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STRENGTHENING TRANSATLANTIC COOPERATION

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STRONG LEADERSHIP AND EFFECTIVE PARTNERSHIPS FOR SUCCESSFUL MUNICIPAL FTTP PROJECTS

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About the Author

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Executive Summary

Access to affordable, high-speed Internet is essential for individuals, businesses, and government to function effectively in the 21st century. Many U.S. and European communities lack access to affordable, high-speed Internet. Communities have tried to address this issue by building municipally owned fiber networks or by engaging the private sector in municipal efforts to expand access to affordable, high-speed Internet.

To help communities improve access to affordable, high-speed Internet, this research examined European municipalities that have undertaken such efforts. These were Umeå and Västerbotten County, Sweden; Amsterdam, Netherlands; and Friesland Province, Netherlands.

Based on insights from these communities, this paper establishes policy recommendations to support municipal efforts to improve access to affordable, high-speed Internet in their communities.

Recommendations: National Government

Provide Strong Leadership: Due to its status as the only actor with the clout to compel participation, national government must lead efforts to create an intentional national broadband Internet ecosystem that balances the needs of all participants.

Set Measurable Goals, Create a Plan, and Allocate Money to Implement Goals: As part of creating an intentional broadband Internet ecosystem, participants must set measurable goals for high-speed Internet connectivity and create and fully fund an implementable plan.

Sweden's national government did an exemplary job with these tasks, thereby paving the way for Umeå and Västerbotten County to launch successful municipal fiber to the premises deployments. On the other hand, the Netherlands has not completed these tasks. The lack of an intentional national broadband Internet ecosystem hindered efforts by Amsterdam and Friesland Province to launch municipal fiber to the premises deployments.

Recommendations: Municipal Government

Create Effective Partnerships: Municipalities must create partnerships with Internet service providers, national government, and consumers to create a workable plan within the framework of their nation's broadband Internet ecosystem.

Secure Funding: Municipal government should allocate local money and pursue external funding to pay for fiber deployment.

Be Prepared to Address Technical Challenges: Municipalities will need to acquire staff — either by direct hiring or contract — who can address the many technical challenges associated with planning, building, operating, and maintaining a fiber network.

Be Prepared to Address Political Challenges: Municipal staff must be able to address the political challenges of a large infrastructure project. This will require managing the project through years of planning and design, environmental impact analysis, and construction. To manage stakeholder expectations about these activities and the entire process, staff must convey the fiber to the premises (FTTP) network's expected costs and benefits, project complexity, level of effort, and anticipated timeline so stakeholders have realistic expectations about potential project obstacles. Project staff also must anticipate project opposition and create strategies to address the concerns of project opponents.

Umeå and Västerbotten County successfully secured expertise and funding to address the technical and political challenges of building a municipal FTTP network. These municipalities also attracted internet service providers (ISP) as partners to serve end-users via their networks.

On the other hand, while Amsterdam and Friesland experienced success in securing funding and addressing technical challenges, both communities experienced challenges in creating effective partnerships and overcoming political challenges.

The first section of this policy discussion introduces the importance of high-speed broadband Internet and outlines common technologies used to provide wireline Internet; compares high-speed Internet access in select U.S., European, and Asian cities; and describes technical, financial, and political reasons why the United States lags in fiber deployment. Because there is abundant literature on these topics, this report does not go into detail.

The second section advocates for more government involvement in U.S. broadband expansion efforts to overcome challenges discussed in the first section.

The third section provides a quick overview of U.S. federal efforts to encourage expanded access to broadband Internet and the mixed results achieved due to slow implementation of strategies.

The fourth section discusses reasons why U.S. municipalities are suited to be key players in efforts to ensure access to high-speed broadband Internet.

The fifth section provides a high-level overview of efforts to expand access to high-speed fiber Internet in four profiled European municipalities.

Umeå and Västerbotten County, Sweden: After successful fiber deployment to homes and businesses in urbanized areas (Umeå City and Umeå Municipality), Umeå's network is adding smart city features. In surrounding Västerbotten County, the focus is on expanding fiber to the most remote areas.

Amsterdam, Netherlands: Efforts to build a fiber network that was partly owned by both the city and by Internet service providers encountered many challenges and achieved mixed results. Amsterdam's story offers lessons for other communities.

Friesland Province, Netherlands: The province utilized financial incentives to entice Internet service providers to deploy fiber to the most difficult to serve areas.

The following three sections detail how the profiled municipalities approached efforts to expand access to high-speed Internet via fiber deployment in their jurisdictions.

The final section shares insight and policy recommendations for both national and municipal government based on the experiences of the profiled European municipalities.

Strong Leadership and Effective Partnerships for Successful Municipal FTTP Projects

JENNIFER TERY

High-speed broadband Internet has become critical to 21st century life. Unfortunately, many U.S. residents do not subscribe to high-speed Internet at home, either because it is physically not available in their neighborhood or because they cannot afford it, even if it is available. U.S. businesses and government also may lack access to high-speed Internet for similar reasons.

The United States lags in making high-speed Internet available in some areas because U.S. Internet service providers (ISPs) often refuse to expand or upgrade networks. Internet in the United States is too expensive for some because its ISPs often charge high prices for service. ISPs can charge high prices, which are not affordable to a significant minority of the U.S. population, due to a lack of competition in most communities.

This unfavorable situation exists because the United States allows ISPs to have outsize influence over laws and regulations governing the provision, purchase, and/or use of telecommunications services.

U.S.-based ISPs have used their influence to ensure that the national broadband Internet ecosystem in the United States is a duopoly that provides the appearance of competition without the benefits — better service and low prices for consumers — while ensuring ISPs earn large profits.

Subsequent sections of this paper discuss the national broadband Internet ecosystems of the United States, Sweden, and the Netherlands so readers can understand how these ecosystems influence municipal efforts to expand high-speed Internet access via fiber deployment in those countries. First, let us discuss national broadband Internet ecosystems in general.

All nations have a national broadband Internet ecosystem comprised of the following:

Crucial roles needed for the ecosystem to function. These include:

- **Infrastructure owner** builds and owns telecom infrastructure, the network.
- **Infrastructure operator** runs and maintains the network. This might be the network owner or an entity hired by the network owner.
- **Telecom services provider** creates and sells Internet service plans to the public.
- **Customers/end users** buy and use telecom services
- **Regulator** creates and enforces laws and regulations governing the ecosystem.

Participants, including:

- **National, provincial/state, and municipal government** typically fill the regulator and customer/end user roles. Government also can be an infrastructure owner, operator, and telecom services provider.
- **Residents, businesses, government and non-profits** buy telecom services. They fill the customer/end user role.
- **Internet service providers (ISPs)** sell service to customers. They are always a telecom services provider. They also can be infrastructure owner and operator.

- **Laws and regulations** that govern which participants perform which roles. This varies dramatically from one nation to another. For example, in Sweden, laws encourage municipalities to own local telecommunications infrastructure and ISPs to lease the capacity to provide telecom services from the municipality for resale to end users. In the United States, some states prohibit municipalities offering telecom services to the public either directly or via an intermediary over municipally owned infrastructure.

The ability for ecosystem participants to fill many roles, and the fact that ecosystem participants may be encouraged to fill a certain role in one country and forbidden from filling that role in another country, contribute to a wide variety in national broadband Internet ecosystems.

Default versus Intentional National Broadband Internet Ecosystems.

Most nations, including the United States, currently have a *default* national broadband Internet ecosystem which evolves based on the behavior of consumers, ISPs, and government when these actors are not in concert with each other or when government allows ISPs to manipulate the ecosystem to benefit ISPs at the expense of consumers.

To ensure affordable, high-speed Internet to all people and locations within its borders, a country must replace its default national broadband Internet ecosystem with an *intentional* one.

An intentional national broadband internet ecosystem is created with input from representatives of all ecosystem participants to balance the needs of all participants and the long-term sustainability of the ecosystem as a whole.

Without an intentional ecosystem, a country will struggle to address access and affordability challenges via solutions permitted by the default ecosystem.

In U.S. states with an ecosystem that allows it, many municipalities have attempted to build municipally-owned fiber to the premises (FTTP) networks, which are also referred to as municipal fiber networks, municipal FTTP networks, or muni-nets, with mixed results. Other U.S. municipalities are considering building such networks.

Typically, municipal fiber networks or muni-nets compete with private sector ISPs by serving residents and businesses directly or in partnership with private sector ISPs that offer Internet service via the municipally owned network. Typically, the municipal network also provides Internet to municipal buildings and facilities and powers smart-city applications.

On the other hand, municipally-owned institutional networks serve a more limited purpose, constraining their mission to serving municipal buildings, facilities, and applications. These networks usually do not serve residents and businesses directly or in concert with ISPs.

This paper explores the critical role of strong leadership and effective partnerships in municipal efforts to deploy fiber to homes and businesses to ensure access to high-speed Internet. Although this discussion focuses on municipal efforts to expand fiber to residents and businesses, the key insights are relevant to institutional networks.

Access to High-Speed Broadband Is Essential in the 21st Century

Since its creation by Sir Tim Berners-Lee in 1989,[1] the world wide web, the millions of websites it hosts and the email, instant messaging, file sharing, Internet phone calling, and other services provided by the Internet (of which the previous examples are only a tiny fraction), have become an indispensable part of life for billions of people worldwide.

The Internet enables people to perform their jobs faster and better; to connect to friends, family, and new contacts; and to invent products to transform life. For

1 Susannah Fox and Lee Rainie, "The Web at 25 in the U.S.," Pew Research Center, February 27, 2014, p. 1.

billions of people, the Internet is as integral to their lives as the air they breathe.

Indeed, many critical life tasks now can be performed only online. During the first decade of the 21st century, most organizations dramatically increased use of online employee recruitment. In 1999, less than one-third of Fortune 500 companies used any form of online recruitment, including posting positions on the firm's website. By 2003, it was 94 percent; and as of 2007, it was 100 percent.[2]

By 2012, many organizations had transitioned to 100 percent online recruiting. In remarks at an event on the future of broadband in the United States, then Federal Communications Commission (FCC) Chair, Julius Genachowski, said "Almost all Fortune 500 companies post job openings exclusively online. Almost all [employers] require online job applications — from Wal-Mart and Target, to many small businesses."[3]

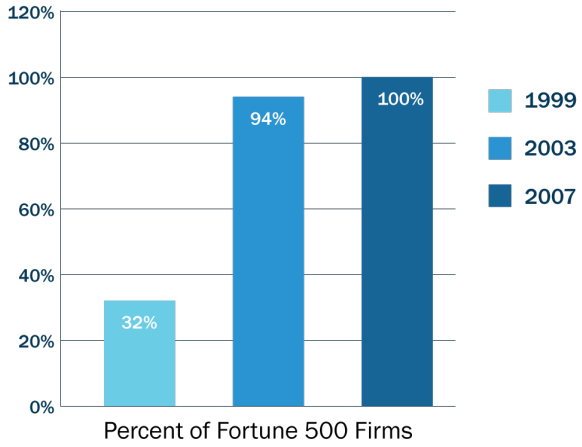
Therefore, U.S. residents must have Internet access to apply for work at a Fortune 500 company and at many smaller firms. The rapid movement of important transactions online is not limited to linking people and jobs. Other tasks now typically conducted online include:

- Purchasing bus, train, or plane tickets
- Applying for college or graduate school
- Applying for unemployment, food stamps, or other public benefits
- Buying items used in daily life like clothes and food
- Looking for a place to live
- Participating in the community's political discourse
- Accessing information and services from local, state, and federal government

2 John Younger, "Online Job Recruitment: Trends, Benefits, Outcomes, and Implications," *OnRec*, November 6, 2007.

3 Julius Genachowski, FCC Chairman, Remarks at Comcast Internet Essentials Event sponsored by Joint Center for Political and Economic Studies, Washington, DC, September 24, 2012.

Figure 1. Share of Fortune 500 Firms Recruiting Online



While people can conduct many tasks offline, using Internet typically saves time and money. Based on the continuing trend of converting in-person transactions to online transactions, U.S. residents need Internet access. The easiest way to access Internet is via an always-on, high-speed broadband Internet connection at home. However, many U.S. residents lack such a connection.

Lack of Access to Affordable High-Speed Broadband Internet in the United States

According to the U.S. Census Bureau's American Community Survey, approximately 73 percent of U.S. households subscribed to high-speed, broadband Internet at home in 2013. Contemporaneous surveys by Pew Research Center found that 70 percent of U.S. households had home access to broadband Internet.[4]

Therefore, approximately 30 percent of U.S. households did not have broadband Internet at home.

Many U.S. households lack affordable broadband Internet service because the available broadband Internet is not affordable to them. With a 2014 broadband Internet penetration rate of 84 percent in the United States,[5]

4 Lee Raine and D'Vera Cohn, "Census: Computer Ownership, Internet Connection Varies Widely Across U.S.," Pew Research Center, September 19, 2014.

5 Internet World Stats.

many U.S. households have broadband near their homes.[6] But the high price keeps many from subscribing.

An 84 percent broadband Internet penetration rate also means that 16 percent of U.S. residents lack physical access to broadband Internet near home, that is broadband networks do not reach their neighborhood. To solve this problem, the United States must address two challenges:

- Physical unavailability of high-speed broadband Internet to 16 percent of households
- High price of high-speed broadband Internet service where it is available

Broadband Internet Is Slower in the United States

As mentioned above, about 16 percent of U.S. residents lack access to broadband Internet at home. This is because ISPs did not install broadband Internet in their communities. Those communities' residents and businesses access Internet via expensive satellite service or slow dial-up service.

However, even the 84 percent of U.S. residents with access to broadband Internet are disadvantaged compared to counterparts in other developed nations because broadband Internet in the United States typically is slower than broadband in other developed nations. This is due to the lag in updating networks by ISPs. Indeed, most ISPs operating in the United States offer service to homes and businesses using cable or digital subscriber line (DSL). These older technologies transmit data via electric signals over copper wires.

In nations with the fastest Internet service, ISPs offer service using fiber optic technology, which transmits data via light signals over glass strands. Because light travels much faster than electricity, fiber Internet service is faster.

Many other nations, including Sweden, the Netherlands, and several nations in Asia, have made significant progress in installing fiber to their homes and businesses. Therefore, even when U.S. residents technically have high-speed broadband Internet, they likely have service that is slower than residents of other developed nations because U.S. networks use slower technology.

Broadband Internet Is More Expensive in the United States

Compared to other nations, broadband Internet in the United States is more expensive for ISPs to deploy and more expensive for consumers to purchase. Table 1 compares the speed and cost of high-speed broadband Internet service for consumers in New Orleans, Louisiana, (a typical mid-sized U.S. city in matters broadband); Umeå, Sweden (examined by this research); Amsterdam, Netherlands (examined by this research); Tokyo, Japan; Singapore; and Seoul, South Korea.

Clearly, residents of Tokyo, Singapore, Seoul, Umeå, and Amsterdam can obtain more bandwidth (faster speeds) for less money. Fiber, the fastest technology available, is not offered to New Orleans residents, only to businesses. Unlike the other cities, pricing in New Orleans is not transparent. Level 3 and Cox do not include prices for high-bandwidth service on their websites; consumers must speak with representatives to obtain a specially prepared quote.

With regard to the lack of fiber service for residents and the non-transparent pricing for higher bandwidth options, New Orleans is typical of mid-sized and large U.S. cities. Therefore, this comparison likely could be made between most U.S. communities and cities in Asia and Europe.

The next section briefly discusses major factors that contribute to the poor availability of high-speed broadband in many U.S. communities and the high prices for service that is available.

First, it can be more expensive to build FTTP networks in the United States compared to other similarly developed nations due to lower population density in the United States. Because U.S. residents are dispersed over a larger geographic area, ISPs must build more extensive networks to serve the same number of people served in more densely populated nations. This increases

6 This compares unfavorably to other advanced nations. As of 2013, the United States ranked 29 in a list of the 50 countries with the highest Internet penetration rates. Ibid..

Table 1. Broadband Internet – Speed and Cost in Select Cities

Location	Providers	Prices	Notes	Source
New Orleans, LA, USA	Level 3	200 Mbps - $4,382/month 1 Gbps - $7,801/month	Fiber not available to residents	Level 3 website and price quote
New Orleans, LA, USA	Cox	200 Mbps - $500 install + $3,900/month 1 Gbps - Info not available	Fiber not available to residents	Quote from Cox
Seoul, South Korea	Private ISPs KT Corporation SK Broadband LGU	Avg. speed: 100 to 300 Mbps Typical price ~ $30/month	Fiber available to residents and business	See Note 1
Tokyo, Japan	Private ISP So-net	2 Gbps down / 1 Gbps up $537 install + $51/month	Fiber available to residents and business	See Note1
Singapore	NetLink Trust formerly OpenNet, a group of 4 telecom + media firms SingTel	1 Gbps ~ $320/month	Fiber available to residents and business	See Note 1
Umeå, Sweden	Private ISPs via municipally owned fiber	Varies by ISP; range 10 Mbps up & down - $6/month 1 Gbps up & down - $46/month February 12, 2018	Fiber available to residents and business	See Note 2, Note 4
Amsterdam, Netherlands	Private ISPs KPN, Tele2, Online	**KPN:** $40/month for 40 Mbps down / 4 Mbps up $70/month for 100 Mbps down / 10 Mbps up **Tele2:** $22/month for 13 Mbps $30/month for 80 Mbps **Online:** $32/month for 100 Mbps down / 30 Mbps up	Fiber available to some households	See Note 3, Note 4

Note 1: https://www.techinasia.com/1gbps-broadband-plan-singapore-cost-bomb/
Note 2: https://ume.net/Service/ServiceSelect?customerType=3d732beb-f6b6-4ea3-abbf-e3a072a524c9
Note 3: Prices obtained for an address in Central Amsterdam by entering data into individual ISP websites https://www.iamexpat.nl/housing/dutch-housing-market/home-utilities/Internet
Note 4: Prices for service in Umeå and Amsterdam were converted from local currency to USD.
Note 5: mbps – megabit per second; gbps – gigabit per second. A measurement of the maximum rate of transfer for electronic data across a given path.

construction cost per customer, even in urbanized areas, because U.S. cities typically are less dense than European or Asian cities.

