BROADBAND MODELS FOR UNSERVED AND UNDERSERVED COMMUNITIES

EXECUTIVE SUMMARY

High-speed internet networks have connected America to an extent unprecedented in our history, bringing advances like digital commerce, telehealth, online education, and digital media to large cities, small towns, and everywhere in between. In recent months, the COVID-19 pandemic has emphasized the importance of our collective connectivity, with millions more people working and learning from home and nearly all of us looking to stay in contact with friends and loved ones.

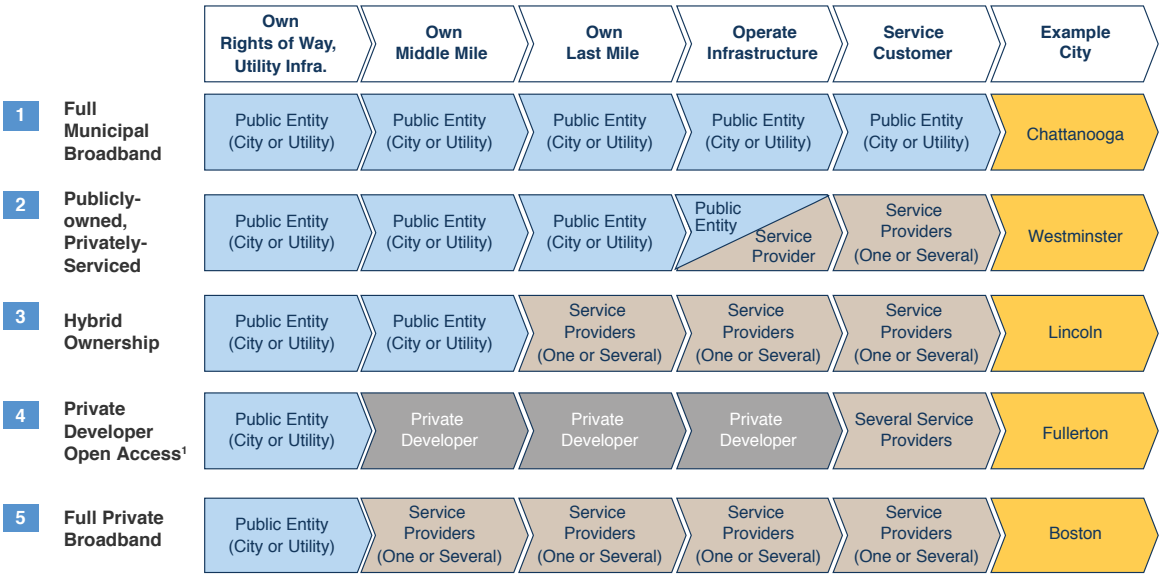
However, using conservative assumptions, we estimate that more than 6,500 U.S. municipalities – nearly one-third of all cities – still lack access to the fast, reliable internet that makes all this possible. Closing this gap is about economic opportunities for rural and urban districts but also addresses quality of life issues for millions of Americans.

The good news is that there is consensus among the major stakeholders that expanding high-speed internet access should be a major priority. Closing the digital divide has been a longstanding policy priority of the U.S. Government, the private sector continues to expand fiber deployments, and there are several communities where the local government is stepping in to ensure improved broadband access. In addition, our analysis shows new strategies emerging for service expansion, particularly where municipal governments are involved.

Altman Solon worked with US Ignite to create a guide for communities considering ways to expand broadband service. The guide includes models for fully private and fully public broadband networks, but also covers a growing range of municipally enabled broadband strategies that rely on a combination of public and private investment. It's intended to help communities understand how much capital is needed for different models of deployment, what returns to expect, and finally how to avoid the most common pitfalls.

We have assembled an extensive database of 1,000+ municipally enabled broadband programs, analyzed publicly disclosed information and case studies, and conducted in-depth interviews with key city officials. We discovered that, despite the many ways that cities have gone about implementing their broadband programs, there are five main ways to do it, each requiring a different level of investment and engagement from the municipality:

City Main Business Model Options for Broadband Expansion



Note: 1) Private Developer is defined as private company that builds, owns and operates the network infrastructure and offers open access to it to several retail SPs that provide service on the top

A vast majority of cities with municipally enabled programs (68%) have chosen to build and operate their networks through a public entity, which is either a public utility or the municipality itself (Model 1). Recently, however, more communities have shown interest in combining public efforts with involvement from the private sector. This can include engaging commercial partners solely for delivery of internet service (17% of cities chose Model 2), or teaming up with private companies that own all or a subset of local broadband infrastructure (remaining 15% chose Models 3-5).

Ultimately, decisions of which model to pursue should carefully weigh the amount of capital available, existing infrastructure and operating capabilities, viability of bringing in private parties, and local support for the initiative. For example, models with significant municipality engagement (1-2) are most suitable for cities with existing utility infrastructure, ample capital and strong local support, or smaller cities where private capital is unlikely to materialize. In other situations, bringing in a private partner can significantly de-risk operations and eventually increase the success of the program.

