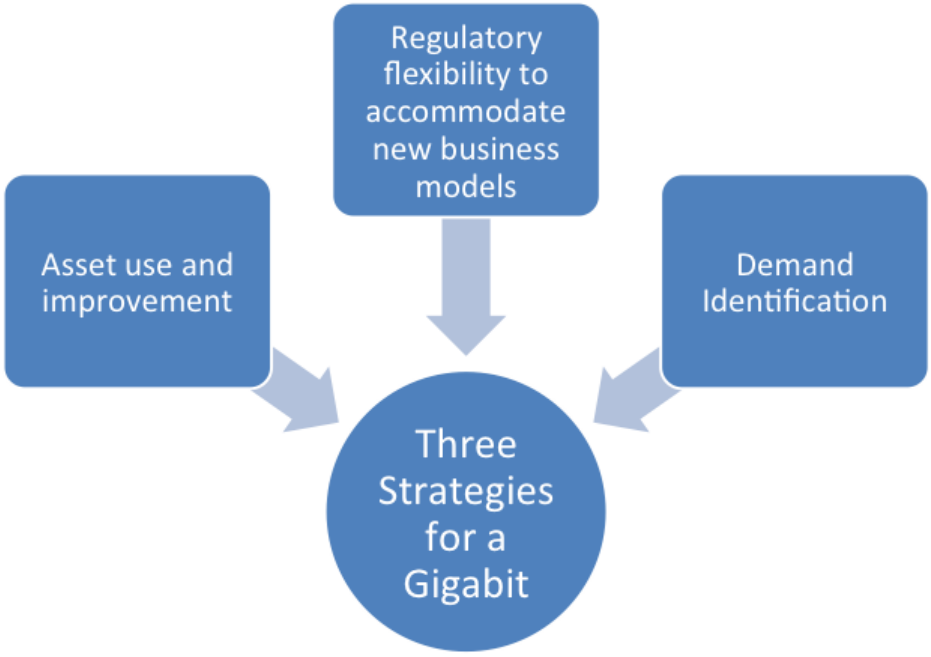
Key Strategies

For U.S. communities seeking gigabit speeds at affordable price points, strategies from abroad have limited value, as they often reflect national strategies or market structures not to be found in the United States. In addition, a number of states restrict municipal or public support for next generation networks, and the number of communities that can rely solely on universal service support, or on Google expanding its network is inherently limited.

On the other hand, *all* communities can benefit from the experiences of communities over the last several years, particularly of the Gig.U communities, that demonstrate that there are three strategies that all communities could, and in our view, should, develop to stimulate investments in better networks. These strategies are:

- Asset use and improvement;
- Regulatory flexibility to accommodate new business models; and
- Demand Identification.

Figure 5. Strategies for a Gigabit



Asset use and improvement. Assets—including rights-of-way, access to ducts and conduit, building access, location of existing fiber assets, as well as how available that information is to potential providers—affect deployment costs. And every city has assets that, if used more efficiently or improved, could lower the cost of deploying next generation networks. Gig.U has developed an inventory to help communities determine their asset profile.

As a next step, cities should consider policies that make rights-of-way and poles available to providers on a clear and reasonable basis though a rapid approval process. Cities should also ensure that make-ready work for pole attachments is done expeditiously, coordinate with providers to save costs and allow those providers to perform the work through approved contractors.

Cities can also act—with minimal cost—to upgrade assets to substantially reduce the cost of new networks. For example, cities can install ubiquitous fiber conduit or even dark fiber that can be leased in exchange for agreements to provide certain services. With a "dig once" philosophy that requires conduit or fiber installation anywhere there is road construction, cities can reduce deployment costs along roadways by 90 percent while adding less than 1 percent to the cost of construction, and also, minimizing disruption to neighborhoods. Indeed, it was Seattle's long history of doing so that put that city in the lead among Gig.U communities building out world leading networks.

Regulatory flexibility to accommodate new business models. Private capital-driven projects like Google Fiber or some Gig.U efforts have found success under a model where individual neighborhoods determine where the service will be built out to first through pre-commitments to buy the service. That is, while the service provider offers the service over a broad area, it only is obligated to build in specific neighborhoods where a minimum number of buyers pre-commits to purchase the service. While it is too early to draw any hard conclusions, in the most advanced case, Google's Kansas City project, 90 percent of eligible neighborhoods qualified, working out to nearly universal coverage of the community. When communities adopt a policy allowing this business strategy, it can dramatically reduce capital expenditures by both lowering the investment risk and facilitating a more efficient neighborhood-by-neighborhood build instead of a costly house-by-house build.

Cities that have attracted next generation networks have also been flexible in expediting permitting and inspections. In construction time is not just money; it's a lot of money. Speeding these processes lowers costs.

Demand Identification. A third principal strategy is demand identification. The pre-commitment tactic noted above serves to identify demand. Google and Gig.U communities have also experienced some success by creating a web site that serves as a one-stop shop for gathering those pre-commitments.