Therefore, in most U.S. communities, incumbent ISPs do not upgrade existing cable and DSL networks to fiber and other ISPs do not build new fiber networks. Thus, a fundamental reason why broadband deployment varies throughout the United States is that areas with a high-cost per user, like rural areas or low-income urban areas, fail to attract private capital.[7]

Second, due to the expense of building fiber networks in the United States, many U.S. cities and their surrounding metropolitan areas only have one or two ISPs offering wireline (fiber, cable, or DSL) service. Even in cities and regions with three or four ISPs, people are limited to one or two choices because most ISPs do not serve every neighborhood. Furthermore, the ability of incumbent ISPs to secure existing customers with long-term contracts increases the risk that a new provider would not secure enough customers to carry the debt on a newly built network — even with drastically lower prices. With little or no existing competition and virtually no likelihood of future competition in most markets, the United States' incumbent ISPs currently charge higher prices for less bandwidth than overseas ISPs. They expect to do so in the future.

Third, executives at ISPs operating in the United States understand that the high-cost of fiber deployment reduces competition and enables them to charge high prices. This is a great situation for ISPs (not for consumers) and they intend to protect the status quo. Like executives in many industries, leaders at ISPs lobby to promote the passage and retention of laws that promote their interests and the rejection of laws that threaten their interests.

During 2013, interested parties spent approximately $2.38 billion on 11,935 lobbyists to discuss their concerns at the federal level. Of this total, 605 firms in the communications and electronics sector spent $288 million on 1,932 lobbyists.[8]

Table 2. Telecommunications Lobbying to Congress, 2013

Firm/Organization	2013 Lobbying Spend
Comcast Corporation	$13,950,000
National Cable and Telecommunications Association	$13,270,000
AT&T, Inc.	$12,300,000
Google Inc.	$11,460,000
National Association of Broadcasters	$10,650,000
Verizon Communications	$10,143,000

Source: Open Secrets–Center for Responsive Politics *(accessed January 2014).*

Table 2 lists the six telecom organizations and firms that are among 2013's Top 20 purchasers of lobbying services and the amount they spent on lobbying Congress and federal agencies that year.

During the 113th Congress, Comcast lobbied on 43 bills; Verizon lobbied on 64 bills; and AT&T lobbied on 75 bills. In addition to lobbying by individual firms, the telecoms lobbied on 186 bills through the National Cable and Telecommunications Association.[9]

ISPs and industry organizations also lobby state and local governments. For example, AT&T and Verizon promote state legislation to restrict publicly funded broadband networks. Most of this legislation is based on templates from the American Legislative Exchange

7 Joanne Hovis, President CTC Technology and Energy, Testimony before US House of Representatives Committee on Energy and Commerce, Subcommittee on Communications and Technology, "Closing the Digital Divide: Broadband Infrastructure Solutions," January 30, 2018, p. 1.

8 Open Secrets – Center for Responsive Politics, (accessed January 2014).

9 Open Secrets Center for Responsive Politics, "Lobbying Database."

Council (ALEC), which promotes the interests of large businesses over those of small businesses and consumers.

As of 2017, ISPs operating in the United States earn record profits from decades-old infrastructure due to their monopoly or duopoly status in most markets, particularly cities and metropolitan regions. ISPs clearly benefit from the status quo as shown by their willingness to spend millions of dollars to protect the current situation.

Therefore, absent government action, ISPs will continue to avoid fiber deployment to high-cost areas. This leaves residents and businesses in those areas without the high-speed broadband Internet they need and deserve, while residents in the areas actually served by broadband will continue to pay too much for service or will do without service if they cannot afford the prices.

Government Should Encourage the Deployment of High-Speed Internet

Despite the numerous obstacles outlined above, there is a need for action. As described previously, broadband Internet has become too essential to allow U.S. residents to do without it. In recent testimony before the U.S. House of Representatives, broadband technology expert Joanne Hovis, highlighted possible remedies to this situation:

- Support public-private-partnerships that ease the economic challenges of constructing rural and urban infrastructure.
- Incentivize local efforts to build infrastructure that is accessible to ISPs by making bonding and other financing strategies more feasible.
- Target meaningful infrastructure capital support to rural and urban broadband deserts to attract private capital and private efforts to gain or retain competitive advantage.
- Empower local governments to pursue many types of broadband solutions, including the use of public assets to attract and shape private investment.
- Require all entities that receive public subsidy, including access to public assets, to make enforceable commitments to build in historically unserved and under-served areas.
- Maximize benefits of competition by requiring all federal subsidy programs to be offered on a competitive and neutral basis for bid by any qualified entity.[10]

As discussed herein, Umeå and Amsterdam pursued public-private partnerships to facilitate fiber network construction. In Umeå, the municipality built and owns the fiber network. Private ISPs offer service over the network without the risk of financing and installing fiber. In Amsterdam, the city attempted to build a network it would own in partnership with ISPs. On the other hand, Friesland Province's low interest loan to an ISP to defray the cost of fiber deployment is an example of a municipality making financing more feasible.

Indeed, the European cities' experiences and the list above, support the idea that many viable options for improving broadband deployment will involve the public sector, both at the national, provincial/state, and municipal levels. The next sections discuss U.S. national broadband goals and policies as defined by the federal government and the case for municipal involvement in addressing the slow pace of fiber deployment in the United States.

Federal Action: National Broadband Plan

The 2009–2010 National Broadband Plan outlined the following goals:

- Goal 1: At least 100 million U.S. homes should have affordable access to actual download speeds of at least 100 mbps and actual upload speeds of at least 50 mbps.

10 Joanne Hovis, President CTC Technology and Energy, Testimony before US House of Representatives Committee on Energy and Commerce, Subcommittee on Communications and Technology, "Closing the Digital Divide: Broadband Infrastructure Solutions," January 30, 2018, pp. 2,3.

- Goal 2: The United States should lead the world in mobile innovation, with the fastest and most extensive wireless networks of any nation.

- Goal 3: Every U.S. resident should have affordable access to robust broadband service and the means and skills to subscribe if they choose.

- Goal 4: Every U.S. community should have affordable access to at least 1 gbps broadband service to anchor institutions such as schools, hospitals, and government buildings.

- Goal 5: To ensure the safety of the U.S. population, every first responder should have access to a nationwide, wireless, interoperable broadband public safety network.

- Goal 6: To ensure that the United States leads in the clean energy economy, every U.S. resident should be able to use broadband to track and manage real-time energy consumption.[11]

Construction of municipal FTTP networks could directly advance or indirectly support these goals. For example, by stipulating that service offered over its infrastructure must meet particular bandwidth requirements, municipal FTTP networks could advance efforts to bring 100 mbps download/50 mbps upload service to at least 100 million U.S. homes and 1 gbps service to schools, hospitals, and government buildings, thereby furthering Goals 1 and 4. Likewise, with careful pricing, municipal FTTP networks could improve broadband affordability, thus providing progress on part of Goal 3.

The Plan's implementation strategies to improve the United States' broadband networks call for "removing barriers to entry by streamlining access to key broadband inputs and improving data collection, analysis, and disclosure to promote competition and empower consumers."[12] Strategies in the Plan include:

- The Federal Communications Commission (FCC) and the Bureau of Labor Statistics (BLS) should collect more detailed and accurate data on actual [broadband] availability, penetration, prices, churn, and bundles offered by broadband service providers to residential and business consumers and should publish analyses of these data.

- The FCC, in coordination with the National Institute of Standards and Technology (NIST), should establish technical broadband performance measurement standards and a process for updating these. The FCC also should encourage input on standards from industry and consumer groups.

- The FCC should continue to measure and publish data on actual performance of fixed broadband services, ideally in a formal report and online.

- The FCC should initiate a rule-making proceeding by issuing a Notice of Proposed Rulemaking to determine performance disclosure requirements for broadband.

- The FCC should comprehensively review its wholesale competition regulations to develop a coherent and effective framework and take expedited action based on that framework to ensure widespread availability of inputs for broadband services provided to small businesses, mobile providers, and enterprise customers.

- The FCC should ensure that special access rates, terms, and conditions are just reasonable.

- The FCC should ensure appropriate balance in its copper retirement policies.

- The FCC should clarify interconnection rights and obligations and encourage the shift to IP interconnection where efficient.[13]

In other words, the FCC recommends that the United States collect and analyze data on ISP performance, share raw data and analysis results, and subsequently establish technical performance standards to evaluate ISP performance so consumers can use the information

11 Federal Communications Commission, "National Broadband Plan," pp. XIV-XV.

12 National Broadband Plan Action Agenda, p. 5.

13 National Broadband Plan, pp. 35, 36.

to make informed choices about ISPs. Unfortunately, improved data is not going to help most U.S. consumers make better choices when they have only one or two ISP options.

Furthermore, the FCC data often is not sufficiently granular for meaningful analysis. FCC data detail broadband availability for metropolitan areas, cities, and individual census tracts[14] (only certain datasets). But, FCC data do not cover smaller areas, like census blocks, making the data inadequate for understanding access to high-speed Internet in underserved parts of a community.

The National Broadband Plan recommends expanding data collection to include location-specific subscribership, price, switching costs, churn, market-share, technology, offered speed, and actual speed by provider at the census block level.[15]

As mentioned previously, many U.S. communities have only two ISPs offering broadband Internet service to residents and businesses — typically, a DSL provider and a cable provider. At a glance, it may appear that everyone in the community has two choices for high-speed Internet and therefore, the community is somewhat adequately served.

This is not necessarily true. Many ISPs serve only the wealthy parts of a community while ignoring poorer areas. So, parts of a community may have two ISP options; some areas may have one choice; and other areas remain unserved. A census block level analysis would capture this discrepancy unlike analyses at the census tract or city-wide level. Therefore, communities need the FCC to share granular, census block level data so analysts can document broadband availability gaps in their communities.

Currently, the FCC does not release census block data because ISPs claim that its publication would reveal their service areas and allow competitors to estimate the location of their infrastructure. As long as the FCC preferences ISPs' desire for secrecy about key aspects of their product (bandwidth, locations served, subscription rates, etc.) over communities' need for data, it is unlikely that better data collection will improve data dissemination and analysis or impact outcomes for U.S. consumers. Indeed, implementation of the Plan's recommended strategies has been spotty as shown by the:

- Tendency of ISPs operating in the United States to offer less bandwidth (slower speeds) compared to ISPs in other countries,
- Persistently high prices for Internet service relative to other developed nations, and
- Difficulty obtaining census tract level data and impossibility of obtaining census block level data on broadband availability and adoption

Unsurprisingly, progress toward achieving the plan's goals lags.

Moreover, during the last decade, the pace of technology innovation quickened and several telecommunications and media firms merged which decreased the number of ISPs in the United States. Because many plan strategies aimed to increase competition and entice ISPs to offer better service and prices, it is likely that the plan strategies may not be as effective at improving broadband Internet availability and pricing now that there are fewer competitors.

However, residents, businesses, and municipal government itself urgently need affordable high-speed Internet. The inadequate federal response has prompted many U.S. municipalities to explore options to increase bandwidth (speed) and to reduce the price of Internet in their communities. The next section explains why U.S. municipalities should play a larger role in addressing this problem.

14 A census tract is an area roughly equivalent to a neighborhood established by the Bureau of Census to analyze populations. They generally encompass a population between 2,500 to 8,000 people. A census tract is smaller than a city but larger than a Block Group or Census Block. Michigan State University, "Finding Census Tract Data: About Census Tracts."

15 National Broadband Plan, pp. 43, 45.

U.S. Municipalities Step Up to Address Inadequate Broadband

Municipal governments are ideally positioned to help address the United States' broadband Internet deployment gap because:

- They are more likely to provide services directly to residents than the federal government and therefore are more likely to understand residents' and businesses' digital needs.
- They enjoy a better reputation among U.S. residents than the federal government.[16]

Indeed, many U.S. municipalities tried to address broadband problems during the last decade. For example, hundreds of municipalities requested that incumbent ISPs upgrade service to their communities. Many of these communities offered incentives to entice fiber deployment, which were sometimes sufficient to induce the ISP to upgrade its infrastructure. However, ISPs unsurprisingly rebuffed most municipalities because building wireline broadband networks requires large fixed and sunk investments, which ISPs were not willing to make.

Indeed, left to its own devices, the telecom industry produces a relatively small number of ISPs offering wireline service. Reducing the cost of entry may encourage existing wireline ISPs to expand service to a few new markets, but it is unlikely to create several new wireline ISPs competing across broad geographic areas.[17]

ISPs' lack of interest in improving their networks and an inadequate federal response convinced some U.S. communities to investigate installing municipal fiber networks. Typically, the municipality will need to partner with other entities to obtain funding and expertise as it embarks on building a municipal fiber network.

Depending upon fiber deployment goals in terms of which end-users the network will serve, desired amount of control over network operations and maintenance, and the amount of money available, communities have many models for partnership with other public sector entities and/or the private sector.

The remainder of this paper profiles selected Swedish and Dutch municipalities and their efforts to improve the availability of high-speed Internet via municipal FTTP networks; and highlights relevant insights and policy recommendations from the experiences of the profiled municipalities.

While the profiled European municipalities aimed to expand broadband to residents and businesses and therefore embarked upon municipal fiber networks, many insights are relevant to municipalities that seek to build institutional networks for government owned and operated buildings and facilities.[18]

Overview: Swedish and Dutch Municipal FTTP Network Projects

This section examines how four European municipalities approached the deployment of FTTP networks to homes and businesses in their jurisdictions and makes policy recommendations based on their experiences. The communities are:

- Umeå City and surrounding Umeå Municipality, Sweden,
- Västerbotten County, Sweden,
- Amsterdam, Netherlands, and
- Friesland Province, Netherlands.

16 Samatha Smith, "6 key takeaways about how Americans view their government", Pew Research Center, November 23, 2015; Pew Research Center, "State Governments Viewed Favorably as Federal Rating Hits New Low", April 15, 2013; Jeffrey M. Jones,, Frank Newport and Lydia Saad, "How Americans Perceive Government in 2017", Gallup, November 1, 2017.

17 National Broadband Plan, p. 36.

18 In the United States, municipally-owned networks are classified as either *municipal networks* or *institutional networks*. Municipal networks install infrastructure to buildings and facilities owned and/or operated city government like City Hall, police stations, public parks, and to private homes and businesses. Institutional networks limit themselves to serving buildings and facilities owned and/or operated city government.

This section focuses on three main topics, which are:

- A brief history of efforts to build FTTP networks in the profiled municipalities and current disposition of those networks.

- Policy recommendations based on insights of the profiled communities' experiences in trying to expand fiber access for residents and businesses.

Brief History and Current Situation of the Profiled FTTP Networks

Umeå City, Umeå Municipality, and Västerbotten County, Sweden

Umeå City is the seat of Umeå Municipality, which is one of several municipalities in mostly rural Västerbotten County, in Northern Sweden. Umeå City is also the county's largest city.

Shortly after the commercialization of the Internet, Sweden recognized the importance of Internet and computer technology (ICT) to full participation in the modern economy. This prompted Sweden's national government to convene the nation's telecommunications and Internet ecosystem stakeholders to co-create an intentional national broadband Internet ecosystem, herein also referred to as Sweden's Internet ecosystem, to bring high-speed Internet to all premises nationwide.

Via laws and funding from national government, Sweden's Internet ecosystem encourages municipalities to build municipal FTTP networks to homes and businesses in their jurisdictions and lease dark and lit fiber to ISPs. Via the municipally owned infrastructure, ISPs sell:

- Dark fiber access to large businesses with robust IT departments, and

- Consumer-ready telecom services to residents and small and medium businesses.

This system defines roles for all participants — consumers, ISPs, and local and national government. The delegation of responsibilities among participants balances participants' needs and leverages their relative competitive advantages for the benefit of all ecosystem participants and the Swedish Internet ecosystem as a whole.

Like other Swedish municipalities, Umeå Municipality and Västerbotten County leveraged the Swedish Internet ecosystem to build successful municipally-owned, open access, FTTP networks: UmeNet in Umeå City and Municipality and AC Net in Västerbotten County outside of Umeå Municipality. These networks contract with private-sector ISPs, which offer affordable, high-speed fiber Internet to residents and businesses via the municipally owned networks.

UmeNet serves a large portion of Umeå's approximately 125,000 residents in addition to businesses and anchor institutions like universities and the hospital. As of 2017, UmeNet provides all Umeå households with access to high-speed broadband Internet. 96 percent of households had access to 30 mbps service and 88 percent had access to 100 mbps service. Thanks to UmeNet, Umeå has attracted many technology and startup firms and the local IT sector has shown tremendous growth for a decade. Currently, UmeNet is focused on adding "Internet of Things" features to provide better service to residents.

In rural Västerbotten County, AC Net installs the FTTP network in cooperation with the county's other municipalities and their constituent villages, providing rural residents the benefits of high-speed Internet access. Currently. AC Net is focused on expanding service to more remote villages. A subsequent section of this document, Expanding Fiber to Premises: Umeå and Västerbotten County, Sweden, tells the story of these networks in more detail.

Amsterdam, Netherlands

Amsterdam is the most populous municipality and capital of the Netherlands. Circa 2001, elected officials and city staff learned that ICT was one of seven pillars defining the city's economy partly because transatlantic fiber cables enter mainland Europe via Amsterdam. This discovery prompted them to consider building a FTTP network to help Amsterdam retain its ICT firms.

In 2004, elected officials directed city staff to investigate the possibility of building fiber to all homes and small businesses. Between 2005 and 2017, Amsterdam attempted to build a FTTP network to serve:

- Households,
- Small and medium business enterprises,
- Internal city IT needs, and
- Various government services for the public.

At the commencement of the FTTP project, the Netherlands had not engaged participants in its telecommunications and Internet ecosystem to negotiate a national framework with clearly defined roles for all participants that could facilitate building municipal FTTP networks in the country. Absent a supportive national framework, Amsterdam officials created a framework, and the required partnerships, and began construction of their FTTP network.