The shift towards private involvement that we have observed is partly a result of significant capital required to deliver a city-wide fiber internet and the complexities involved in planning and delivery of the service. For example, a city with 100,000 residents should be prepared to spend approximately $150M+ of capital, with operating margins often less than 50%.

This calculus will still make sense for a subset of cities, and successful municipally owned networks can deliver relatively healthy IRRs (9%-16%, depending on model), but those that choose this route should be prepared for challenges along the way. To maximize chances of success, rather than take a "one-size-fits-all" approach, cities that choose to build networks without engaging private partners should explore all the many sources of funding available to them and build a detailed business case that considers the unique characteristics of their city. To offset the unavoidably high cost of building the network, cities should be creative in leveraging the fiber network to serve non-residential customers (e.g., enterprises), deliver non-broadband services (e.g., voice) and use it for other means (e.g., smart cities or backhaul for fixed wireless deployments), but start with "quick-win" opportunities first to gain traction.

While working with the private sector avoids the many budgeting and costing issues mentioned above, it brings about a different set of challenges. First, attracting attention of private ISPs, particularly for smaller cities, could be a challenge. Cities should be persistent in soliciting private engagement and think creatively about how to entice private cooperation. For example, streamlining permitting and rights-of-way, enabling access to backhaul and middle mile infrastructure (if such exists or can be leased), becoming the anchor institution for the private ISP, or co-sponsoring an Open Access network and enlisting a Private Developer to sign up the ISPs (Model #4) all can improve chances of finding a partner. Once a partner is found, it is also important to clearly define rules and goals for the program to maintain some degree of control and ensure city objectives are met.

Despite these challenges, we have seen many examples where cities were able to overcome initial difficulties and build a successful program. Municipalities can be powerful vehicles of change and help close the digital divide. We hope that this document helps cities across the nation with that important goal.

BROADBAND MODELS FOR UNSERVED AND UNDERSERVED COMMUNITIES

Most cities in the U.S. have fast, reliable broadband networks available to at least a subset of homes, but a large share of population still lives in areas that remain underserved and unserved. While the U.S. Government and independent private sector efforts are helping narrow this digital divide, municipalities themselves are increasingly taking a role in addressing lack of broadband in their communities.

Situation

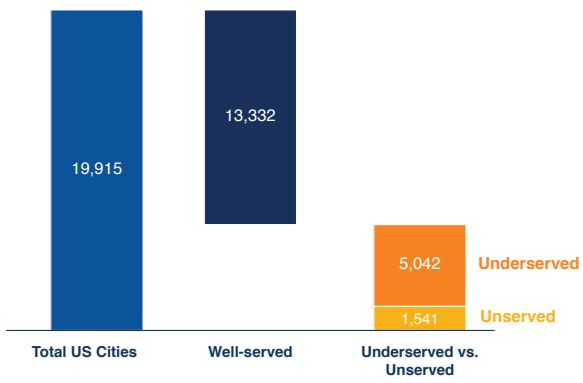
America's high-speed internet networks have the potential to push our society into the future. They are critical both outdoors, where they enable increasingly smart devices, vehicles and even entire cities, and are also pivotal in our homes which often double as digital workplaces and entertainment supercenters. This is truer now than ever before, with millions of Americans relying on internet connections to work, shop, and socialize from home. But, using conservative assumptions, we estimate that more than 6,500 U.S. municipalities still lack access to the fast, reliable internet that makes all this possible.

There are multiple forces working to expand fast, reliable broadband to the nation's communities in the greatest need. The Federal Government is involved. Currently, the FCC is offering $20.4B through its Rural Digital Opportunity Fund (RDOF) for areas without internet access at or above 25Mbps. Likewise, small ISPs, larger cable operators, and national carriers are all expanding. Unfortunately, these solutions cannot bring all U.S. cities the fast, reliable broadband they need. Not all cities will benefit from these subsidies and investments, and even the ones that do may still end up with unreliable or slow broadband. Many existing broadband networks require major investments and overhaul to support rapidly evolving broadband use cases, but frequently only receive small incremental upgrades.

U.S. CITIES BY BROADBAND AVAILABILITY AND TIER

U.S. Cities by Broadband Availability

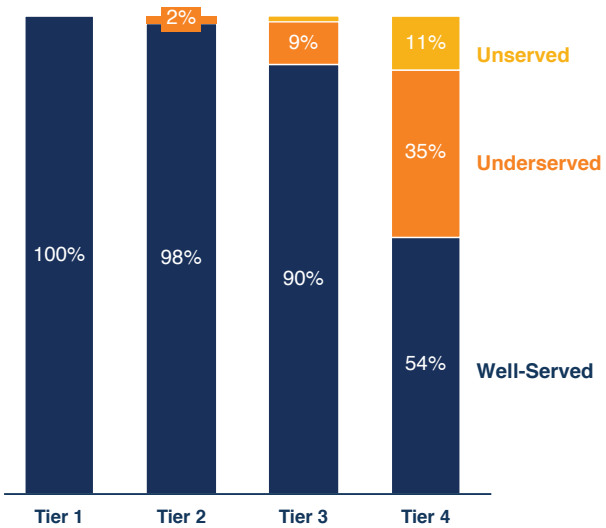
(Unserved: 50%+ of city with access to at most 25 Mbps BB speed
Underserved: 50%+ of city with access to at most 250 Mbps BB speed
Well-Served: 50%+ of city with access to 250+ Mbps BB Speed)