New York City offers another approach, relying on greater transparency and competition in targeted areas, to bring together demand for higher bandwidth, thus improving the economics of deployment for those areas. The city is assisting small and medium-sized businesses in unwired or underwired buildings by offering them free, fast-track wiring.

Whatever the choice of tactics, cities should approach the opportunity as it would if going after any important economic development project. When that happens, city agencies, anchor institutions, like universities and health care facilities, major business interests and other community institutions come together to pitch in various ways and to make the economics work for the project. So here, bringing together major beneficiaries of abundant bandwidth helps providers have the confidence to invest in better networks.

Lessons Learned.

The experiences over the last several years have also provided many lessons for all communities that that wish to have improved bandwidth for their businesses and residents. These lessons include:

- *Organizing community resources and stakeholders are essential for making gigabit projects economically viable.* While different cities have different demographics, different construction costs, and other variable factors that affect the feasibility of a gigabit network, communities that have moved forward are similar only in that they have decided to make improving the

broadband available to the community a high priority. Any community has the ability to organize community resources to lower capital expenditures, operating expenditures, risk and raise revenues—the key to making gigabit projects economically viable.

- *Start with a clear understanding of how your city 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 the public documents from the Google Fiber project also provide a road map for how cities should think about the impact of their rules and assets on network economics.

- *As 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 a future deployment.

- *While success depends upon broad support, it also depends on quick decision-making.* One reason Google choose Kansas City as its initial project was that the unified government structure gave Google the confidence it would get quick decisions on a variety of issues as the project proceeded. Other projects have not gone as quickly as hoped due to multiple decision makers. For a project to be successful, there must of a broad coalition of interests supporting it, but that coalition must have confidence in the local leadership to enable that leadership to act quickly on behalf of all; otherwise, there will be delays that ultimately raise the costs and could injure the project's long-term prospects.

- *There is not one-size fits all solution; there are multiple solutions to different community needs. And there are multiple trade-offs. But all efforts improve the situation relative to the status quo.* As one can see from the multiple ways in which Gig.U communities have approached the opportunity, there are many different ways to accelerate the deployment of a next-generation network. Each has advantages and disadvantages relative to alternative approaches. 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 causes 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 performance.

- *Scale matters.* As these projects are not cookie-cutters, there is a significant start up cost. In that light, scale is an advantage; the larger the ultimate addressable market, the more a provider is willing to risk that start up cost. It is unlikely, for example, that the eight respondents to the NCNGN project noted above would have been willing to each 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 larger efforts must make sure the desire for scale does not result in complicated and lengthy decision-making.

- *Experiments don't always work the first time. That's why they are called experiments. Make sure the community leadership understands this and that there is a path to learn from experiments and 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 are 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.

- *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 can be proud of what it has done over the past several years. It has provided 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 local leadership. In every community where an effort has moved forward, there has been strong local leadership that has made it a priority for local political, business and civic leadership.

Conclusion. *Thinking Ahead to the Bandwidth Delivered Economy.*

In looking back over the last several years of Gig.U activities, we see two big changes. First, an increasing number of cities are recognizing the importance of upgraded broadband networks for economic development purposes. It is different than having a phone network, which was a binary; one either had dial tone or one didn't. It is different than cable, which in its early decades was fundamentally about entertainment. Broadband networks are diverse in character and there is a wide spectrum of capabilities. But in an information driven economy, the better the network, the better the economic development prospects.

Second, an increasing number of cities are recognizing their role in the economics of investing in networks. Both within the Gig.U membership and with many other communities we have talked with, city leadership recognizes that it has to adopt new strategies to make the math for upgrades work. Not all cities have adopted this view, but Randall Stephenson's comment about cities

becoming more interested in improving the investment climate, cited above, is no small thing.

In approaching this opportunity, no two cities are identical. But just as a century ago, when all cities had to start thinking differently about common infrastructure—land for an airport, roads that could handle cars and trucks, access to water and inputs for electricity for manufacturing and growth—so today, all cities have to be prepared for an economy that will increasingly be delivered over bandwidth.

This will mean different strategies for different cities, but the bottom line for all is this: in ten years, whether a city has faster, cheaper, better broadband networks will affect everything a it does; today many things a city does affects what kind of broadband networks it will have in ten years.

In this light, every city can be a gigabit-ready city.

A few years ago, that seemed liked a distant vision. Thanks to the efforts of local leadership in communities all around the country, that vision is now within view, no longer beyond the horizon.

This is not the moment to pop the champagne corks. We are not past a tipping point where it is inevitable that gigabit networks will become commonplace; indeed it is very early in the process. Some of the current efforts will no doubt face set backs. But enough progress has been made over the last two years that we can be optimistic that enough early seeds will sprout and point the way for all communities that wish to have faster, better, cheaper broadband to take action to make it so.