Amsterdam initially wanted a distribution of responsibilities between the municipality and ISPs similar to Sweden's Internet ecosystem. The refusal of local ISPs to offer telecom services via municipally owned infrastructure doomed that approach. Instead, the city crafted a partnership with local housing authorities and Reggefiber, an ISP that built fiber networks in small Dutch villages which wished to expand into Amsterdam. The city, housing authorities, and Reggefiber started construction of an open-access FTTP network.

Reggefiber's participation attracted banks to the project. Seeing initial success in connecting homes to fiber, Amsterdam's main ISP, KPN, which offers telecom services via slower digital subscriber line (DSL) technology, purchased other ISPs serving Amsterdam. With this action, KPN limited the number of ISPs in Amsterdam and therefore, the number of competitors that could decide to offer faster service than KPN by utilizing the city's fiber network.

Despite this anti-competitive behavior, officials invited KPN to join the project via direct investment and by purchase of shares in Reggefiber, a partial project owner. This reduced combined public sector ownership to 30 percent. Shortly afterward, newly elected officials from a different political party demanded that the city exit the project.

Unfortunately for Amsterdam, only 70,000 housing units out of approximately 350,000 total housing units (20 percent) were connected to fiber when the city withdrew from the project. Once, it had total control of the project, KPN ceased fiber installation to new premises. Therefore, the total number of Amsterdam residences connected to fiber remains at about 70,000.

Lacking a viable option to build a municipal FTTP network to homes and businesses, Amsterdam has decided to create an institutional fiber network for public sector use. An institutional network will allow the city to meet two original project objectives — providing for internal city IT needs and supporting government services to the public.

Also, Amsterdam is transitioning traffic lights from a legacy copper network to 4G. The city may re-purpose the copper network as a redundant, less "hackable" offline network for some city operations. A subsequent section of this document, Expanding Fiber to Premises: Amsterdam, Netherlands, tells the story of this network in more detail.

Friesland Province, Netherlands

Friesland, the northernmost province in the Netherlands, requires fast Internet to meet the needs of its many agricultural enterprises, other businesses, and residents.

Realizing that existing ISPs were not meeting demand for high-speed Internet, the provincial government decided to entice ISPs to upgrade infrastructure to provide more bandwidth and to expand service to more remote areas.

Because the Netherlands had not created an intentional national broadband Internet ecosystem to facilitate building municipal FTTP networks, like their counterparts in Amsterdam, Friesland officials had to

create a framework, and the associated partnerships, to pursue their FTTP network.

Their first idea involved the province buying an equity stake in a local ISP to increase provincial ability to convince the ISP to expand networks and increase bandwidth. When Dutch and European Commission officials rejected the proposal, Friesland Province issued a "tender procedure" (similar to a Request for Proposals) for FTTP network construction and operation services for under-served rural areas. The province offered a low-interest, subordinated loan up to €35 million (approximately $38 million), which is half the estimated €70 million construction cost, to reduce the winner's project risk.

Kabelnoord, the chosen vendor, must to begin construction within 6 months of contract signing, which was mandated to happen by April 3, 2018. Within three years, at least 90 percent of addresses in Friesland's outlying areas must be connected to fast Internet. Kabelnoord submitted a list of 21,000 addresses to connect; the Province will create a plan to connect the last unconnected addresses to high-speed Internet. Because this project is ongoing, it is too early to gauge the ultimate success of these efforts. A subsequent section of this document, Expanding Fiber to Premises: Friesland Province, Netherlands, tells the story of this network in more detail.

Expanding Fiber to the Premises: Umeå and Västerbotten County, Sweden

Umeå City, the seat of Umeå Municipality and the largest city in mostly rural Västerbotten County, in northern Sweden, boasts some of the fastest Internet service in the world thanks to its municipally-owned, fiber to the premises (FTTP) network, UmeNet.[19]

In fact, in 2012, Umeå had the 15th fastest Internet in the world, which helped garner UmeNet the Operator of the Year award in 2012 from the Swedish Local Fiber Alliance, a non-profit entity representing more than 100 municipal fiber network owners.

While relative rankings among cities have changed since then, Umeå City still boasts fabulous Internet connectivity. As of 2017, all households had access to broadband; 96 percent of households had access to 30 mbps service; and 88 percent had access to 100 mbps service.

UmeNet serves a large portion of the city's approximately 125,000 residents. It also serves businesses and local anchor institutions like Umeå University, which is one of Sweden's largest universities with 35,000 students and the local hospital, which is the major hospital north of Stockholm. Thanks to this network, Umeå has attracted many technology and startup firms and the local IT sector has shown tremendous growth for a decade.

This section explains how Umeå City, Umeå Municipality, and Västerbotten County built their publicly owned FTTP networks and how these entities, like hundreds of other muni networks in Sweden, chose an open access model in which the municipality partners with private sector ISPs to ensure their residents and businesses can access affordable, high-speed fiber Internet. The next section introduces the key players in Sweden's Internet ecosystem to provide context for the story.

Sweden's Internet Ecosystem

In Sweden, as in other nations, vertically integrated private sector ISPs own telecommunications networks used to offer Internet (data), telephone (voice), and/or cable (video) service to consumers via a variety of landline and mobile technologies.

Sweden also has many municipal fiber networks that partner with ISPs to offer data, voice, and video in places traditionally neglected by ISPs. To accomplish this, Sweden created a complex system of shared responsibility for providing residents and businesses affordable high-speed Internet service.

19 This section of the report is based conversations with the following people: Mikael Ek, Swedish Local Fiber Alliance; Mats Bergman, Chief Executive Officer of UmeNet; Carin Andersson and Jessica Lowgren at Bostnet; Jessica Thorve and Johan Westermark at T3/AllTele, one of Sweden's largest Open Access ISP's — the firms had recently merged when I spoke to them; Ida Laestander, Project Manager at AC Net; Maria Olofsson, Umeå Innovation; Isak Finer, COS Systems.

The text below describes the main participants in this unique, intentional national broadband Internet ecosystem, their roles, and the relevant Västerbotten County entities:

National government realized early the benefits high-speed broadband could bring and partnered with municipal governments and ISPs to create an Internet ecosystem to facilitate construction of municipal FTTP networks to supplement and provide competition to legacy ISPs to lower prices for consumers and accomplish Sweden's nationwide fiber network deployment goals. In this Internet ecosystem, national government creates regulations that determine which entities participate in the ecosystem, what their roles are, and the rules under which they operate. These regulations attempt to balance competing priorities of ecosystem participants as described below.

- Residents and businesses as end-users who want fast, reliable, and affordable Internet service.
- Municipal government (including municipal housing authorities and utilities) as network owners who want to ensure that residents, businesses, and municipal government itself can access fast, reliable, and affordable Internet service.
- ISPs as vertically integrated firms and as customers of the municipal FTTP networks who want to sell Internet service to the public for a profit.
- National government (representing the interests of Swedish society) via regulations to allow network owners and ISPs to be financially and operationally stable organizations that can compete to provide the affordable, high-speed Internet everyone needs while being able to survive market disruptions.

Municipal government includes counties and the municipalities and villages within counties. These entities often build municipal FTTP networks to serve homes and businesses within their borders. Municipalities and villages can build fiber within their jurisdictions or negotiate with the county to install fiber. Typically, the county installs fiber to the more rural areas.

In Umeå City and Umeå Municipality, Umeå Energi, the local public, electricity and centralized heat utility, built and owns the municipal FTTP network, Ume.net. In rural Västerbotten County, outside Umeå City and Umeå Municipality, AC Net built fiber backbone to the remaining municipalities in the county.

Despite being predominantly rural with a low population density (38 people per square mile, similar to Kansas and Utah), by 2015, 77.5 percent of Västerbotten County residents were connected to fiber and 87 percent of county residents were within 150 feet of a fiber connection, according to Post och Telestyrelsen, Sweden's Telecommunications Agency.[20]

Currently, AC Net, municipalities, and villages are partnering to expand fiber to the county's last unconnected houses in the most remote areas.

Municipal housing authorities often build FTTP networks to the multiple dwelling units (MDUs) they own to enhance property management and offer high-speed home Internet to residents. In Umeå City and Umeå Municipality, the municipal housing authority, Bostaden, owns Bostnet, a FTTP network that serves publicly-owned, rental housing managed by Bostaden. Bostnet operates over UmeNet infrastructure built by Umeå Energi.

Internet service providers are private-sector firms that offer telecom services to end users over FTTP networks owned by municipalities and municipal housing authorities and over ISP-owned infrastructure where the ISP operates as a vertically integrated private-sector firm. Also, some ISPs own backbone and middle-mile infrastructure between municipalities. Therefore, the extent of an ISP's control over end-user Internet experience varies by location. Many ISPs in Sweden operate entirely on Open Access municipal networks and lease capacity to transfer data between municipalities, and therefore own no fiber themselves.

Sweden's residents and businesess are the end users for whose ultimate benefit the system was created and is maintained.

20 Post och Telestyrelsen

In addition, all participants in the ecosystem must comply with relevant European Commission regulations. Table 3 shows the complex Swedish Internet ecosystem in a multi-layered configuration; it shows the major categories of participants, their roles in the system, and their relationships to each other.

Swedish society, the nation's residents and businesses, is the base layer upon which the entire edifice rests. It is for their benefit that the system was created; it is for their benefit that it is maintained. The top layer is the Swedish National Government, which led creation of the system and continues to oversee the system for the benefit of Swedish society. In between are the municipal FTTP networks and the ISPs, which share the day-to-day responsibility of providing residents and businesses with fast, affordable, high-speed Internet.

Table 3 shows that each layer of the system has multiple responsibilities. It also demonstrates that ISPs participate in the system both as intermediaries between municipal FTTP networks and the consumer and as vertically integrated firms.

This rest of this section tells the story of municipal FTTP networks in Umeå and surrounding Västerbotten County. It focuses on how Umeå City built its network and how it partners with local housing authority, Bostaden, and multiple ISPs to ensure affordable fiber service to end users in Umeå City. It also explores how municipal governments provide service to the wider Umeå Municipality and to rural areas outside the municipality in the rest of Västerbotten County. It will discuss:

- Sweden's Internet goals,
- Sweden's regulatory environment,
- Västerbotten County Internet ecosystem participants,
- Internet in Umeå City,
- Internet in Västerbotten County,
- Impact, and
- Lessons learned

Sweden's Internet Goals

As of 2018, almost 200 individual Swedish municipalities have built open-access, FTTP networks, mainly self-funded, but also with subsidies from the Swedish national government and the European Union. Swedes are willing to pay for the construction of municipal FTTP networks because they view these networks as an investment that will:

- Decrease other government costs as they move aspects of education, government services, healthcare, elder care, sport, culture, and other activities online. For example, according to the Swedish tax agency, 73 percent of Swede's completed their income tax return online in 2017.
- Enable residents and businesses to save money by performing tasks online and enhance their competitiveness with peers elsewhere in Sweden and in other countries.
- Eliminate travel and reduce climate impact for certain tasks while saving time and money.
- Promote economic development throughout Sweden.

To gain the benefits outlined above, Sweden's national government has set the following goals.

- By 2020, 95 percent of Swedes will be connected to 100 mbps or greater service at home. In 2015, 67 percent of Swedes were connected to 100 mbps or greater service; in early 2018, at the time this report was written, estimates indicated that more than 80 percent of Swedes were connected to 100 mbps or better service.
- By 2025, all Swedes will have access to at least 30 mbps service; 99.9 percent will have access to 100 mbps service and 98 percent will have access to 1 gbps or more, which implies FTTP service at home.

Table 3. Sweden's Intentional Broadband Internet Ecosystem

System Layers	Participants & Responsibilities	
Regulation	Swedish National Government: Convenes ecosystem participants, sets rules, provides funding for FTTP construction	
Ownership	**Municipally owned and housing authority owned networks** All networks • Provide construction funding • Build & own FTTP network • Lease dark fiber to ISPs Most networks (not Stokab in Stockholm) • Lease lit fiber & equipment to ISPs • Define services (e.g. 10 mbps, 100 mbps, 1 gbps) **Västerbotten County Participants** • AC Net and village FTTP networks serve rural Västerbotten County outside Umeå Municipality; UmeNet provides connection to the internet • UmeNet serves Umeå City & some rural villages in Umeå Municipality • Bostnet serves MDUs owned and managed by Bostaden, the public housing authority using UmeNet infrastructure	**ISPs as vertically integrated firms** • Provide construction funding • Build & own FTTP network • Lease dark fiber to ISPs • Lease lit fiber & equipment to ISPs • Define services (e.g. 10 mbps, 100 mbps, 1 gbps) • Manage end user relationship
Service Provider	**Internet service providers (ISPs):** • Lease dark fiber from network • Lease lit fiber from network • Define services (e.g. 10 mbps, 100 mbps, 1 gbps) • Manage end user relationship • Participating ISPs: Riksnet, T3, Bredband 2, Bahnhof, B2 Bredband AB, Universal Telecom, AC-Net, AllTele	
Users	**Residents & Businesses:** Buy & use telecom services and convey need for network changes as their needs change	

- In the near future, 100 mbps service will become the lowest bandwidth option. Currently, many ISPs are introducing 1 gbps service as their high bandwidth offering and eliminating 10 mbps service, which is the slowest speed available today on fiber networks.

Unfortunately, the SEK 44 million allocated to finish the construction of a nationwide fiber system by extending fiber to rural areas is short of the SEK 250 million needed to build fiber to Sweden's most remote homes.[21] However, Sweden can meet its goals by increasing funding for fiber construction and utilizing non-fiber solutions like microwaves to bring high-speed Internet to the most remote locations.

Sweden's Regulatory Environment

To get funding for construction and remain eligible for operations, municipal FTTP networks must comply with many Swedish and European Commission (EC) regulations, some of which are described below.

Regulations for Construction

Regulations governing network construction ensure the financial and technical viability of proposed projects. Some rules help ensure the network will have enough paying customers to cover construction and operations and maintenance costs and reasonable profit for partner ISPs before construction commences. For example:

- Preliminary market studies typically must show that 85 percent of residents will connect to the network and register for service to obtain a promise of construction funding from national government.

- Municipalities often ask residents to pre-order Internet via webpage and to pay a onetime connection fee of about $2,000. When 50 percent to 60 percent of residents have subscribed, network construction begins.

- Additionally, communities must provide local funds to pay for part of the cost.

Other rules help minimize the need for costly network repairs or upgrades in the near-term. Consequently, Swedish FTTP networks in general:

- Deploy active Ethernet (not GPON) technology because active Ethernet is cheaper in the long term because it requires little hands-on work once deployed and is more likely to be able to support larger future bandwidth requirements from both businesses and residents.

- Install one fiber conduit and at least one empty conduit to accommodate future needs.

- Install fiber underground because the harsh climate makes aerial installation risky and more expensive in the long term due to maintenance and repairs.

Regulations for Network Operations

Regulations governing network operations also help ensure the financial and technical viability of municipal FTTP networks. The rules clearly differentiate between the responsibilities of municipalities as infrastructure owners and ISPs, which occupy a middle positon as customers of the fiber networks and providers of services to end users.

For example, Swedish law allows, but does not require, municipalities to build municipal FTTP networks. Municipalities can operate their networks directly or via a local utility company or a specially created stock company.

This provides municipalities with flexibility to meet the needs of residents and businesses. Vertically integrated ISPs sometimes opt not to serve a municipality, often because fiber installation costs make it infeasible to serve the number of customers in that municipality profitably. Thankfully, due to their long timeframe for return on investment, municipalities can undertake expensive fiber infrastructure construction while ISPs handle customer service.

21 In recent years, the value of $1 fluctuated between SEK 8 and SEK 10. Using the average ($1 = SEK 9), the government allocation is approximately $4,900,000 while approximately $28,000,000 is needed to install fiber to the most remote locations.

Although there are no legal restrictions preventing Swedish municipalities from also selling services to end users, only a few Swedish municipal networks do so. Based on the belief that market forces should control the development of service offerings and that the private sector is best positioned to provide the quality and support customers need, the Swedish Local Fiber Alliance recommends that municipal networks contract with the private sector to provide retail services to end users. This informal rule maintains the presence of ISPs in the Internet ecosystem and allows ISPs to leverage their expertise in service delivery and customer service.

Furthermore, per negotiation among Sweden's fiber players when they developed their Internet ecosystem, municipal FTTP networks must offer all ISPs access to their network under the same terms and conditions. Therefore, with relation to the municipal FTTP network, all ISPs enjoy the same:

- Service-level agreements,
- Business systems for interacting with the municipal FTTP network,
- Framework for local fiber connections between FTTP network and ISP,
- Framework for ISP to manage connection requests from end users,
- Purchasing terms, and
- Digital contract negotiation and signing via a system called Caesar

Therefore, all ISPs buy dark fiber, Ethernet, and capacity to provide Internet to homes wholesale from the municipal fiber network at the same price, under the same terms. This lack of flexibility in negotiating key terms ensures all ISPs are treated the same and helps maintain the financial and operational health of ISPs. This allows small ISPs to compete, which ensures the market has enough competition to reduce prices for end-users and assure a high quality of service and customer support.

The municipal FTTP networks follow one of the following three business models.

- PLOM — Wholesale — Sell dark fiber only; used only in a few networks.
- ALOM – Wholesale – Sell Ethernet only; used only in a few networks.
- 3LOM – Wholesale – Sell dark fiber, Ethernet, operations; preferred model.

Customers Served

Based on the rules outlined above, the main customers of Sweden's municipally owned networks are large entities as listed below.

- ISPs to provide wireline service, triple-play packages, and mobile service to residents and businesses.
- Owners of large buildings so they can provide wireline service to building tenants and smart building services to reduce cost and improve energy efficiency for themselves and their tenants.
- Municipality itself to provide internal IT services and improve administration of municipal services like childcare, elder care, monitoring air and water pollution, checking labelling of food, etc.[22]
- Large firms in industries (IT, finance) that require internal networks to meet business demands.

Outcomes

Many Swedish fiber networks are municipally owned as shown in orange in Map 1.