Using conservative assumptions, nearly 1 in 3 U.S. cities lack access to high-speed internet, disqualifying their residents and businesses from multiple emerging technologies

U.S. Cities by Broadband Availability and Tier

(Unserved: 50%+ of city with access to at most 25 Mbps BB speed
Underserved: 50%+ of city with access to at most 250 Mbps BB speed
Served: 50%+ of city with access to 250+ Mbps BB Speed)



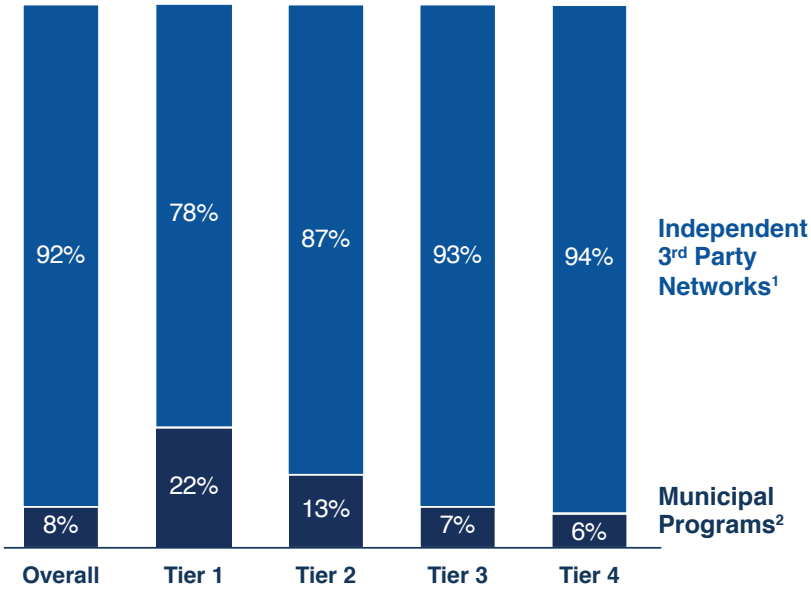
Tier 1: Cities ≥100k Households
Tier 2: Cities ≥10k Households
Tier 3: Cities ≥1k Households
Tier 4: Cities <1k Households

The digital divide doesn't affect all cities equally either: smaller cities are especially vulnerable, with 99.7% of unserved or underserved cities containing a total of 10,000 households or less

With this digital divide remaining despite government and private sector efforts, municipalities are increasingly taking it upon themselves to enable fast, reliable internet access for their communities. Where incumbent providers and federal funding fall short, cities are creating municipal ISPs, finding novel ways to incentivize private partners to enter their market, and/or working hand-in-hand with private developers and ISPs to reach their goals.

U.S. Well-Served Cities by Municipal Engagement

(Well-Served: 50%+ of city with access to 250+ Mbps BB Speed)

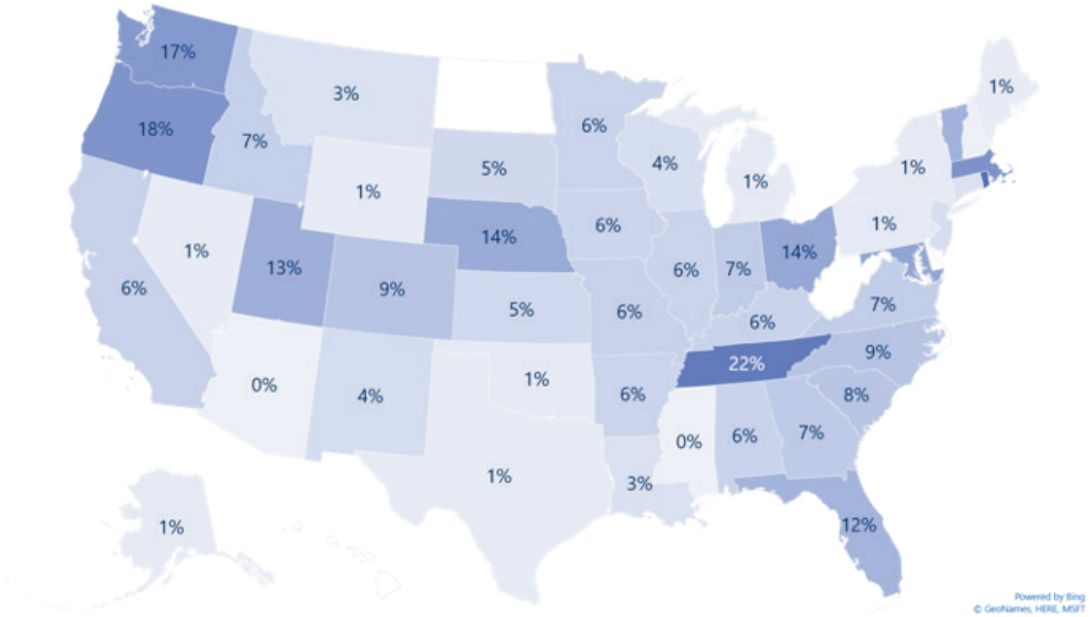


Note: 1) Cities with Municipal Programs are those where the public entity (city or utility) was involved in making broadband available across the city (e.g., by providing it themselves or enabling the private sector) 2) Cities with independent 3rd Party Networks defined as those where the public entity did not contribute to the enablement of broadband access

These "Municipal Broadband Programs" are not a new solution, but rather a growing one. Nationwide, 8% of well-served cities in the U.S. – slightly more than 1,000 in total – are served by some form of municipally enabled program. These programs are seen from large cities, to small rural towns of a few thousand residents.