Approximately, 160 publicly owned fiber networks serve 190 municipalities[23] leading to some outstanding outcomes as listed below.

22 Sweden's municipalities provide many services that are delivered by the private sector or other levels of government in the United States.

23 There are more municipalities served than networks because some networks serve multiple municipalities.

- By early 2018, more than 80 percent of Swedes had access to 100 mbps or better service.
- 91 percent percent of Swedes subscribed to high-speed Internet at home in 2016.
- Incumbent ISP, Telia, upgraded its network from copper to fiber. The upgraded network is open to competitor ISPs who want to offer service on it per Swedish law.

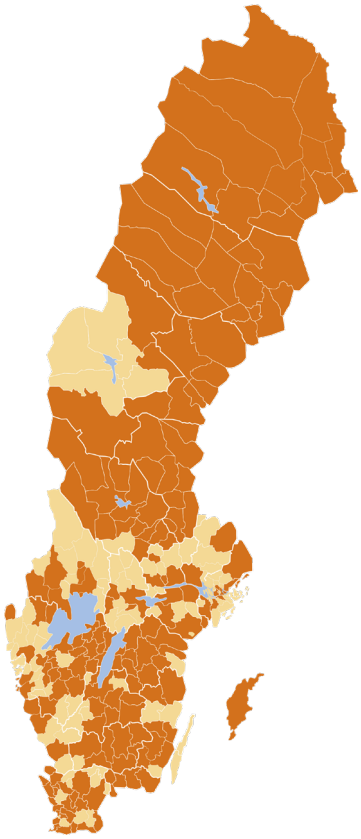
Benefits of Sweden's Municipal FTTP Open Access Networks

Sweden's municipal FTTP networks provide considerable benefits to municipalities and their residents and businesses. First, the availability of low-cost, high-speed fiber Internet helps businesses, residents, and the municipality to save time and money by completing tasks online, making them more competitive. Second, municipal FTTP networks can enhance the provision of community services to all residents and help less advantaged residents leverage Internet to improve their lives.

Third, because municipal FTTP networks exist to serve residents, businesses, and the municipality, and because their success is inextricably linked to the locality's success, they often cater to user needs. Certain businesses benefit greatly from this hyper local customer focus as listed below.

- Financial firms which have significant security needs.
- Firms with multiple offices which can create a private network on the FTTP network.
- Cable firms that use fiber to transmit TV programming.
- Mobile telephone operators which must offload traffic from wireless networks.
- Music and gaming firms whose operations frequently require data heavy applications.
- Startups which typically employ technology as part of product and service offerings.

Map 1. Prevalence of Municipal Fiber Networks in Sweden



Note. Orange: municipal network; tan: no municipal network

Fourth, competition from municipally owned networks encouraged private ISPs to upgrade their networks to fiber, further expanding access to high-speed service to more residents nationwide.

Västerbotten County Internet Ecosystem Participants

As preceding sections discussed, Sweden's national government led efforts to create an Internet ecosystem that ensures the provision of affordable, high-speed Internet via shared responsibility between municipalities as fiber network owners and ISPs as the entities to provide Internet service to users.

The following sections discuss how Umeå City, Umeå Municipality, and Västerbotten County built municipal FTTP networks and lease capacity to ISPs that provide telecommunications service to residents and businesses.

Overview

In Umeå City, the public utility, Umeå Energi built the city's FTTP network, UmeNet. The public housing authority, Bostaden, uses UmeNet infrastructure to create a network for the MDU properties it owns and manages called Bostnet. Both UmeNet and Bostnet lease capacity to ISPs to serve end users over UmeNet infrastructure.

In Umeå Municipality, villages in rural areas access high-speed, fiber Internet via UmeNet or village owned networks. Bostnet serves Bostaden properties in the municipality. ISPs lease capacity to serve end users via these networks.

In rural Västerbotten County outside of Umeå Municipality, AC Net built a fiber backbone. Either AC Net or the municipalities can extend fiber to premises and own the network. ISPs serve end users over AC Net and municipally-owned infrastructure.

In Umeå City, UmeNet and Bostnet provide infrastructure that ISPs use to provide service. In Umeå Municipality, UmeNet, Bostnet, and village networks provide infrastructure over which ISPs offer service. In the other municipalities in Västerbotten County, AC Net and village networks provide infrastructure for ISPs to use to serve consumers. Multiple ISPs offer service on each network, providing Umeå and Västerbotten residents and businesses with many choices for Internet service.

Internet in Umeå City and Umeå Municipality

UmeNet — History

As is common in FTTP network construction in Sweden, the City of Umeå relied on its 100 percent municipally-owned utility firm, Umeå Energi, to build its publicly owned FTTP network.

For years prior to construction of the FTTP network, Umeå Energi had provided electricity, centralized heat, and other utility services to Umeå residents and businesses. Its staff had experience building, operating, and maintaining complex infrastructure systems. Therefore, Umeå Energi was the ideal organization to undertake fiber installation.

Umeå Energi took a gradual approach to building the city's FTTP network. Umeå Energi began installing fiber to improve its provision of electricity to customers.

In 1994, Umeå Energi started installing fiber for telecommunications purposes to multiple dwelling units. Subsequently, the network expanded to serve government buildings, businesses, and single family dwellings. By 1996, Umeå had the first fiber citynet in the world.

By 1999, Umeå Energi offered an open access network, UmeNet, and invited private ISPs to provide Internet to customers via the municipally owned network. Initially, only two or three ISPs were willing to serve end users on UmeNet. So, UmeNet bought 50 percent of shares in the new ISPs to reduce the ISPs' risk. Once it was clear that the ISPs could make money, UmeNet sold their shares in the ISPs back to the ISPs.

In 2001, efforts to connect Umeå's homes to fiber began in earnest. After 2003–04, it became easier for UmeNet to get customers (ISPs) and for ISPs to get customers (end users) because more homes were connected to fiber and the Internet had enough functionality to be useful to a larger share of the population and had become easier to use. Since that time, more ISPs have contracted with UmeNet to provide Internet to customers, including Sweden's large, private sector incumbent telecom, Telia, bringing the total number of ISPs offering service via the network to eight.

An Internet portal allows partner ISPs to change the price and terms of service plans for the public. As of 2017, Umeå Energi has invested approximately $60 million to install UmeNet's infrastructure to create a fully functional FTTP network for the city. The result is that approximately 88 percent of residents had 50 mbps

or better service within 200 meters of their homes as of 2017.

UmeNet — Current Service

As shown in Table 4, currently, UmeNet offers IP telephony; bundled Internet, TV, telephone packages; and public WiFi.

Through a portal accessible via desktop or mobile, residents and businesses can request a fiber connection to their premises,[24] compare service plans from the eight ISPs offering service on UmeNet, and select which ISP will be their provider. Table 4 summarizes services offered via UmeNet and demonstrates their success in attracting multiple ISPs to the network thereby providing competition to encourage high quality service for end users.[25]

As of 2017, UmeNet provides each house with four fiber strands — one for Internet, one for cable, two unused ones for future needs.

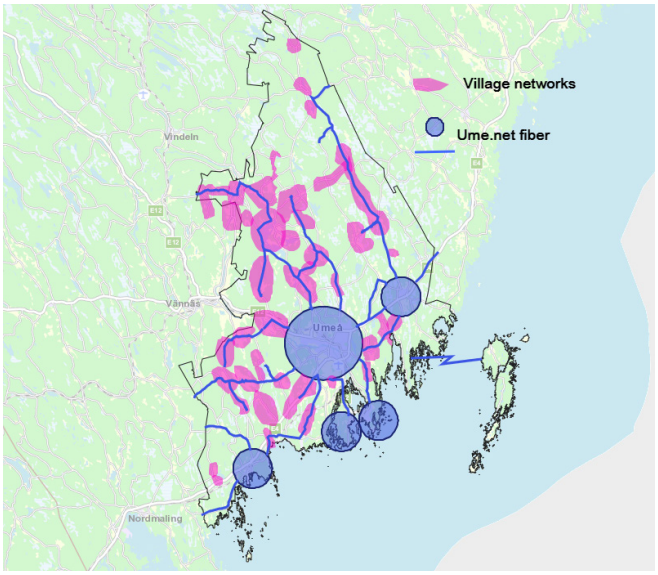
Although UmeNet primarily serves the City of Umeå, the utility also serves some villages in more rural parts of Umeå Municipality. In addition, some villages have built small, village-owned networks, which connect to UmeNet. The result is that 80 different villages also have fiber Internet service.

Map 2 shows UmeNet owned and built fiber in blue and small village networks, which are connected to UmeNet infrastructure, in pink. The largest blue dot represents portions of UmeNet in Umeå City, the densest part of the municipality.[26]

UmeNet — Organizational Structure

Initially, Umeå Energi purchased detailed design, construction, and materials separately. As Umeå Energi and UmeNet gained experience, they brought network design and the creation of specifications (detailed design and materials) in house. As shown in Figure 2, UmeNet currently includes departments tasked with planning future network expansion, designing additions to the network, and managing the network. Currently, Umeå Energi only hires outside firms for construction, the step between network design and network management because its leaders prefer to handle everything else in-house.

Map 2. Umeå Municipality's Public Networks



Bostnet

While UmeNet installs fiber to most premises in Umeå municipality, Bostnet specifically serves the 50 percent of MDU rental properties in the municipality that are owned and managed by the municipal housing authority, Bostaden.[27] Like UmeNet, Bostnet is an open access fiber network. Many ISPs that offer service via UmeNet also offer service on Bostnet. Bostnet offers discounted Internet service to students by placing student addresses in a group that receives preferential pricing.

Via Bostnet, Bostaden staff runs building management systems to monitor:

- Fire alarms,

24 The cost for a fiber connection to the premise is about SEK 16,000 or $1,600.

25 "Umeå Energi Broadband," Umeå Energi Presentation by Mats Berggren, Chief Executive Officer of UmeNet.

26 Ibid.

27 Most Bostaden rental properties are open to anyone although a few are reserved for students or the elderly.

Table 4. UmeNet Telecommunications Services

Internet Access Service Providers	Television Service Providers	Telephone Service Providers	Other Services
Riksnet	Canal Digital	AllTele	Emergency services
T3	AllTele	Bahnhof	Storage
Bredband 2	Viasat	T3	Real Est. monitoring
Bahnhof	Boxer	Bredband 2	Tele medicine
B2 Bredband AB	Canal Digital		Back-up
Universal Telecom			Home healthcare
AC-Net			Video conf.

- Water and Electricity usage,
- Use of city distributed heating system,
- Amount of snow on the roof, and
- Efficiency of solar panels.

Even without an Internet subscription, tenants can use Bostnet to:

- Apply for apartments,
- Sign lease electronically as required,[28]
- Book time in the common laundry room, and
- Buy data service (no video or voice service) via multiple ISPs that use Bostnet infrastructure.

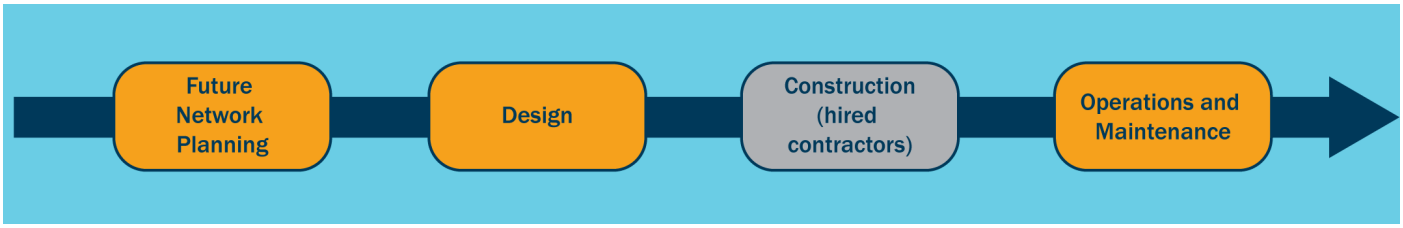
These options cater to the Swedish preference to complete tasks themselves while helping businesses to save money by reducing the need for customer service staff.

Approximately 13,000 of 15,166 tenants subscribe to Internet. In the future, Bostaden hopes to use Bostnet to run many Internet of Things services like:

- Monitor car engine heaters,
- IP-TV, and

28 Bostaden eliminated manual lease signing to reduce paperwork. Bostnet offers videos to help renters perform tasks online. Swedes are dedicated to eliminating paper processes and prefer to help with digital processes instead of maintaining old manual, paper processes along with new online processes.

Figure 2. Ume.Net Organizational Structure



- Welfare broadband, which uses Internet to bring social services to the elderly to ensure they get food, medicine, and monitoring to enable them to live at home as long as possible

ISPs — Partners to UmeNet and Bostnet

Eight ISPs offer Internet service to residential and business end users via UmeNet. Seven ISPs offer Internet service to residents of Bostaden properties via Bostnet. These ISPs work with the networks to create plans with different bandwidths and pricing for end-users. The ISPs then market their plans to consumers and handle all aspects of customer service like complaints and collecting payment.

Because all Swedish ISPs obtain Ethernet, dark fiber, and lit service to be re-sold to end-users under the same predetermined terms by law, ISPs cannot gain an advantage over competitors by negotiating a better price or more favorable terms.

Therefore, Swedish ISPs must distinguish themselves based on customer service and price, to a lesser extent. ISPs can offer lower prices than competitors only by finding efficiencies in their own operations or accepting less profit.

The customer service focus encourages local hiring, the development of service plans that meet customer needs, and creative marketing to entice consumers to access UmeNet via your ISP rather than your competitors who offer service via the exact same infrastructure.

Via online platforms, ISPs interface with the network infrastructure and with customers. The platforms allow them to respond quickly to changing market conditions by:

- Changing prices frequently to attract customers,
- Updating descriptions of service plans to include special items like a free router,
- Checking invoices,
- Checking new fiber connections that have not registered for service with an ISP. These are targets for marketing, and
- Creating tailored offers to meet the unique needs of specified groups — a collection of addresses that receives telecom services. Groups can be defined geographically (e.g. a neighborhood) or based on other characteristics (e.g. student apartments, areas with average income below a certain level). It is possible to differentiate within a building by apartment number to ensure that only eligible people receive the discount.

UmeNet Future Plans

To reach its goal of connecting every premise to fiber, UmeNet employs two business-to-business salespersons and two business-to-consumer salespersons.

Like Bostnet, UmeNet plans to add more Internet of Things (IoT) features in 2018 to focus on health, security, sustainability, and comfort. Target customers are apartment buildings not owned by Bostaden, private houses, schools, hotels, and other businesses. IoT can help home-owners and commercial property managers to monitor building systems, energy and water usage, and building occupants. IoT supports Swedish

environmental goals, desire for self-service, and desire to save money.

UmeNet is partnering with a local developer to build 42 "smart" apartments. These will allow property managers and residents to monitor electricity and water usage, charge their electric cars, etc.

Internet in Västerbotten County

Due to the large number of potential customers, Swedish ISPs often install fiber in urban apartment-block areas. The result is that some urban areas had several ISPs before Sweden started building municipal fiber networks. However, due to the high cost to connect each housing unit, ISPs were less willing to extend fiber to single-family houses in urban areas and to rural areas

Sweden overcame this hesitancy by tasking government with network construction and ownership, which reduced cost and risk for ISPs. In rural Västerbotten County outside of Umeå Municipality, AC Net is the public entity that installs the FTTP network in cooperation with rural municipalities and their constituent villages. The Västerbotten municipalities own their networks and contract with ISPs to serve residents and businesses. Therefore, AC Net provides wholesale broadband services in Västerbotten County like UmeNet does in Umeå City and Umeå Municipality.

AC Net has built fiber backbone to core areas of all rural Västerbotten County municipalities as shown in Map 3.[29]

As of April 2017, Västerbotten County's goal is to extend fiber to small villages. Either AC Net or the municipality can install final connections to homes and businesses. AC Net also works to attract ISPs to Västerbotten County to increase competition and lower prices.

Västerbotten County's FTTP construction was successful because a grassroots champion rallied municipalities to seek funding. Their funding is from the European Union

29 "The Story of Vasterbotten," AC Net Presentation by Ida Laestander, Project Manager.

Map 3. AC Net Fiber Backbone in Rural Västerbotten County

(50 percent), the Västerbotten region (11 percent), and individual municipalities (39 percent).[30]

Benefits of Fiber Networks

Umeå and Västerbotten County derive the following benefits from their municipal FTTP networks.

- Complete municipal control over infrastructure, which makes network upgrades easier.
- Increased municipal influence over quality and price of Internet service in the community.
- Ability to deploy smart city technology.
- Ability to leverage the network for business attraction, economic development, workforce development and community devevlopment.

First, municipal ownership provides these government entities with control of key telecommunications infrastructure that their communities require. This

30 Initially, Swedish and EU law allowed municipalities to provide labor (e.g. residents would dig trenches) as part of their required financial contribution. Changes to rules mean that labor cannot reduce the money contribution. Furthermore, younger residents would rather pay money than provide labor.

allows Umeå and Västerbotten County to expand service to new areas as people and businesses move in; to increase network capacity; to maintain acceptable levels of security to protect data; and to provide enough redundancy to ensure network reliability.

Second, municipal ownership enables communities to influence the type of service plans offered via their networks to ensure the plans meet the needs of residents and businesses. Umeå and Västerbotten County do this by providing guidance on the bandwidth levels and pricing of plans that ISPs offer via their networks. Currently, many Swedish municipalities are eliminating 10 mbps plans making 100 mbps plans the lowest bandwidth plans on their networks. They are doing this in a manner that ensures these plans are affordable for everyone. Given their profit motive, it is unlikely that private telecoms would have increased bandwidth without also increasing price significantly.

Third, municipal network ownership via Bostnet, UmeNet, and AC Net allow Bostaden, Umeå City and Municipality, and Västerbotten County, respectively to expand smart city services communitywide to make these municipalities better places to live. This expansion will help residents and businesses to use less energy, which is good for the environment, and to save time and money. Due to the need to earn profit, private telecoms likely would not have added smart city functions unless they thought it would be profitable.