Estimated % of Homes in Cities with Municipal Broadband Programs by State

(Homes in Cities with Municipal Broadband Programs Over Total Homes in the State)



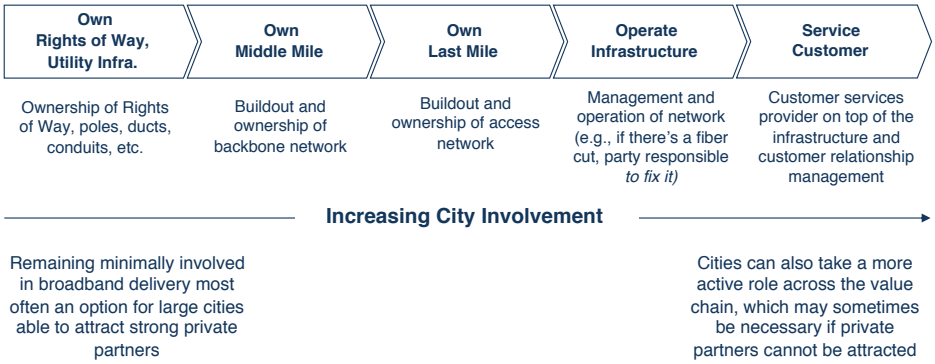
Municipally enabled networks are not specific to a particular region; they are spread across the U.S. Though municipal involvement is more prevalent in some areas than others, as shown in the map above, there are few states with no municipal broadband programs. While these programs face challenges from legislative barriers to their own operational complexity, many have found successful approaches.

Altman Solon worked with US Ignite to create a guide to help those municipalities that choose to play a leading role decide how to expand internet access in their communities, understand how much capital is needed and what returns to expect, and finally how to avoid the most common pitfalls. We have assembled an extensive database of 1,000+ municipal broadband programs, analyzed publicly disclosed information and case studies, and conducted in-depth interviews with key city officials, of which there are many that contributed invaluable knowledge and experiences to the creation of this report.

BUSINESS MODELS

We analyzed 1,000+ municipal broadband models and found that the primary way municipalities differentiate their broadband programs are by their engagement in network ownership, operations, and service delivery. This variability in ownership gives rise to five models differentiated along a value chain of asset ownership and broadband delivery:

Infrastructure Ownership and Service Value Chain

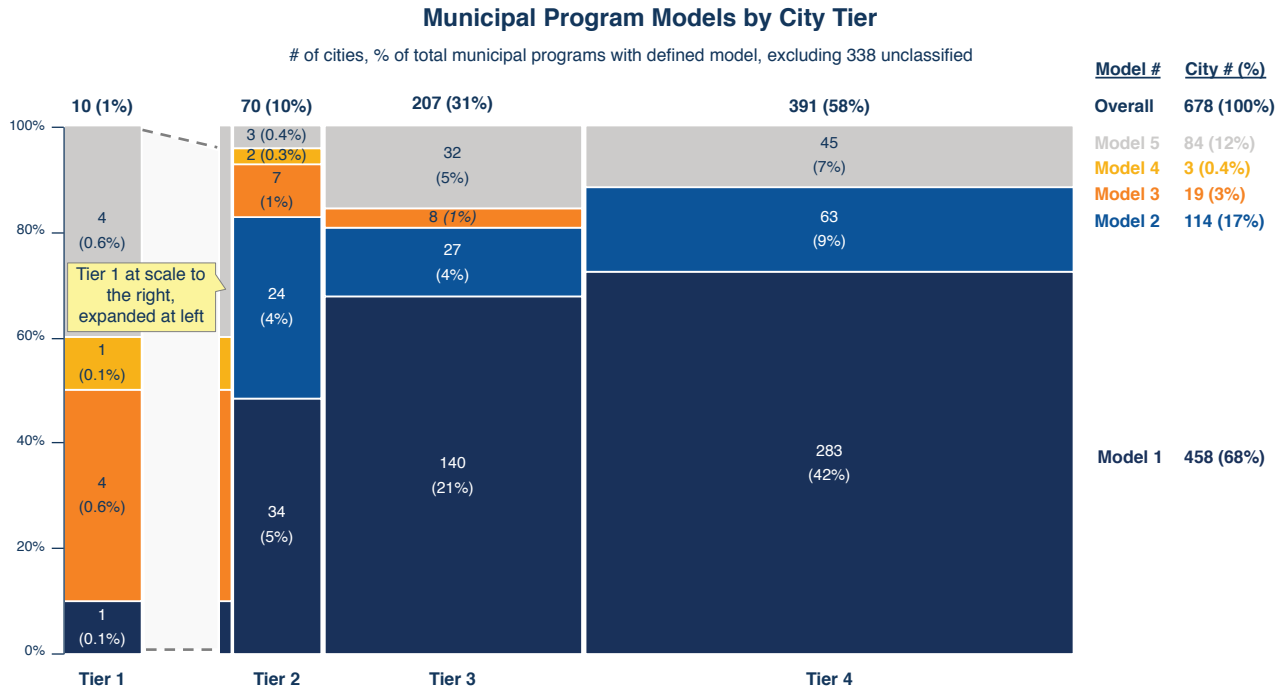


City Main Business Model Options for Broadband Expansion

		Own Rights of Way, Utility Infra.	Own Middle Mile	Own Last Mile	Operate Infrastructure	Service Customer	Example City
1	**Full Municipal Broadband**	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity (City or Utility)	Chattanooga
2	**Publicly-owned, Privately-Serviced**	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity / Service Provider	Service Providers (One or Several)	Westminster
3	**Hybrid Ownership**	Public Entity (City or Utility)	Public Entity (City or Utility)	Service Providers (One or Several)	Service Providers (One or Several)	Service Providers (One or Several)	Lincoln
4	**Private Developer Open Access**[1]	Public Entity (City or Utility)	Private Developer	Private Developer	Private Developer	Several Service Providers	Fullerton
5	**Full Private Broadband**	Public Entity (City or Utility)	Service Providers (One or Several)	Service Providers (One or Several)	Service Providers (One or Several)	Service Providers (One or Several)	Boston

Note: 1) Private Developer is defined as private company that builds, owns and operates the network infrastructure and offers open access to it to several retail SPs that provide service on the top

While a vast majority of cities with municipal programs (68%) have chosen to build and operate the network themselves (Model 1, as seen in Chattanooga, TN), there has recently been a shift towards engaging the private sector more, either as partner only in delivery of the service (17% of cities chose Model 2, as seen in Westminster, MD), or owner of all or a subset of the infrastructure (remaining 15% chose Models 3-5, as seen in Lincoln, NE, Fullerton, CA, and Boston, MA respectively).



The prevalence of Model 1 is especially high amongst smaller (Tier 4) cities where there may not be any options for private cooperation. More generally, we found that there are four key factors that cities consider when making decisions on which municipal broadband model to pursue:

Key Decision Factors	Options	Definition	Impact on City Decision
Capital Availability	**Good Access to Capital / Funding**	There's sufficient financing sources to fund significant part of the build	Good capital availability should push city to own / fund larger part of the project without bringing in private ISPs
	Poor Access to Capital / Funding	There's limited capital / funding availability, seeking commercial capital will be required to fund	
Existing Infrastructure	**Good Existing Infrastructure / Capabilities**	There's existing public utility with conduit / infrastructure and operating capabilities	Presence of existing infrastructure and/or capabilities should push city to take more control over project, provides a "bargaining" chip with ISPs
	Poor Existing Infrastructure / Capabilities	There's no existing utility or there is but infrastructure and operating capabilities are poor	
Partnership Options	**Viable ISP Partner(s)**	City has attractive demographics or good value proposition for third party ISP	Lack of viable ISP partnerships limits city options to those models that require significant involvement from the ISP
	No Partner Options	City is too small, too remote, or otherwise unattractive for 3rd party ISP	
Objective and Risk Tolerance	**Community Benefit**	Using the broadband infrastructure to create innovation and benefit community in non-financial ways	Strong public support towards anchoring project around community benefits should push city to seek more control / ownership over infrastructure
	Meeting Financial Goals (High Risk)	Using the broadband infrastructure to meet measurable financial goals while maximizing broadband availability	Focus on meeting financial goals / targets should push city to more predictable financial models (e.g., 3rd party driven)
	Meeting Financial Goals (Low Risk)		

Depending on where cities fall on these criteria, there may be a business model that is a more optimal choice for them. To steer cities in the right direction we have distilled the choice into a decision tree that could help communities develop the best strategy:

Municipal Broadband Model Decision Tree

Capital Availability	Existing Infrastructure	Partnership Options	Objective and Risk Tolerance	Optimal Business Model	
Good Access to Capital / Funding	Good Existing Infrastructure / Capabilities	Viable ISP Partner(s)	Community Benefits	**Full Municipal Broadband** – maximizes community benefits when capital / infrastructure are available	1
			Meeting Financial Goals	**Publicly-owned, Privately Serviced** – reduces risk when full control over service not as important	2
		No Partner Options	Community Benefits	**Full Municipal Broadband** – maximizes community benefits when capital / infrastructure are available	1
			Meeting Financial Goals	**Full Municipal Broadband** – is the only option when no ISPs will partner	1
	Limited Existing Infrastructure / Capabilities	Viable ISP Partner(s)	Community Benefits	**Publicly-owned, Privately Serviced** – reduces risk in absence of operational capabilities	2
			Meeting Financial Goals, High Risk	**Publicly-owned, Privately Serviced** – maximizes return potential while leveraging ISP partnership	2
			Meeting Financial Goals, Low Risk	**Private Developer Open Access** – limits risk to the city but maximizes chances of success w/ ISP partner	4
		No Partner Options	Community Benefits	**Full Municipal Broadband** – is the only option when no ISPs will partner but there's capital	1
			Meeting Financial Goals		
Limited Access to Capital / Funding	Good Existing Infrastructure / Capabilities	*Does not matter*		**Hybrid Ownership** – hybrid models are optimal when capital is limited but there's existing infrastructure, regardless of other factors	3
	Limited Existing Infrastructure / Capabilities	Viable ISP Partner(s)	Community Benefits	**Private Developer Open Access** – maximizes city control in light of limited funding / infrastructure	4
			Meeting Financial Goals	**Full Private Broadband** – maximizes chances of success while ensuring goals are met	5
		No Partner Options	*Does not matter*	*Limited options, have to go back and seek more capital, likely government funding / subsidies*	

While a decision tree like this may suggest that picking a business model is easy, it is quite the contrary. While the above is a good "rule of thumb" there are unique circumstances that each city faces and doing a thorough diligence across all potential options should always be the starting point. To do that analysis accurately, a city first needs to understand how much capital is required and what the financial returns of the program may be.

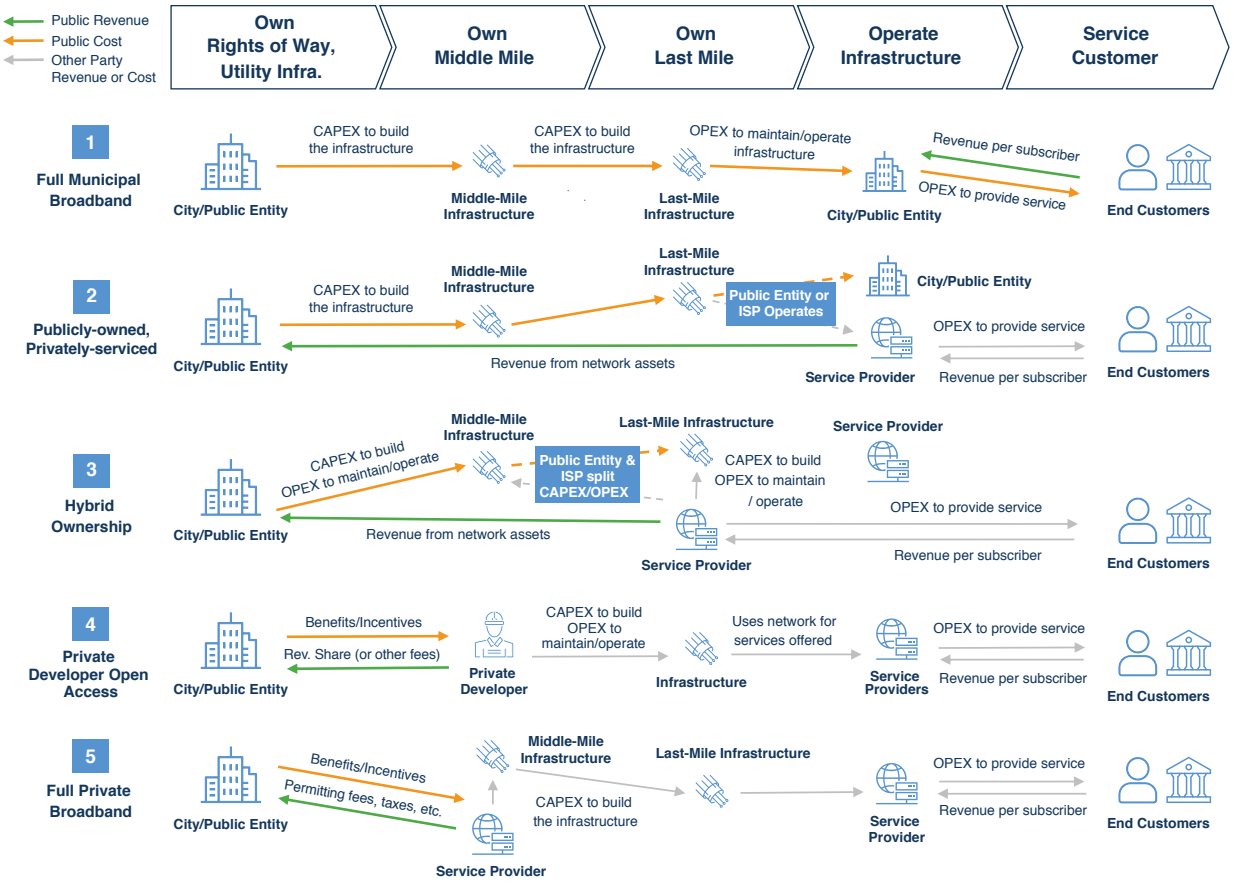
FINANCIAL CONSIDERATIONS

Municipal broadband programs are long-term investments, and these projects can take up to five to ten years to complete. Fiber is a resilient and future-proof piece of telecom infrastructure, but it is also expensive to deploy. This means investment in fiber is hardly a "no-brainer" for all municipalities. Cities looking to invest to close the digital divide in their communities should prepare for payback periods of 15+ years, particularly across smaller and/or rural communities. These paybacks have often deterred interest from the private sector and make careful planning and business analysis critically important for any municipal broadband program.