Fourth, Umeå and Västerbotten County have leveraged their FTTP networks to help residents and businesses (workforce development and community development) and to promote economic development and business attraction as discussed below.

Workforce and Community Development; Business Attraction and Economic Development

Circa 1987, Umeå University created a center to help people start companies and navigate trademark, copyright, and other challenges to protect their ideas. In 2003, Uminova Innovation, a non-profit funded by city government, the university, the hospital, and the European Commission, was launched. Its mission is to promote startups in Umeå and Västerbotten County, especially tech-based businesses (e.g. biotech, life science, and information technology) in industries identified as more likely to be successful in a relatively remote location with excellent broadband like Umeå. It offers the following assistance to entrepreneurs.

- Regular events to introduce IT job hunters to local employers needing IT services.
- Weekly, high-level business coaching, which allows coaches to refer driven entrepreneurs with mature ideas to formal coaching programs.
- Coaching with subject matter experts who help entrepreneurs start and grow businesses.
- Incubator Program to help entrepreneurs with their top four challenges: getting qualified staff, finding money, going global, and integrating into the startup community.
    - One to two years Phase 1 pre-incubator program—accept 60 ideas out of 150.
    - Participants: 1/3 students, 1/3 researchers, 1/3 local firms.
    - Two to four years Phase 2 incubation—accepts the best 10 to 15 ideas from Phase 1.
    - One to three years Phase 3 growth — help startups expand their networks, scale up, get clients, become profitable, and leave the incubator so another firm can move in.
- Summer Entrepreneur Program — college students create and run a startup to consult on a specific project to an existing startup. This connects students to jobs and businesses to staff.
- Networking events for women in technology.
- Recruitment of Umeå natives back to Umeå.

- Promotion of Umeå's IT scene via three articles per day on Uminova Innovation.[31]

Efforts to promote IT innovation in Umeå and promote Umeå have been successful. Swedbank located its IT department in Umeå, bringing new jobs to the region, which aligns with economic development goals. Since 2015, college graduates have expressed a desire to stay in Umeå, which will support workforce development goals as will requirements in some high schools for students to learn basic entrepreneurship by starting and disbanding a business during their last year.

Conclusion

Sweden recognized that private telecoms would expand service to new areas, increase bandwidth or otherwise upgrade their networks only if the potential profit meets a pre-determined threshold. Of course, municipalities could ask telecoms to make these enhancements anyway. But, telecoms might decide it is too expensive from their perspective and decline to make improvements. Alternatively, telecoms might pursue upgrades only to parts of the community that it deems profitable.

The decision to improve telecom infrastructure in part of a community or to forgo improvements altogether has a chilling impact on equity.

Swedish communities (and some U.S. ones) already own infrastructure to provide fresh and grey water; storm water and wastewater management; electricity; transportation via roads and bridges; and education via public schools.

These systems and services are deemed to be so important that their ownership cannot be left in private hands and their provision cannot be subjected to calculations of return on investment. Swedes have decided that telecom infrastructure is equally important and have added it to the list of items worthy of public ownership.

Subsequently, Sweden created a uniquely Swedish intentional national broadband Internet ecosystem analyzed in this paper to enable its municipalities to partner with the private sector to ensure that all Swedes get access to affordable Internet. The ubiquity and affordability of high-speed Internet allows Swedish communities to leverage broadband Internet as a tool to promote equity among all residents.

Umeå City, Umeå Municipality, and Västerbotten County successfully utilized this Internet ecosystem to build municipal FTTP networks. As desired by the system creators, multiple ISPs offer affordable, high-speed service via the networks, enabling residents and business to obtain Internet.

The result is that residents and businesses use the low-cost Internet to save time and money while performing a range of tasks, including creating startup business enterprises. Simultaneously, economic and workforce development professionals have been able to attract jobs and job-seekers to Umeå and to Västerbotten County. The successes in Umeå and Västerbotten County benefit these communities and provide strong evidence that Sweden was successful in creating a multi-tiered Internet ecosystem that balances the desires of national government, municipal government, ISPs, residents, businesses, and Swedish society.

Expanding Fiber to Premises: Amsterdam, Netherlands

With approximately 850,000 residents, Amsterdam is most populous municipality in the Netherlands. Its urban area has approximately 1.3 million residents while the metropolitan region boasts about 2.4 million residents. While Amsterdam serves as the capital of the Netherlands, it is not the seat of the national government.[32]

Amsterdam's decision to build a fiber to the premise (FTTP) network started with a political discussion. Circa 2001, as part of an analysis of Amsterdam's economy, city staff and elected officials discovered that seven pillars defined Amsterdam's economy, one of which was Internet

31 Uminova Innovation.

32 This section is based on conversations with: Hans van Tijl, an urban and spatial planning official in Dutch national government and former Deputy Director — City of Amsterdam Urban Planning Department; who led Amsterdam's FTTP project; and Ger Baron – Chief Technology Officer, City of Amsterdam.

and computer technology (ICT). Follow-up research into why Amsterdam had so many ICT firms uncovered the startling fact that international fiber cables from North America enter mainland Europe through Amsterdam.

In 2004, with approval from elected officials, city staff began investigating the possibility of building fiber to all homes and small businesses in the city. They felt the network would help ensure that Amsterdam retained its ICT firms. By December 2005, the city had decided to build an FTTP network.[33] City officials intended for the network to serve:

- Households,
- Small and medium business enterprises,
- Internal city IT needs, and
- Various government services for the public.

By building an open access network, the city also hoped to foster competition and provide residents with affordable, high-speed fiber service over the publicly owned infrastructure.

Between 2005 and 2017, Amsterdam attempted to build a FTTP network. Unfortunately for its residents, Amsterdam's efforts to install fiber to all housing units were only partly successful with about 70,000 housing units out of approximately 350,000 total housing units (20 percent) connected to fiber when the city withdrew from the project.

Furthermore, the effort to build a publicly-owned FTTP network ultimately failed due to political factors beyond the control of city staff responsible for the project. Along the way, the project encountered significant political and legal challenges that often bedevil municipally led efforts to build fiber infrastructure.

This section discusses some of these challenges to enable staff and elected officials in other cities to benefit from Amsterdam's experience and the insight shared by Amsterdam city staff who worked on the project. The remainder of this post will focus on the following topics.

- Dutch Internet ecosystem — the context in which Amsterdam pursued its efforts to build a municipal FTTP network.
- Amsterdam Citynet — the story of Amsterdam's efforts to build a network, including many changes in strategy to respond to political and legal challenges.
- Lessons Learned — insight into how to overcome similar political and legal challenges to their FTTP projects.
- Next Steps – ideas on how Amsterdam can meet some of the original project objectives.
- Conclusion.

The Netherlands' Internet Ecosystem

In the Netherlands, national government had not convened participants in the telecommunications ecosystem to create an intentional national broadband Internet ecosystem when this research was conducted in 2017. Therefore, Dutch residents, businesses, and municipalities seeking to ensure affordable, high-speed Internet to their constituents, must navigate a default ecosystem in which the ISPs heavily influence many laws, regulations, and policies.

Both private sector Internet service providers and publicly-owned networks offer telecommunications [Internet (data), telephone (voice), and/or cable (video)] service to consumers via a variety of landline and mobile technologies. The national government regulates these entities for compliance with Dutch law. In addition, entities offering these services must comply with European Commission regulations.

Internet Service Providers

Several vertically integrated private-sector Internet service providers (ISPs) offer landline Internet via digital

33 Commission Decision of 11.XII.2007 on the State Aid Case C 53/2006 (ex N 262/2005, ex CP 127/2004), Investment by the city of Amsterdam in a fibre-to-the-home (FttH) network, p. 6.

subscriber line (DSL), cable, and fiber to the Netherlands' 7 million households. Approximately 97 percent of Dutch households and 91 percent of Dutch businesses have access to a wireline connection of at least 30 mbps.[34] Most households can purchase DSL service; which transmits data over copper telephone (voice) transmission lines. In addition, as of 2017:

- 2.5 million households could buy 500 mbps to 1 gbps fiber service, and
- 4.5 million households could buy at least 50 mbps cable service.

Under current Dutch law, ISPs, which are regulated as telecommunications firms, must allow competitors to use their infrastructure while media companies are not subject to this requirement.

Many private-sector ISPs have not installed fiber to end-user premises. Because ISPs have rights to dig in city streets under Dutch law, unlike other utilities that must get permission to dig, many are frustrated by ISPs unwillingness to take advantage of their right to dig to upgrade their networks. Some of the Netherlands private-sector ISPs include:

- Ziggo offers data service via cable; it merged with mobile operator Vodafone and former cable competitor UPC Nederland in recent years. UPC was regulated as a media company and therefore did not have to allow competitors to use its infrastructure. It's unclear if these regulations apply to UPC infrastructure in the new merged firm. Furthermore, because UPC was originally a public corporation before being sold to private firms, different rules may apply in certain contexts.
- KPN offers data service via DSL
- Tele2 Nederland offers data service. It is unclear whether this is via DSL or cable. It also offers high-speed service via fiber. It has less than 10 percent market share. Tele2 Sweden owns approximately 75 percent of its shares.[35]
- Stipte (Scarlet Telecom) offers data service. It is unclear whether this is via DSL or cable.

Not all firms serve all municipalities. Therefore, many markets may have only one or two providers despite the fact that the nation as a whole has several ISPs.

Although the main ISPs typically do not offer service via fiber, smaller ISPs like Fiber Netherlands offer data service via DSL and fiber to households in various communities.[36] The result is that some cities achieve relatively high fiber connection rates while others have low fiber connection rates. For example, 75 percent to 80 percent of Eindhoven households are connected to fiber, which is considerably better than Amsterdam's 20 percent fiber connection rate.

Furthermore, in rural areas, the public sector has been involved in building telecommunications networks for several decades. In the 1970s, different government entities partnered to bring cable television to the rural province of Friesland. More recently, the province, its municipalities, businesses, farmers, and residents banded together to build Fryslan Ring, the provincial fiber network, which they own together. Currently, Friesland provincial government is pursuing efforts to entice the private sector to install fiber to 90 percent of the households with the worst Internet and offer affordable service — a maximum of €50 more than the price for service in other parts of the Netherlands.

Mindset, Perspective, and Goals

Many Dutch want a fiber connection to every home in the country. However, the limited number of ISPs reduces competition thereby removing the incentive for ISPs to install fiber to premises. In fact, at current rates of fiber installation, it will take approximately 50 years for the Netherlands to connect every household to fiber.

34 Digital Agenda for the Netherlands: Innovation, Trust, Acceleration, published by The Ministry of Economic Affairs – Regulatory Reform and ICT Policy Department, July 2016, pg. 20.

35 Wikipedia, "Tele2 Netherlands".

36 Fiber.nl, "Internet Only".

Since the end of the Great Recession, some officials are beginning to discuss the national government's role in ensuring that the Netherlands' residents have access to fiber at their homes and businesses. Consistent with Dutch preference for private-sector solutions, they are not promoting the idea that government must build, own, and operate networks. However, they do believe that the national government needs to determine how to incent fiber network construction by the private sector if the national government does not install fiber itself.

Amsterdam Citynet

Initial Strategy — Partnership with Internet Service Providers

Amsterdam's elected government officials were willing to invest large sums of city money to lay dark fiber for a FTTP network, but they did not want to involve the city in network operations or customer service to end users (consumers).

Instead, they wanted the private sector to provide network operations and customer service to end users because they philosophically preferred a public-private partnership to the creation of a city-owned vertically integrated telecom organization similar to Dutch private sector ISPs.

Therefore, elected officials directed city staff to create partnership options that would limit direct city involvement in network operations or customer service. At the outset of the project, city staff envisioned a multi-tiered partnership similar to what is depicted in Table 5.

As part of their proposal, city officials demonstrated the business case and potential profit associated with network operations and serving business and residential subscribers to entice interest from ISPs and showed that the city would be able to cover construction and maintenance costs for the fiber network infrastructure.

The proposed system was very similar to what Sweden developed, which has been extremely successful in ensuring affordable, high-speed Internet to Sweden's residents and businesses via municipal FTTP networks and preserving the role and profitability of private sector ISPs as discussed in the prior section on Umeå City and Municipality and Västerbotten County.

Unfortunately, Dutch telecommunications firms were not interested in the proposed partnership. This forced the city to secure other partners as discussed below.

Instead, VECAI, the association of cable operators in the Netherlands, and UPC (now Ziggo), which had considerable operations in Amsterdam, registered formal complaints to the European Commission in 2005 to prevent the city from implementing its plans. They argued that the city's involvement constituted "state aid" that could distort markets and competition and was prohibited by European Commission rules.[37]

While the city waited for a decision from the European Commission, it began network construction in 2006. UPC then sued to stop construction in Amsterdam District Court.[38]

By May 2007, Dutch and European Commission authorities decided that the city's role in the project did not constitute "state aid." Therefore, the city moved forward with construction. Furthermore, the Dutch national government decided that the presence of DSL operator, KPN, and cable operator, UPC, in the Amsterdam market meant that the city had enough competition to avoid significant national government involvement in Amsterdam's municipal FTTP project.[39]

Revised Strategy — Partnership with Housing Corporations

After the ISPs declined to participate, the city partnered with public housing corporations to build a FTTP network. This was not a new strategy for Amsterdam. Years ago, the city had worked with UPC, which was

37 Commission Decision of 11.XII.2007 on the State Aid Case C 53/2006 (ex N 262/2005, ex CP 127/2004), Investment by the city of Amsterdam in a fibre-to-the-home (FttH) network, p. 3.

38 Commission Decision of 11.XII.2007 on the State Aid Case C 53/2006 (ex N 262/2005, ex CP 127/2004), Investment by the city of Amsterdam in a fibre-to-the-home (FttH) network, p. 4.

39 Amsterdam wanted what the Swedes actually implemented: a layered fiber ecosystem in which different entities handle different responsibilities to ensure adequate competition leading to good service and affordable prices for end-users.

Table 5. Amsterdam's Desired FTTP Network Partnership Structure

Roles	Responsibilities
Fiber Network Funders	Amsterdam municipality and partners (TBD) would provide money to build network
Fiber Network Owners	Own and maintain passive network infrastructure – ducts, fiber, and street cabinets; lease to wholesale operator
Wholesale Operator	Lease dark fiber from owner Manage and maintain network via active layer - the switches, routers, and splitters that make the network transmit data Sell access to retail ISPs on a non-discriminatory basis
Internet Service Providers	Private-sector ISPs offer television, broadband, telephone and other internet service to end users over this network This will represent competition to existing ISPs
End users	Amsterdam residents and small and medium businesses buy and use internet service

then a public corporation, and its housing authorities to install cable infrastructure in Amsterdam residences.

The city chose a point-to-point fiber topology because it is the most flexible and future-proof topology. Point-to-point systems runs individual fibers from each apartment back to the local aggregation point (think of the phone system model). Point-to-point systems support all known technologies (GPON, active Ethernet, lambda, RF video overlay, and others) by patching individual fibers in the aggregation point and allow easy unbundling of individual lines, a feature much appreciated by European regulators and customers.[40]

At the time fiber network construction began, various public housing corporations owned 200,000 housing units out of a total of 350,000 housing units in the city. Therefore, working with the housing corporations was a smart way to bring fiber to a majority of housing units.

Most housing corporations gladly allowed the city to install fiber in their properties. Other housing corporations wanted greater involvement and asked to become investors in the network. The city agreed to include those housing corporations as equity partners.

At the outset, network ownership was split equally between the City of Amsterdam, several housing corporations, and Reggefibre, a private firm that built fiber networks to small villages, whose owner was interested in bringing fiber to Amsterdam as depicted in Figure 3.

40 Ars Technica, "How Amsterdam was wired for open access fiber."

This participation was enough to attract financing from ING and other banks. This allowed Reggefibre to reduce its ownership share to 1/6. After multiple rounds of negotiations, Amsterdam built a partnership to support its ambition of installing publicly owned fiber to the premises as represented in simplified form in Figure 4. [41]

Network Construction and Operation

After securing partnerships needed to implement the project, the city released two Requests for Proposals (RFPs) for its FTTP network.

The construction RFP was released first. It included technical specifications to ensure that Amsterdam's network would be an open access network in the present and in the future. This would allow multiple competitors to offer service via the publicly owned infrastructure and help ensure affordable prices for Amsterdam residents. The RFP asked responders to explain how they would build the network and how much construction would cost.

The network operations RFP followed. It received several responses from ISPs based in the Netherlands and other European Union countries.

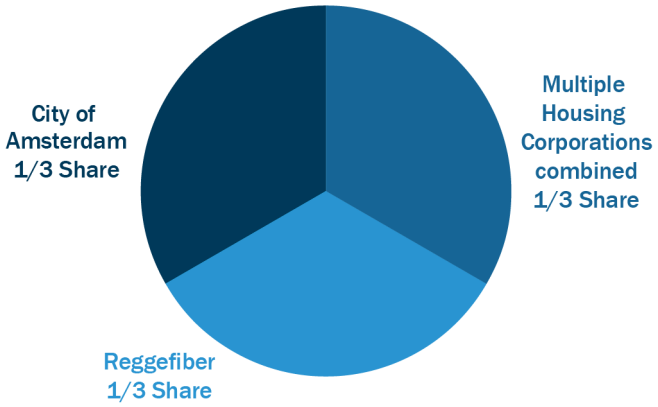
KPN, a Dutch telecom firm selling landline Internet service to customers in Amsterdam responded to the network operations RFP. City officials deemed their proposal as subpar and awarded the contract to Telecom Italia.

KPN responded by buying other ISPs to ensure that it would have few competitors on the future Amsterdam city fiber network.

Major Project Ownership and Strategy Changes

ING later sold its share in the project to back to Reggefibre. At the behest of high-level officials, KPN joined the project as an equity investor by directly buying shares in the network and buying shares in partial network owner, Reggefibre. KPN's equity participation in the project and in Reggefibre reduced the share of the project owned by the city and the public housing authorities from a combined 66 percent to around 30 percent shown in Figure 5.