The capital expenditures (CAPEX) associated with building a fiber-to-the-home network include a range of fixed and variable costs. These include the cost of laying the initial network infrastructure, which could range from $500 to $4,000 per home largely depending on the density of the city, as well incremental costs to connect each customer. Costs to connect each customer can include the cable drop to the home, the modem at the home, and the labor cost of the installation. Those could add up to $1,000 for each incremental customer. All-in, capital requirements for a broadband program in a city with 100,000 residents could end up around $150M.

Operating costs can vary greatly as well, and those depend on experience and efficiency of the broadband provider, amount of synergies with the core city staff (if any), and types of services delivered to the customers. Cities that want or need to offer TV to its residents must prepare for lower margins given high and rising content costs (although this can be mitigated with Over-The-Top offers). We see cities most often budgeting between $40 and $100 of OPEX monthly for each residential subscriber they sign up.

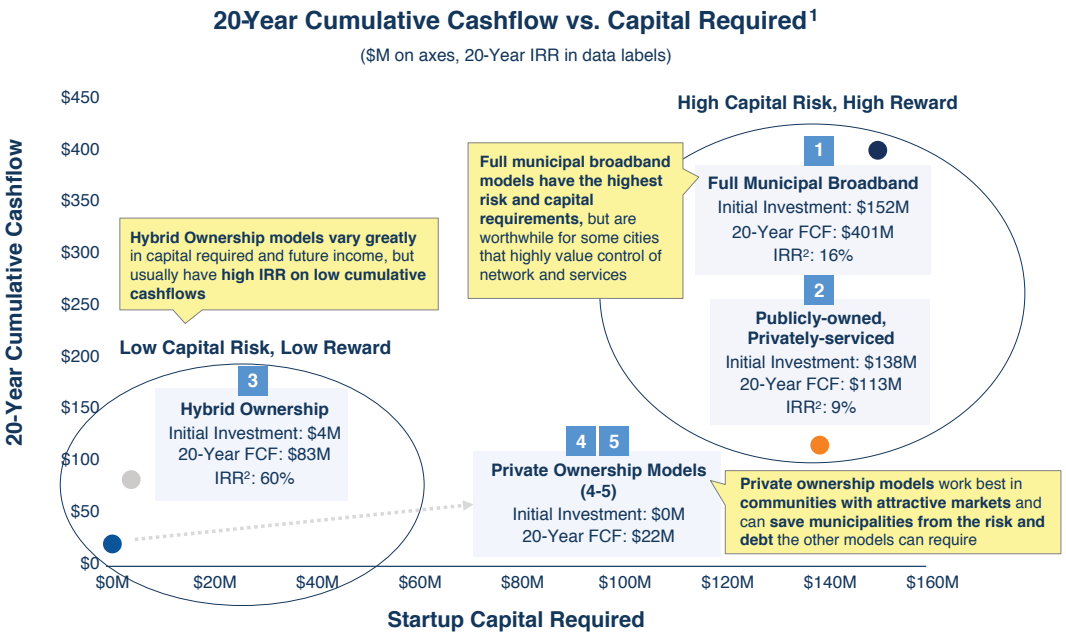
Not all cities will have to cover all these costs. Those that bring in a private ISP or developer to help service the customers and/or build the network can split operating costs, capital costs, or both with that third party. In return they would most typically offer free or low-cost access to city infrastructure, fixed payments, or some variable revenue share typically tied to the number of subscribers in the municipal broadband program:



In addition to impacting share of required costs, the business model also dictates the amount of revenue that cities can generate from the program. On the high-end, cities that deploy and operate Full Municipal Broadband themselves could generate direct revenues of up to $140 per residential customer every month, without considering additional revenue streams from businesses and other anchor institutions. On the low-end, cities that choose Full Private Broadband models would generate limited revenues, aside from permitting and tax fees, which could even be waived in many cases to entice private engagement.

It should be clear by the broad ranges quoted above that the financial performance varies greatly not only by the model, but even from city to city. Using an "average" set of assumptions for a city of 100K residents, we've arrived at typical IRRs between 9% and 16% for Models 1 and 2, with significant amount of capital required but also significant cash flow potential once the program is mature. Cities that are not ready to take on this amount of risk could pursue hybrid models or fully give up network ownership to third parties – those investments will be relatively low risk, result in high IRRs but also (typically) more limited cash flow upside:

Cash Inflows/Outflows by Business Model



Notes: 1. Example city standardized across models for consistency, capital required is total negative cashflow accumulated before model reaches breakeven;
2.15-Year IRR using a 15x OPFCF multiple

While financial performance varies from city to city, the inability to budget appropriately is a main reason some programs fail, reinforcing the need to develop a detailed business case as the first step in any city's implementation plan.