Figure 3. Amsterdam Network – Initial Ownership Structure



As a result, the public sector, the city and the housing corporations, no longer controlled the project outright although they retained the power to block decisions not in the public interest.

The 2007–12 financial crisis and its aftermath made it difficult to get money to build the network. However, elected officials agreed to add money to the project if city staff developed a strategy to exit the project by 2024.

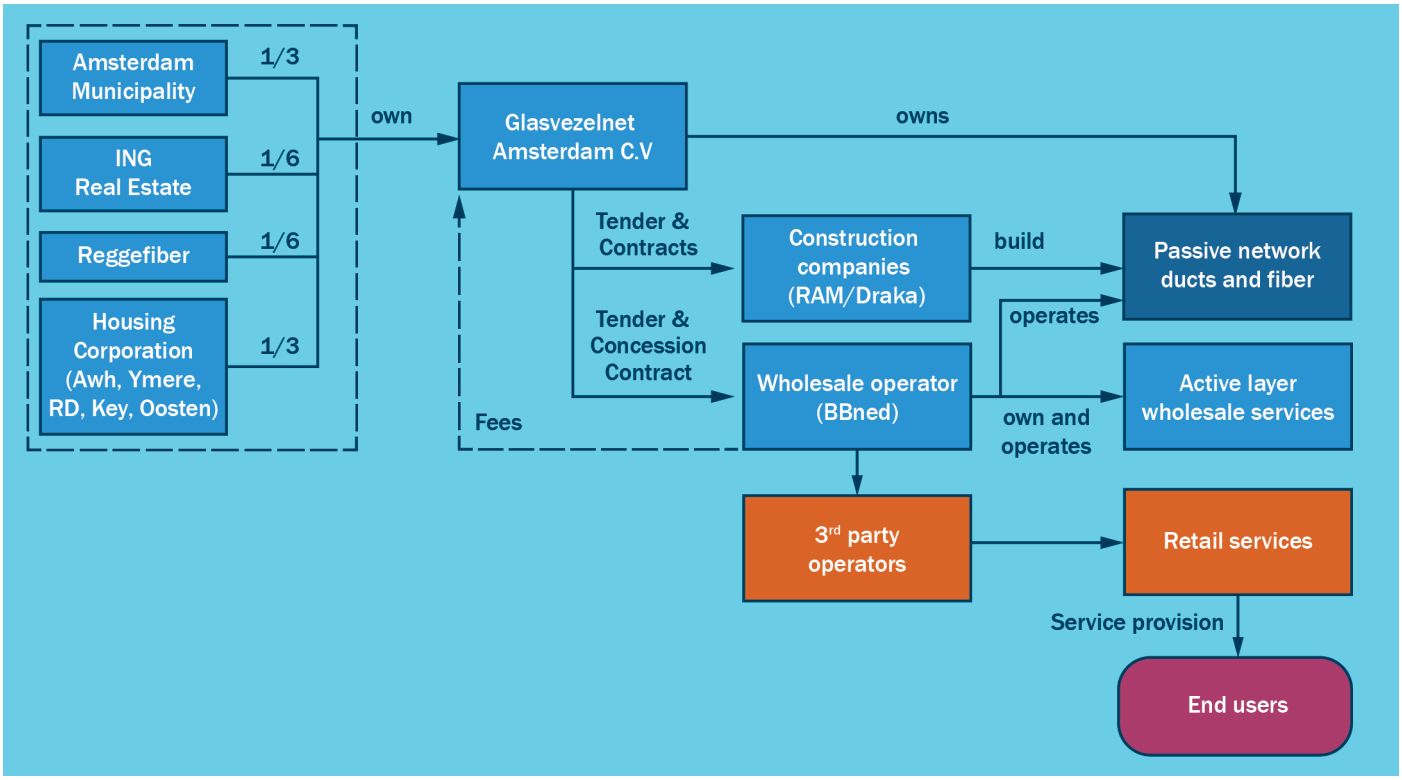
The city therefore negotiated a compromise with the other three network owners: KPN, Reggefibre, and the housing authorities to ensure that Amsterdam's future privately-owned fiber network would remain open access thereby allowing competitors to offer service over the network. This solution satisfied Dutch law and European Commission regulations. Dutch regulators liked it so much they codified it into law.

New Administration Accelerates City Exit from Fiber Network

After the financial crisis, control of Amsterdam city government shifted to a different political party whose officials decided to exit the fiber project as soon as possible.

41 Commission Decision of 11.XII.2007 on the State Aid Case C 53/2006 (ex N 262/2005, ex CP 127/2004), Investment by the city of Amsterdam in a fibre-to-the-home (FttH) network, p. 6. Glasvezelnet Amsterdam C.V. owns the network, which is called Citynet

Figure 4. Amsterdam Network – Second Ownership Structure



The new administration sold the city's share of the project to KPN with no pre-conditions for an extremely low price. At that time, 70,000 housing units had been connected to fiber.

KPN also bought more shares of Reggefibre to secure control of the other firm to ensure that KPN would remain the only large ISP in Amsterdam with fiber to premises. With no competition, KPN stopped installing fiber to new premises. So, the number of Amsterdam households connected to fiber remains at 70,000.

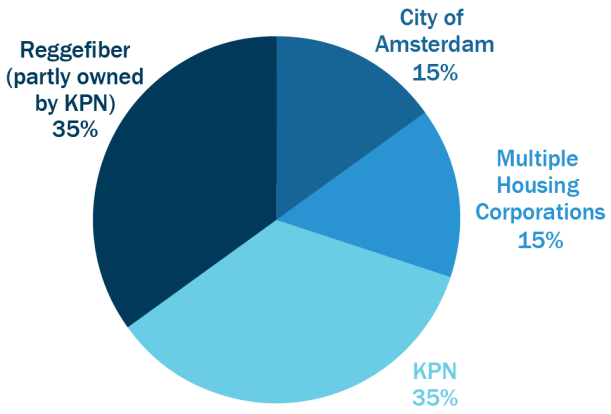
KPN flouts Dutch telecom laws that require ISPs to provide open access to their networks to their competitors by making it expensive for competitors to offer service via KPN's network.

KPN does this by strategically replacing copper with fiber between its historic hubs, large buildings with thousands of network switches, and neighborhood street cabinets to create many neighborhood street-cabinet "hubs" where the fiber now ends. Under the new system, each neighborhood street-cabinet "hub" serves a much smaller number of customers than the previous hubs.

To reach potential customers, KPN's competitors now must connect to many neighborhood hubs rather than a few large hubs. This increases their cost to start operations on the KPN network. Because a certain share of customers is likely to switch providers, it is rarely worthwhile for competitors to spend money setting up operations on KPN's network to acquire a few customers. Figure 6 compares KPNs former and new network hubs.[42]

42 Graphic created using icons from the Noun Project. Major Hub: Leo - The Noun Project; Neighborhood Hubs: Chameleon Design - The Noun Project; Houses: Obercam - The Noun Project

Figure 5. Amsterdam Network – Third Ownership Structure



Lessons Learned

Amsterdam made two major mistakes in its efforts to bring fiber to residents and businesses. The first was ceding control of the multi-party, fiber build project to KPN; the second was selling the network infrastructure to KPN under terms that did not require further installation of fiber to premises.

Loss of Public Control Precipitates Decline in Official Interest in FTTP Network

The first mistake is that the public sector (the city itself and local housing authorities) ceded too large a share of project ownership (70 percent) and therefore project control to KPN. KPN's previous behavior had demonstrated that KPN would serve its interest rather than the public interest. For example, KPN previously had purchased ISPs in the Amsterdam market to limit competition when Telecom Italia won the network operations contract rather than KPN.

It was reasonable to expect that KPN would continue to prefer its interests over the public interest once it acquired control of the network. Their actions since acquiring control - the replacement of large hubs with neighborhood hubs to increase costs for potential competitors and deter competition - show that KPN's mindset has not changed.

Given the changing political environment, the city likely was going to reduce its stake in the network. It is unclear if city staff would have been able to convince the elected officials demanding the sale to retain a controlling interest in the project.

From the perspective of serving the public interest and meeting the original project goals, it would have been better for the public to retain project control longer. Once the public sector did not control the project, it became difficult to ensure the project met goals. Once the project did not meet stated goals, support for it eroded which made it impossible to save the public-private partnership leading the second and third mistakes.

Selling the Network Outright

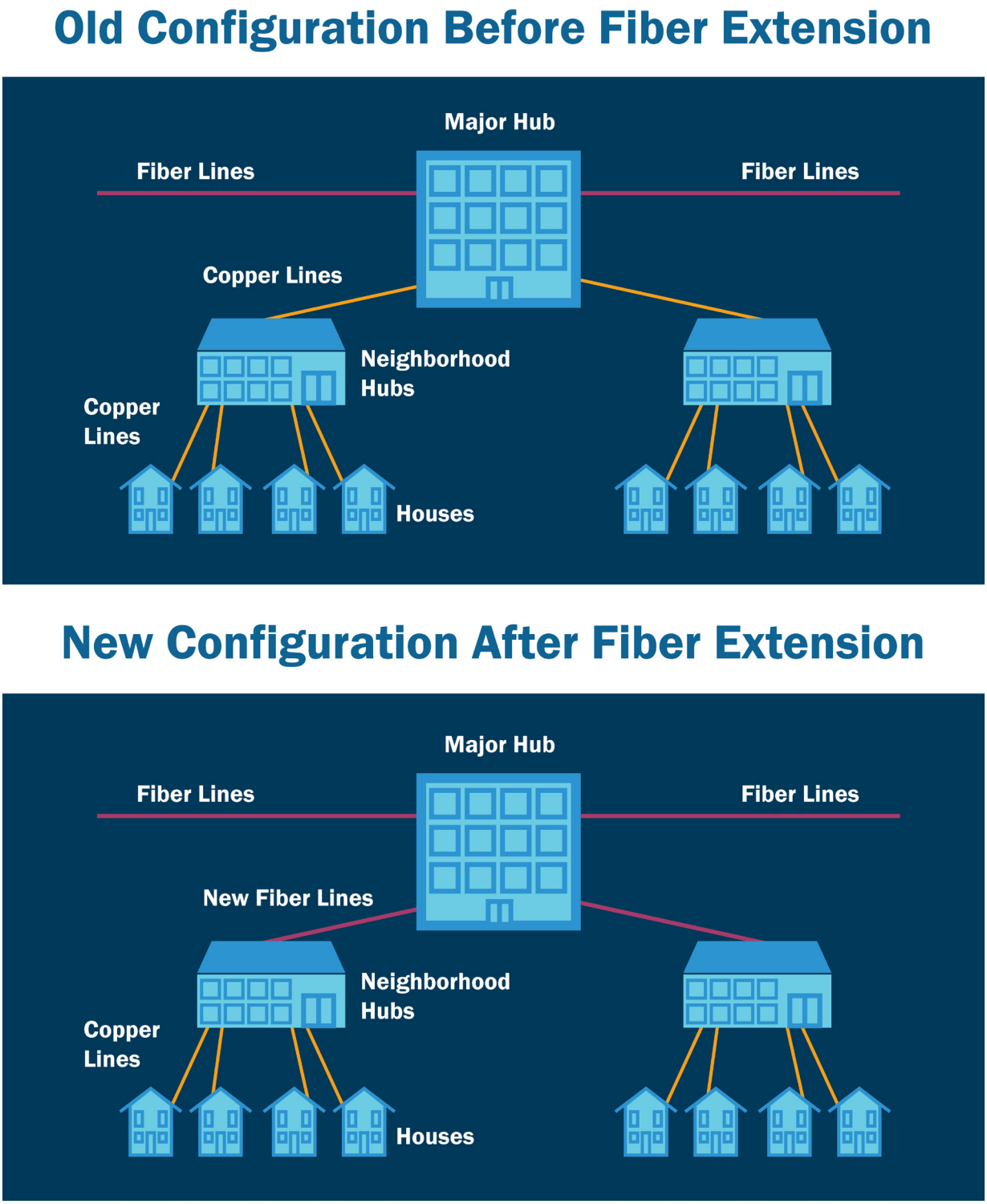
Selling the network outright means the network may never meet the original project goal of bringing affordable FTTP service to all Amsterdam residents and small / medium business by fostering competition over an open access network. KPN has stopped connecting new housing units to fiber and their neighborhood street-cabinet hub strategy effectively renders the open access network a closed KPN network, thereby ensuring no competition.

However, the city could have sold the network while meeting some project objectives if they had demanded more from KPN at the time of sale, which leads to the third major mistake.

Selling the Network with Poor Terms for Residents

The city made a fatal error when it sold the fiber network to KPN without legal requirements that KPN complete fiber installation to the remainder of Amsterdam's housing units and install fiber to future housing units. This allowed KPN to cease fiber installation to homes, leaving Amsterdam with only 20 percent of households connected to fiber.

Figure 6. KPN Network Configurations



Had the city included those terms, it would have been able to get fiber service to Amsterdam residents and small and medium businesses even if it failed to meet the other main objective, fostering competition to reduce prices.

Result

The failure of the FTTP project means that Amsterdam did not meet its original project goals, which were to:

- Connect all housing units and small and medium businesses to FTTP service,
- Foster competition and lower prices via an open access network,
- Provide for internal city IT needs, and
- Support various government services for the public.

Next Steps

Build Institutional Fiber Network

Lacking a viable option to build a municipal FTTP network to serve homes and businesses, Amsterdam decided to create an institutional fiber network for public sector use. This will allow the city to meet two of its original project objectives – providing for internal city IT needs and supporting government services to the public. Additionally, ISPs may off-load data from small cells to city fiber in the future.

Current efforts to build an institutional network for internal city use represent a significant scaling back of ambitions compared to the municipal network, which would have served residents and businesses directly.

City staff view this as feasible because the City of Amsterdam and city-owned agencies and authorities (water, transport, bridges, airport, harbor operations, etc.) own a lot of fiber.

As of May 2017, staff were developing a framework to connect fiber owned by individual city agencies to create a coherent fiber network for public entities to use. That plan called for each agency to continue to own, operate, and maintain its existing fiber while allowing other city entities to transmit data over it. City agencies would be free to handle maintenance themselves or hire ISPs to perform maintenance. This effort involves:

- Negotiating legal agreements to allow agencies to use each other's fiber,
- Creating physical connections between infrastructure owned by various agencies, and
- Establishing technical specifications to ensure current and future compatibility of equipment and infrastructure.

Dutch law requires ISPs to remove infrastructure they have not used in the last 10 years. City staff can use the law to pressure ISPs to remove the copper. When the ISPs open the streets to remove the copper, the city can install fiber cheaply because the ISPs will pay the cost of opening the streets, which is typically 80 percent to 90 percent of the cost of fiber construction. In this manner, city staff can defray the cost of building physical connections between infrastructure owned by various agencies.

On the other hand, if the city insists that ISPs remove copper infrastructure, ISPs may decide to install fiber at that time to take advantage of the "sunk cost" for street excavation to remove copper systems at the city's request. If the ISPs choose to install fiber infrastructure, then Amsterdam's residents and businesses could benefit directly.

Regrettably, an institutional fiber network likely will not result in fiber service to end-users. Amsterdam seems likely to await the outcome of national conversations about FTTP. Therefore, it may be many years before Amsterdam has a FTTP network. Fortunately, most Amsterdam residents can access 100 mbps or better service via options available from the ISPs.

Other Projects: Re-purpose Old Copper Network

Amsterdam is transitioning its city-owned traffic lights from a copper network to a 4G network. The city may disconnect the copper network from the Internet and retain it as a redundant, less "hackable" offline network for some city operations. While not related to the efforts to expand fiber access in the city, this effort should support city goals to improve internal IT operations and improve provision of services to residents.

Conclusion

Amsterdam's effort to build a municipal FTTP network ultimately met with partial success.

Only 70,000 housing units out of approximately 350,000 total housing units (20 percent) are connected to fiber leaving the goal of connecting all housing units and small and medium businesses to high-speed fiber unmet. Likewise, the project has left public ownership and control therefore eliminating its potential to foster competition and reduce prices.

However, efforts to build an institutional fiber network for public sector needs should allow the city to satisfy two other project objectives:

- Provide high-speed service for internal city IT needs, and
- Provide high-speed Internet to support government services for the public.

Although the effort to build a publicly-owned FTTP network ultimately failed due to political factors beyond the control of city staff running the project, their flexibility and ingenuity as they overcame significant political and legal challenges were impressive.

Because similar challenges bedevil many municipally-led efforts to build fiber infrastructure, officials in other cities should heed the lessons in Amsterdam's story.

Fortunately, officials in Dutch national government know the challenges Amsterdam faced and are beginning to discuss how the Netherlands can support municipal and other efforts to deploy fiber in an effort to ensure affordable high-speed Internet for residents and businesses. These recent efforts are discussed in Insights and Policy Recommendations further below.

Expanding Fiber to Premises: Friesland Province, Netherlands

Provincial Context and History of Telecom Networks

At the start of 2015, 3 percent of Dutch households and 9 percent of Dutch businesses were not connected to 30 mbps or better Internet service.[43] The national government is focused on connecting these 330,000 households and businesses, which are located in mostly rural areas throughout the country.[44]

Friesland, the northernmost province in the Netherlands, is a rural area. Agriculture is a substantial share of its economy and Frisian farmers demand fast Internet to run their businesses.

In Friesland, private sector ISPs and a cooperatively-owned entity install fiber. ISPs typically solicit commitments to subscribe from residents and businesses. The ISPs present these subscriber commitments as proof of future revenue to secure loans to install fiber.

Currently, at least two ISPs serve Friesland. **KPN** provides 30 mbps or less service in rural parts of the Province. Bandwidth may be more than 30 mbps in cities.[45] **Kabelnoord** is a Dutch ISP founded in Friesland in 1979 as a "common scheme,"[46] a partnership of several government entities, to offer cable television. In 1996, Kabelnoord converted to a public limited company with

43 This summary is based on conversation with Fedde Moedt, Project Leader/ Secretary in Friesland Provincial Government in May 2017 and followup emails to learn about progress on the project. He leads efforts to expand the existing fiber network.

44 Digital Agenda for the Netherlands: Innovation, Trust, Acceleration, published by The Ministry of Economic Affairs – Regulatory Reform and ICT Policy Department, July 2016, p. 20.

45 Wikipedia, "KPN".

46 The English translation from Dutch Wikipedia entry might not be 100 percent accurate.

the municipalities as shareholders. Today, Kabelnoord offers telecom services in Friesland.[47]

Fryslân Ring is Friesland's provincial open access fiber network founded in 2006 with funding from the province's pool of money designated for expanding fiber access[48] and secured loans underwritten by subscriber commitments. Initially, the province, municipalities, businesses, farmers, and residents owned the network. After the network became financially independent, the province relinquished active involvement in decision-making. Fryslân Ring offers consulting services to locations outside the province that want to improve connectivity.[49]

Due to lower population density in mostly rural Friesland, it is challenging for Fryslân Ring to offer prices comparable to those offered in larger cities. Therefore, subscribers must pay monthly subscription costs and a personal contribution to cover part of the higher connection costs. However, the network has committed to keeping extra charges as low as possible and to levying the charges only long enough to cover additional costs.[50]

Unfortunately, the most remote areas still lack fiber to the premises, leaving about 10 percent of the province's population unconnected[51] despite the network's efforts to install fiber in areas not served by the ISPs.

Recent Efforts to Expand Broadband Internet

Residents and businesses want more bandwidth (faster speeds) leading the provincial government to devise several plans to coax ISPs into improving service.

Kabelnoord Partnership: Friesland Province wanted Kabelnoord to expand 30+ mbps Internet service to the more remote areas of the province. To do this, the Province wanted to buy shares in Kabelnoord to gain some control over product offerings, pricing, and operations to ensure improved service for rural residents. However, the proposed purchase terms did not comply with Dutch or European Commission law. So, the Province abandoned the idea of becoming a partial owner in Kabelnoord and switched tactics as described below.

Solicitation for ISP Services: During summer 2017, Friesland Province issued a "tender procedure" (similar to a Request for Proposals) to acquire fiber network construction and operation services for under-served rural areas. The Province offered a low-interest, subordinated loan up to €35 million (approximately $35 million), which is half the estimated €70 million construction cost, to reduce the winner's project risk.

The tender procedure requirements included:

- A list of mostly rural addresses that must be connected,
    - Responses must include a list of under-served addresses they will connect,
- Stipulation to connect at least 90 percent of households with the worst Internet to fiber,
    - Connecting more than 90 percent of households is viewed favorably,
    - Responses can use other technology to connect households beyond the 90 percent,
- A requirement for affordable Internet service, which is defined as a maximum of €50 more than the price in other parts of the Netherlands.

In October 2017, Friesland Province chose Kabelnoord to install fiber optic cable to the outlying areas of all municipalities, which currently lack fast Internet connections.[52]

Now, the Province is drafting contracts for Kabelnoord's subordinated loan and Kabelnoord is negotiating €60 million of loans from commercial banks. The Province aimed to complete contract negotiations by April 3, 2018 with construction to begin within six months. Within

47 Wikipedia, "Kabelnoord" and "Wet gemeenschappelijke regelingen".

48 Fryslân Ring, "Over Fryslân Ring".

49 Fryslân Ring, "Breedband in Bedrijf".

50 Fryslân Ring, "Glasvezel cooperatie".

51 Computeridee Magazine, 2015.

52 Samen Snel Internet, "Abbega op glas".

three years, at least 90 percent of addresses in Friesland's outlying areas must be connected to fast Internet.[53]

Kabelnoord submitted a list of approximately 21,000 addresses that it planned to connect. Now that Friesland Province knows which currently unconnected addresses will remain unconnected by Kabelnoord, the Province will devise a plan to connect the last unconnected addresses to high-speed Internet based on feedback from a market consultation.[54]

Summary

In recent years, Friesland's approach to securing high-speed fiber broadband Internet for its residents and businesses entailed pursuing partnerships. The province was willing to become co-owner in an entity owned by Friesland's municipalities and ISPs. Unfortunately, their model proved unworkable under the law, which led them to try to entice the private sector into serving people and households that the private sector normally would not serve by subsidizing the project via a low-interest, subordinated loan to an ISP.

Insights and Recommendations

The following policy recommendations derive from insights from the profiled communities. Because political systems typically establish different roles for national and municipal government, this missive provides policy recommendations for both types of government. Municipal officials can collaborate with peers in other municipalities to lobby national government to take actions that make it easier for municipalities to build municipal FTTP networks (ideal solution as discussed in the detailed studies of the profiled cities) or to encourage the private sector to build FTTP networks (a less preferred option if municipally owned networks are not feasible).

Recommendations: National Government

This section highlights policies national government can pursue to create an environment that allows national government, municipal government, and the private sector to collaborate to expand access to affordable, high-speed Internet.

In the absence of action by national government, in some countries, provincial or state government may be able to provide leadership and set frameworks and therefore enact some of these policies. Such action could improve access to affordable, high-speed Internet for some people and provide a template for changes at the national level.

Provide Strong Leadership

It is difficult to overstate the importance of strong leadership from national government to ensure that all residents and businesses can access high-speed Internet.

Profit-seeking ISPs do not voluntarily provide high-speed Internet to locations and people deemed unprofitable to serve. Therefore, if a nation wants to ensure service to "unprofitable" people and locations, national government must convene the participants in its default national broadband Internet ecosystem and lead them in the process of co-creating an intentional national broadband Internet ecosystem specifically designed to balance the needs of all participants. Upon completion, all participants must make the necessary changes to replace the default system with the newly created intentional system.

While consumers can raise awareness of problems with the default national broadband Internet ecosystem and propose possible remedies to address those problems, typically consumers cannot force ISPs that operate with little or no competition to expand service to unserved areas, increase bandwidth, or reduce prices.

Therefore, the eventual success of any initiative begun by residents and/or businesses will require participation from national government because national government creates the laws and regulations underpinning the broadband Internet ecosystem.

Absent leadership from national government to address problems, the default national broadband Internet ecosystem will continue to operate — not serving

53 Fryslân Ring, "Snel internet op het Friese platteland".

54 Friesland Province, "Snel internet op het Friese platteland"..

certain locations and portions of the population and not increasing bandwidth. Left unattended, this situation can result in a nation's telecommunications infrastructure becoming obsolete with negative impacts to all aspects of society that rely upon the Internet, which is everything.

National government is the only actor in the default national broadband Internet ecosystem with the clout to force ecosystem participants to undertake the complex process of reconfiguring the default ecosystem into something that works for everyone.

Therefore, national government should invite all broadband ecosystem participants to create an intentional ecosystem to serve all participants equally — governments, ISPs, and consumers while ensuring long-term ecosystem sustainability. Crucially, all participants will have to compromise as they determine which participants assume responsibility for certain roles within the ecosystem.

A participant's newly re-defined role may require it to relinquish certain tasks and the benefits associated those tasks. However, the role also will protect a participant's responsibility for other tasks and ensure that the participant reaps benefits associated with owning those tasks. Ideally, all participants will support, not undermine, the new intentional system because the system was developed with their input and provides tangible benefits to them.

Absent Strong National Leadership: Amsterdam's challenges in implementing a municipal FTTP network demonstrate the risks inherent in a broadband Internet ecosystem in which national government has not taken a strong leadership role. ISPs sued the city in both Dutch and European Commission courts to try to derail the FTTP project. While the lawsuits were unsuccessful, the city had to expend human and monetary resources to address them, which delayed fiber deployment.

Even if ISPs do not sue, they can obstruct a project. In Amsterdam, KPN derailed the FTTP project by becoming the majority shareholder, buying out the public sector partners and then ceasing efforts to deploy fiber to all premises. This ensured that KPN would not acquire a new competitor and face the prospect of having to upgrade its legacy DSL network to remain commercially viable.

Clearly, the lack of strong national leadership creates a vacuum that allows ISPs to challenge or derail municipal FTTP projects, sometimes based on specious factors unrelated to the technical merits of the project.

Set Measurable Goals, Create a Plan, and Allocate Money to Implement Goals

As part of strong leadership, national government should convene representatives of broadband Internet ecosystem participants to set goals for high-speed Internet connectivity, create a plan to implement goals, and devise a fully-funded strategy to implement the plan.

Measurable Goals: At a minimum, goals should define specific bandwidth to be available to a specific portion of the population or specific currently unserved or underserved locations by a specific time in the future.

For example, Sweden set a goal of connecting 95 percent of Swedes to 100 mbps or greater service at home by 2020. The specificity of the goal makes it easy to measure progress toward achieving the goal. With that information, government can evaluate whether ongoing fiber deployment will meet the goal. If not, government can adjust the goal or devise a plan to increase fiber deployment to meet the goal. The specificity of the goal also guides municipal FTTP networks in determining how much fiber and conduit to install to provide a certain bandwidth, reliability, etc. as required by national goals.

On the other hand, the U.S. goals do not allow clear evaluation of progress in broadband deployment. As mentioned previously, the National Broadband Plan states that "at least 100 million US homes should have affordable access to actual download speeds of at least 100 mbps and actual upload speeds of at least 50 mbps." The goal focuses on connectivity to housing units rather than people. Without knowledge of the number of people in a housing unit, which clearly varies by home, one can't determine what percent of the U.S. population would be served if the United States were to meet its goal. Framing the U.S. goal around housing units allows the United States to deploy fiber in urban areas to connect many housing units. If there are enough urban housing units,

the United States potentially could meet its goal while neglecting rural areas.

Unlike U.S. broadband deployment goals, Sweden's population-based aspirations are easy to understand and don't allow Sweden to neglect segments of the population or regions of the country.

Plan and Implementation: After setting goals, national government must lead broadband ecosystem participants in creating a plan with concrete actions to implement those goals.

Sweden's national government led the creation of a plan to support deployment of municipal FTTP networks via a partnership model that defines clear roles for every participant and works for all participants. The participants and their roles are as follows.

- National government: convenes participants, leads discussion, and passes and enforces laws upholding the system.
- County, municipality, town, and village: build and own broadband infrastructure directly and/or through municipally owned utilities and housing agencies.
- Internet Service Providers: offer service over a combination of ISP-owned and municipally owned infrastructure with the municipality clearly owning the connection to the residential or commercial premise. Some ISPs lease capacity between municipalities and therefore offer service entirely over infrastructure owned by other entities.

Furthermore, all broadband ecosystem participants provided input to Sweden's Internet ecosystem. Therefore, these contributors support the system, which reduces behavior to undermine the system or other actors in the system. As a result its success, Sweden's municipalities have connected urban and suburban residents; their focus has shifted to connecting households in the most rural areas.

Unlike Sweden, the Netherlands does not have a fully developed framework that both supports municipal FTTP networks and guarantees ISPs' role in the national broadband ecosystem. Therefore, many Dutch ISPs seem to view municipal fiber deployment as an existential threat. The result is strong opposition as exemplified by Dutch ISP lawsuits against Amsterdam to thwart its municipal fiber network.

Many Dutch leaders recognize the need for a plan; they are beginning a conversation about how to modify their default broadband ecosystem into an intentional ecosystem that ensures access to high-speed Internet for all of the Netherlands' residents.

Dedicated Funding: Finally, national government must provide dedicated funding to implement its plan. Sweden's national government allocated funding to pay for FTTP network construction to ensure progress connecting all residents to affordable, high-speed Internet because Sweden has made fiber deployment a priority.

On the other hand, it is unclear if the Netherlands national government had allocated money for fiber deployment at the time that Amsterdam and Friesland Province began their efforts to expand high-speed Internet access.

However, as of 2016, national government is investigating the demand for a national umbrella scheme for public funding of broadband projects by decentralized government bodies. The scheme would relieve government bodies of the obligation to develop individual support schemes and present it to the European Commission.[55] Creating a coherent process for all Dutch government entities to use to fund their broadband projects is a laudable step in the direction of creating an intentional national broadband Internet ecosystem.

Establish a National Framework for Construction of Municipal FTTP Networks

If a nation decides that municipal FTTP networks are a preferred tool in their toolkit to expand access to high-

55 Digital Agenda for the Netherlands: Innovation, Trust, Acceleration, published by The Ministry of Economic Affairs — Regulatory Reform and ICT Policy Department, July 2016, p. 20.

speed Internet, national government must lead the creation of an intentional national broadband Internet ecosystem that specifically supports construction and operation of municipal FTTP networks. National government will need to ensure that the resulting intentional ecosystem benefits all ecosystem participants and the ecosystem as a whole.

Sweden: Under the leadership of national government, Sweden did an exemplary job of intentionally creating their national broadband Internet ecosystem to support municipal FTTP networks. Because it was developed via consensus, all parties believe in the system and abide by it. Sweden's municipalities know that they will not face legal challenges from ISPs if they build an FTTP network.

Rather, Swedish ISPs are more likely to begin discussions to offer service via the network. Swedish ISPs appreciate avoiding the risk of building, operating, and maintaining fiber networks. The Swedish system allows ISPs to focus on the tasks at which they excel: determining customer needs and creating service plans to meet those needs.

Freed of the responsibility to undertake debt to pay for construction, ISPs can offer high-bandwidth service at low prices and make an attractive profit. Meanwhile, government assumes the risk of building and owning the network, which is ideal because government can accept a longer time frame to receive a return on investment than ISPs.

Umeå (City and Municipality) and Västerbotten County leveraged Sweden's intentional national broadband Internet ecosystem to build successful FTTP networks with local ISPs as their enthusiastic partners.

Netherlands: On the other hand, national government in the Netherlands had not convened participants in the default Dutch broadband ecosystem to modify it to work for everyone as of 2017. This absence forces Dutch cities attempting to build a municipal FTTP network to convene local broadband ecosystem participants, forge essential partnerships, and create a framework to benefit everyone.

This costs time and money; success is not guaranteed. The experiences in Amsterdam and Friesland demonstrate this. For example, Amsterdam officials initially wanted the municipality to install fiber while another entity managed the network and ISPs served consumers via municipally owned infrastructure. Local ISPs did not agree to this. So, Amsterdam revamped their model so that the city:

- Partnered with different entities — municipal housing corporations and one ISP, Reggefibre, rather than multiple ISPs as originally contemplated, and
- Assumed a larger role in network management and customer service than it might have if the ISPs been interested in offering service via city owned infrastructure

Likewise, officials in Friesland Province developed and evaluated different partnership models, before they created one that passed muster under Dutch and European Commission law.

Initially, the province wanted to buy shares in local ISP, Kabelnoord, which would have brought some fiber infrastructure under partial provincial control thereby giving the province influence over the ISP's future network deployment and operations. After Dutch and European Commission regulators rejected this idea, the province proposed to reduce ISP financing costs via a low-interest loan to encourage deployment. Regulators accepted this approach and ISPs, responded to the tender offer with proposals to deploy fiber in more remote parts of Friesland.

If the Netherlands had an intentional broadband ecosystem supporting construction of municipal FTTP networks, Amsterdam and Friesland officials could have used it. Instead, they had to create a framework for a local ecosystem - i.e. generate ideas on how to structure a partnership to build, operate, and maintain a municipal FTTP network (Amsterdam) or entice the ISPs to build a private FTTP network (Friesland). Because initial ideas did not receive support from potential partners (Amsterdam) or regulators (Friesland), officials in these communities expended time to generate multiple ideas before they found viable strategies, which delayed fiber deployment.

Final Remarks on National Support of Municipal FTTP Networks

Obviously, municipalities can create successful partnerships to support municipal FTTP projects (Amsterdam) or private FTTP projects (Friesland) without a previously negotiated national framework to facilitate such projects. However, Amsterdam and Friesland officials expended more effort than they would have if there had been a framework to use.

Likewise, many U.S. municipalities have built municipal FTTP networks without guidance from federal or state government. Like Amsterdam and Friesland, these US communities expended extra effort to create the partnership framework needed to deploy an FTTP network. Furthermore, other US municipalities have built municipal FTTP networks in states that created frameworks to hinder efforts to construct municipal FTTP networks that serve residential and business consumers,[56] which is even more challenging.

Umeå and Västerbotten County's overwhelming success leveraging Sweden's supportive broadband Internet ecosystem to deploy municipal FTTP networks contrasts with the difficulties and partial success experienced by Amsterdam and Friesland Province in the absence of a similarly helpful ecosystem in the Netherlands.

Clearly, the presence of a broadband ecosystem designed to support municipal FTTP projects reduces friction for municipal officials embarking upon such projects. Likewise, municipal builders of institutional networks that do not serve residential or business end users also can benefit from an ecosystem supportive of municipal ownership of fiber infrastructure.

Support Flexibility in Delivering FTTP Networks

Alternatively, if a nation decides to pursue many options to encourage consumer access to affordable, high-speed Internet, rather than specifically promote municipal FTTP networks, national government must lead the creation of a flexible intentional national broadband Internet ecosystem that supports innovation to meet broadband deployment goals.

For example, to improve consumer access to affordable, high-speed Internet, the United Kingdom focused on encouraging competition on existing networks. Throughout the United Kingdom, a duopoly between, British Telecom (BT) and a local cable provider resulted in high prices, slow service, and the United Kingdom's decline in international rankings of broadband service.[57] Beginning in 2000, to encourage competition and benefit consumers, the United Kingdom required BT to allow other ISPs to deliver service over its lines. Ten years later, the number of Britons served by multiple broadband providers had increased from 12,000 to 6M. As of 2011, the post office and supermarket chains offered broadband and a consortium of ISPs had requested access to BT infrastructure to build its own fiber network.[58]

Unlike national government in the United Kingdom and Sweden, which preferred certain approaches to expanding access to high-speed Internet in their countries, Dutch national government had not created an intentional Dutch broadband Internet ecosystem or even indicated preferred approaches. Therefore, there was no common template that all Dutch municipalities could use to guide efforts to expand access to high-speed Internet.

The lack of a common template means that Dutch municipalities enjoyed (and continue to enjoy) significant freedom to devise strategies to bring high-speed Internet to residents and businesses. Therefore, they will devise a wide range of approaches as shown by the experiences of Amsterdam and Friesland Province as they attempted to build FTTP networks owned with other parties (co-ownership) or to encourage ISPs to build FTTP networks as described below.