IMPLEMENTATION AND LESSONS LEARNED

There are four key challenges common to most cities pursuing a municipal broadband program: in addition to poor budgeting, some choose the wrong business model due to a "one-size-fits-all" mentality, struggle to secure adequate funding, or fail to maximize their program's value.

1. **Budgeting:** Detailed budgeting is critical to success. A detailed analysis— including designing a full network plan —is essential during the planning phase. It is also important not to overlook any major sources of costs. Those most typically include labor for delivering the service, managing and maintaining the network, but also costs to support any debt and interest payments. As costs increase, it is also important to be clear-eyed and consider private sector involvement; many private ISPs have much lower operating costs due to their scale and experience, while having private developers build and operate the network can significantly reduce the cost associated with network operations and maintenance.

2. **Funding:** Especially when the total budget is high, securing the right funding may become a roadblock. More "traditional" funding options include soliciting contributions from anchor institutions, selling bonds, enlisting local utility involvement, securing federal and state grants, or asking private partners to co-fund the builds. When those are not an option and/or are not enough, cities often get creative. For example, some had their residents contribute money to the program, by either paying for several months of service upfront, or pooling money across neighborhoods and buying bonds from the city. Creative approaches like this may work for certain cities when securing more traditional funding is not an option.

3. **Diligence:** Even when budgets are finalized and capital secured, it is also tempting to just copy a "success story" from another city. Skipping the diligence on evaluating which business model to pursue, however, can lead cities down the wrong path. In our research, we have encountered numerous examples of cities ultimately having to pivot from the initially selected business model because they "dove-in" too quickly.

4. **Related Benefits:** Lastly, when the path is chosen and business model is selected, cities should think holistically about how else they can use the program to serve their communities and ensure the network has the architecture to support that plan. For example, while residential service is often the primary motivation, cities should not forget about enabling internet access to the commercial sector, which can spur job and value creation. Additionally, while few cities have thus far used their municipal fiber to enable "Smart City" solutions, these solutions can spread digital literacy to more residents. And, while the municipality focus has been on fiber services thus far, there are also scenarios where mobile or fixed wireless broadband are more appropriate for last mile connectivity. Communities should consider where fiber investment is valuable and how it can be tied to other network technologies as needed.

While these challenges are common regardless of the selected business model, cities pursuing models with more municipal involvement are more prone to many of these. To maximize chances of success, special attention should be paid to budgeting and costing, and revenue generation should be prioritized and accelerated to the extent possible. For example, targeting densest business and residential areas first or starting with commercial-only services is one way to generate a steady inflow of cash to help cover program costs.

Working with the private sector avoids many of the budgeting and costing issues mentioned above, but it brings about a different set of challenges. First, attracting the attention of private ISPs, particularly for smaller cities, could be a challenge. Cities should be persistent in soliciting private engagement and think creatively about how to entice private cooperation. For example, streamlining permitting and rights-of-way, enabling access to backhaul and middle mile infrastructure (if such exists or can be leased), becoming the anchor institution for the private ISP, or co-sponsoring an "Open Access" network and enlisting a private developer to sign up the ISPs (Model #4) all can improve chances of finding a partner. Once a partner is identified, it is also important to clearly define rules and goals for the program to maintain some degree of control and ensure city objectives are met. This is especially true for the "Open Access" programs which require participation of a private developer and one or several ISP partners. These models have been relatively rare in the U.S., but "Open Access" has proven successful in Europe and should be considered as an option for any city considering a municipal broadband program today, particularly as it strikes a good balance between providing a city the control it needs while also de-risking the investment and operations.

Although the digital divide that remains in our country is unlikely to be fully closed soon, municipalities can still be powerful agents of change. We hope this study will pass along the hard-won lessons of prior programs and aid municipalities considering broadband expansion to better serve their residents. The faster we work together to bridge the digital divide, the sooner we all benefit from the technologies of the future.

There are many people – from municipal IT directors to municipal telecom general managers to local elected officials – who have contributed their knowledge and experiences to the creation of this whitepaper. The real-world experiences of these leaders provided an essential complement to the data analysis we conducted. We thank everyone who participated for their wisdom and willingness to share important lessons.

ABOUT US IGNITE

US Ignite is a high-tech nonprofit with a mission to accelerate the smart community movement. We work to guide communities into the connected future, create a path for private sector growth, and advance technology research that's at the heart of smarter development. For more information, visit www.us-ignite.org.

ABOUT ALTMAN SOLON

Altman Solon is a global strategy consulting firm that works across the Telecommunications, Media, and Technology (TMT) sectors. Our consultants are united by passion and intellectual curiosity for TMT and work with market leaders, challenger brands, and investors in these industries.

Altman Solon was formed following a merger between Altman Vilandrie & Company and Solon Management Consulting in 2020, cementing a decade-long partnership across the Atlantic to form the world's largest global strategy consulting firm with an exclusive focus on the TMT sectors.

Altman Solon has extensive international reach with around 300 employees based in Boston, London, Milan, Munich, New York, Paris, San Francisco, and Warsaw, with successful projects completed across more than 100 countries.

For further information, please visit www.altmansolon.com.