Co-ownership: Amsterdam and Friesland attempted to create partnerships that involved the public sector co-owing an FTTP network with other public sector

56 Jason Koebler, "The 21 Laws States Use to Crush Broadband Competition," Vice, January 14, 2015.

57 Rick Karr, "Why is European broadband faster and cheaper? Blame the government," *Engadget*, June 28, 2011.

58 Ibid.

entities and ISPs, often referred to as public private partnerships or PPPs.

After ISP, KPN, refused to offer service via municipally owned infrastructure, Amsterdam pursued a partnership in which the City, municipal housing authorities, and ISP, Reggefibre, co-owned the fiber network. Subsequently, changes in the political environment that allowed KPN to take a direct equity stake in the project combined with KPN's strategic purchase of Reggefibre shares to make KPN the majority partner. Once municipal ownership fell below 50 percent, Amsterdam lost control of the project and elected officials sold the unfinished network to KPN.

Likewise, Friesland Province first proposed buying shares in local ISP, Kabelnoord, which is partly owned by Friesland municipalities and other shareholders. By becoming a shareholder (co-owner) of the ISP, officials hoped to promote fiber deployment for the province. However, the proposed Kabelnoord buy-in was deemed inconsistent with the law, leading the province to develop and pursue the option of offering a subordinated loan to entice ISPs to expand fiber.

In Friesland, the proposed PPP failed immediately due to legal challenges while Amsterdam's co-ownership efforts were successful initially, only failing later due to political factors that transferred project control from the public sector to the ISP, KPN.

Privately owned FTTP networks: When co-ownership proved unworkable due to legal factors (Friesland) and political factors (Amsterdam), both municipalities delegated fiber deployment to ISPs. Amsterdam's abrupt exit from FTTP deployment means that it has ceded leadership to the ISP, KPN, which stopped fiber deployment. This is not what city staff desired; it was what elected officials wanted.

On the other hand, Friesland Province retains leadership of FTTP deployment. Under provincial oversight, Kabelnoord, will install fiber to premises starting in late 2018. If successful, the project will demonstrate how to encourage ISPs to deploy fiber in less dense, rural areas.

On the other hand, one possible disadvantage of such flexibility is that municipalities pursue different approaches to expand access to high-speed Internet. If municipalities do not use similar strategies, it becomes challenging for each municipality to learn from the mistakes of its predecessors and to refine the strategy for use by successors.

This was true in the Netherlands. Lessons learned by Amsterdam officials were not directly transferable to Friesland Province because their attempted solutions were so distinct. In Sweden, a municipality seeking to build a municipal FTTP network would be able to leverage knowledge from other municipalities thanks to the common approach used by all Swedish municipalities.

Recent Developments

The Dutch national government continues to support flexibility and innovation in expanding access to affordable, high-speed Internet. To this end, market participants (ISPs, government entities, and even individuals) can start broadband initiatives.

In the years since Amsterdam and Friesland Province began efforts to expand fiber deployment, Dutch national government has created tools to facilitate fiber projects. For example, the Samen Snel Internet website explains how individuals and government entities can execute fiber initiatives.[59] The website contains:

- Extensive information on broadband initiatives and how to connect to discuss possible collaboration for expansion to new areas;
- Step-by-step guidelines on how individuals can execute an initiative from idea to fully operational fiber network;
- Overview of government-led initiatives, including:
  - Legal considerations including state aid rules;
  - Monetary limits on municipal support to private firms;

59 Samen Snel Internet.

- Alternate options like public-private partnerships and competition rules;
- Rules for government entities that intend to offer services as a market party;

- Interface to ask questions of technical, legal, political, marketing and other experts;
- Knowledge base; and
- Guidelines on construction depth for fiber deployment, which is crucial in the Netherlands because much of the country is below sea level.

Aggregating the collective knowledge of how to execute a successful broadband project and contact information for people with this expertise in an easy to use website is a great way for national government to support fiber deployment.

The introduction of this website and the proposal for a coherent process to fund government-led broadband projects (discussed earlier in this section) show a realization of the need for a coherent system to support fiber deployment in the Netherlands. People interviewed in Amsterdam expressed this view and indicated that the Netherlands is beginning a national conversation about its broadband future.

Recommendations: Municipal Government

This section outlines policies municipal government can adopt as part of efforts to ensure that all residents and businesses can access high-speed Internet. Unlike national government whose policies typically focus on creating an environment and framework for effective collaboration between national government, municipal government, and the private sector, local government policies often focus on conceiving and executing projects.

Depending on the size of administrative units and their legal role, in some countries, provincial or state government may be able to build publicly owned networks. If true, provinces and states will face similar challenges as municipalities and can follow similar policies to address those challenges.

Create Effective Partnerships: Comparison of successful efforts to build municipal FTTP networks in Umeå and Västerbotten County, Sweden with the mixed results of similar efforts in Amsterdam reveal that one differentiating factor is successful partnerships. The Swedish municipalities created effective partnerships with ISPs that allowed the ISPs to offer service via the municipal networks.

On the other hand, Amsterdam had to parry efforts from local ISPs to derail the municipal FTTP project. Eventually, Amsterdam found a cooperative telecom partner in a rural ISP that wanted to expand fiber service to Amsterdam. Unfortunately, the local ISP that initially opposed the municipal FTTP network muscled its way into majority ownership and subsequently ended fiber deployment to new premises.

The Swedish municipalities were able to establish effective partnerships with ISPs because Sweden already had an intentional national broadband Internet ecosystem with a partnership framework to benefit municipalities, residents and businesses in the role of customer, and ISPs. Amsterdam failed to establish these partnerships in the long-term because the Netherlands had not created the intentional broadband Internet ecosystem to facilitate this type of collaboration between municipalities and the private sector.

Interestingly, as part of more recent efforts to expand fiber, Friesland Province did not attempt to utilize pre-existing relationships with the municipalities, residents, and businesses with which it created a fiber ring many years ago.

Instead, it sought to increase its influence over a local ISP by becoming a shareholder. When that plan was not approved, it created a plan to subsidize private ISPs to install fiber to premises.

In both instances, the province focused on solutions to increase the province's power to impact fiber deployment outcomes, rather than solutions in which the province is

one of many equal partners. This may be because the lack of an intentional Dutch broadband Internet ecosystem makes it hard for municipalities to establish and maintain successful partnerships with ISPs as shown by Amsterdam's challenges.

Secure Dedicated Funding: Like national government, municipal government must allocate money for fiber deployment to ensure access to high-speed Internet for residents and businesses.

Umeå, Västerbotten County, and rural municipalities in Västerbotten County expended local money to build fiber networks in their respective jurisdictions. Likewise, Amsterdam allocated money for the FTTP network build and Friesland allocated money for a subordinated loan to the private ISP eventually selected to build a FTTP network.

Pursue External Funding: Municipal government also should pursue external funding to defray the cost of municipal investment and reduce reliance on funds from national government. For example, Umeå and Västerbotten County sought and received money from the European Union.

Be Prepared to Address Technical Challenges

There are many technical challenges associated with planning, building, operating, and maintaining a fiber network. Municipal fiber network owners face a steep learning curve at every stage of deploying an FTTP network.

Based on Umeå's experience, the first 10 years of deploying a fiber network are difficult. Many municipalities do not have staff with the relevant technical skills to perform network planning, construction, operations, and maintenance. Therefore, these municipalities will need to acquire that expertise – by hiring staff directly or via contract. Either method can take considerable time and involve complex legal issues.

It also will be important for the municipal network owner to set policies to support the long-term health of the network. For example, large infrastructure projects typically require modifications to the design during construction to accommodate conditions in the field. It is important to document these changes in the final as-built drawings. Accurate drawings are crucial to proper network operation and maintenance. Therefore, municipalities should enact and enforce appropriate policies to ensure that as-built drawings are accurate.

Another challenge facing nascent FTTP networks that serve residential and business end users is the need to attract partners and/or customers. This can be taxing if the network needs to lure partners and/or customers from a competing network. It takes time to establish these relationships. The municipality also must budget for the time period immediately after the launch of service when the revenue from customers is not sufficient to cover expenses.

The municipality's level of involvement in these activities will depend upon its business model. In Sweden, municipal networks attract ISP partners. Then, the ISP partners attract end users — customers. However, if a municipal network chose to serve end users directly, then it would be responsible for attracting end users, but not partners. If a network chose to serve end users directly and via partnership with ISPs, then municipal staff would be responsible for initiating and maintaining both types of relationships.

Be Prepared to Address Political Challenges

In addition to technical challenges, municipal staff must be prepared to navigate political challenges.

Large municipal infrastructure projects, like a FTTP network, frequently require years of project planning and design, environmental impact analysis, and construction. During this time, municipal staff expend time and money. Also, the municipality likely will hire consultants, which requires more money. The municipality is spending money, but the public is not benefitting yet. This situation provides a basis for opponents to challenge the municipal FTTP project.

First, project staff must convey the FTTP network's expected costs and benefits, level of effort for the project,

and anticipated timeline for completion to elected officials and the public. Understanding the benefits in relation to costs helps to generate support for an FTTP project.

Likewise, municipalities that build institutional fiber networks also must communicate the expected benefits of their projects. The fact that these projects do not serve residents and businesses at their premises is a blessing and a curse. On one hand, these projects face less ISP opposition because the ISP stands to lose one large customer rather than many small customers. But, residents and businesses may not support the project because they do not think they will benefit. Therefore, staff must ensure that people understand benefits of an institutional network despite the lack of fiber to their homes and businesses.

It is equally important that elected officials and the public understand the complexity of a fiber network project so they have realistic expectations about potential obstacles that may impact the time to completion.

In the United States, regulations often require projects that involve significant amounts of public money or considerable impacts to the built and/or natural environment to utilize a formal public engagement process from the earliest stages of a project.

The public engagement process typically allows potentially impacted people to learn about a project and to provide feedback. To ensure that all interested parties have an opportunity to engage, public involvement must consider the types of events, event locations, transportation options to event venues, how events are publicized, how far in advance events are publicized, time of day when events occur, and many other factors to ensure that the most vulnerable populations are not excluded. The goals of a public engagement process are to:

- Establish two-way communication between officials managing the project and the public,
- Gain public support for a project (project staff will have obtained support from elected officials earlier in the project process), and
- Help project staff gather feedback from a diverse and representative cross-section of potentially impacted people that staff can use to reduce or eliminate negative impacts from the project and to improve the project.

U.S.-style public involvement may not exist in Amsterdam, Friesland, Umeå, or Västerbotten County because it may be unnecessary. The consensus driven decision-making popular in the Netherlands and Sweden suggests that residents and businesses provided input to these fiber projects via culturally relevant processes that are different from U.S. processes.

Furthermore, in Amsterdam, the logistical constraints of fiber installation to densely packed, 400-year old canal houses, which have multiple tenants, certainly required advance notification and coordination that would have been difficult to accomplish among a population opposed the project. Therefore, it is reasonable to believe that project officials informed residents and business owners about the project and they supported the municipal FTTP network.

Likewise, Friesland Province's prior successful experience in partnering with municipalities, residents, and businesses owners to build a fiber ring suggests that residents and business owners would support continued fiber expansion efforts by the province.

In Västerbotten County, the willingness of residents to work on fiber projects (before legal changes prevented municipalities from reducing their financial contribution with physical labor) demonstrates support for the project.

Therefore, it seems permissible to say that the profiled projects included public engagement to obtain public support.

Second, once project staff gather support for an FTTP network project, they must maintain that support by being transparent about changes to a project and its timeline. These steps can increase project complexity as staff adapt project design or implementation based on

feedback. But, these changes also can strengthen a FTTP project and increase support for it.

Project Opponents

Municipal FTTP projects encounter opposition from several sources. These include:

- ISPs that want to maintain the status quo to ensure their profits.
- People who oppose municipal FTTP networks based on philosophical beliefs that government should not build and own telecommunications infrastructure or that government is incapable of implementing certain types of projects. In the United States, their public statements often take advantage of and seek to increase the U.S. public's historically low opinion of government. It is unclear if their counterparts in other nations wage similar battles in the court of public opinion.
- People who oppose municipal FTTP networks based on opportunistic, political considerations such as not wanting to support projects associated with a previous administration or a different political party.

ISPs and people who philosophically oppose municipal FTTP projects often fight a project from its inception. Opportunistic opposition, however, may arise at project inception or later. Often, ISPs and people with philosophical objections leverage political opportunists to derail a project they have opposed from the beginning.

This appears to be the case in Amsterdam. Amsterdam's status as the most populous city in the Netherlands meant that Dutch ISPs were understandably nervous that they would lose many customers if the FTTP network were successful. Amsterdam's prominence as the nation's capital meant that ISPs were leery of the impact of a successful municipal FTTP network that other Dutch cities could emulate.

KPN, which had opposed the municipal FTTP project from the beginning via lawsuits, leveraged a change in administration to convince Amsterdam to sell its share in the municipal FTTP network to KPN. Once KPN had total control of the project, it promptly ceased fiber installation to new premises.

The swift demise of Amsterdam's municipal FTTP network is a stark warning that project staff must anticipate opposition and develop measures to counteract such opposition.

Create Strategies to Address Project Opponents

Given the tendency for opponents of municipal FTTP projects to spread mis-information, project staff must communicate with elected officials and the public early and often to achieve and maintain support for the project. This does not imply that projects should not be subject to an open and rigorous debate about purpose, goals, objectives, and implementation plans. They should. However, it is imperative that the public understands how a municipal FTTP network benefits individuals, families, businesses, government, and the community as a whole. This will help the public become a bulwark against efforts to derail the project.

Final Words

The experiences of the profiled European municipalities offer lessons for municipalities that wish to promote high-speed Internet access via deployment of fiber networks. Likewise, the national legal and political contexts in which the profiled municipalities worked offer lessons for nations that want to create an environment to support municipal efforts to promote high-speed Internet access via deployment of fiber networks.

Lessons for Municipalities

The experiences of the profiled communities demonstrate the importance of strong project management and leadership at the local level to overcome technical and political challenges that municipal networks face, especially if the national broadband ecosystem does not fully support municipal FTTP networks.

Amsterdam and Friesland officials exhibited strong management and leadership. When initial plans did

not garner local ISP support (Amsterdam) or meet legal requirements (Friesland), they crafted new proposals. For Amsterdam, this involved partnering with a non-local ISP. In Friesland, the province abandoned efforts to become a shareholder in a local ISP; instead it devised a strategy to entice ISPs to deploy fiber.

On the other hand, Umeå and Västerbotten County did not encounter opposition so their FTTP deployments progressed smoothly. These communities are adding "Internet of Things" applications to enhance service to residents and businesses.

Lessons for Countries

Likewise, countries that want to support municipal efforts to promote access to high-speed Internet will need to rationalize their default national broadband Internet ecosystem into an intentional national broadband Internet ecosystem. Ideally, national government will provide strong leadership for efforts to create an Internet ecosystem that works for all participants.

Under strong leadership from national government, a nation can create an ecosystem to support the deployment of municipal FTTP networks. Such systems decrease the time, money, and human capital that local officials must expend on municipal FTTP projects because they eliminate baseless opposition to the municipal FTTP network. This allows local officials to focus on project planning and execution, rather than defending the project.

The Swedish Internet ecoystem, with its clearly defined roles for all participants, prevented Umeå and Västerbotten County from facing the lawsuits and political opposition that Amsterdam faced in the presence of a Dutch Internet ecoystem that allows, but does not encourage, municipal FTTP networks. Indeed, the ease of municipal FTTP deployment in Umeå and Västerbotten County contrasts starkly with the serial challenges in Friesland and Amsterdam.

Sweden is reaping the benefits of its decision to promote municipal FTTP networks. Swedish residents enjoy faster service at cheaper prices than residents of other nations thanks to approximately 160 municipal networks that collectively serve about 190 Swedish municipalities. While in the United States and many other nations, the success of the municipal FTTP networks in Umeå and Västerbotten County would be rare, it is common in Sweden.

Absent a national broadband Internet ecosystem that supports municipal FTTP networks, some municipalities try to deploy municipal FTTP networks because their communities desperately need high-speed Internet, which the ISPs have not provided. The results are mixed.

Amsterdam did not deploy fiber to all housing units and businesses so most residents still have cable or DSL Internet. Furthermore, an ISP now owns the fiber that was deployed. Likewise, Friesland's in-progress fiber network will be controlled by an ISP, rather than the province. Therefore, these municipalities still do not control their Internet destiny unlike Umeå and Västerbotten County.

Literature on U.S. municipal FTTP networks is full of stories about ISPs suing municipalities and lobbying legislatures to pass laws that hinder municipal FTTP networks. Amsterdam's challenges with KPN and other ISPs mirror this trend.

To promote municipal FTTP networks, countries should convene stakeholders in their default national broadband Internet ecosystem and create an intentional national broadband Internet ecosystem to benefit all participants, as Sweden did. These new ecosystems likely will not be exactly like Sweden's system due to differences in history, political climate, and technical factors (population density, landscape, climate, etc.). In the United States, this effort would need to advance the 2009-10 National Broadband Plan and create a system to support municipal FTTP networks.

Ideally, U.S. and other national governments will assume leadership in this area. However, if they do not, municipalities, states, and provinces can assume leadership. Via umbrella organizations like the U.S. Conference of Mayors, International City/County Management Association, the Government Information Technology Executive Council, the National Governors

Association and others, US elected officials and city staff can convene stakeholders to generate ideas for a well-functioning national broadband ecosystem and present those to national government. Municipalities and provinces in other nations could leverage comparable organizations, if these exist, for their efforts.

While this paper highlights specific policy recommendations for nations and municipalities (and states or provinces if they perform similar roles), successful municipal FTTP deployment requires cooperation between municipal and national government.

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As nations create an intentional national broadband Internet ecosystem and municipalities launch municipal FTTP networks, municipal government and national government must work together to deploy critical fiber networks demanded by their residents and businesses.

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