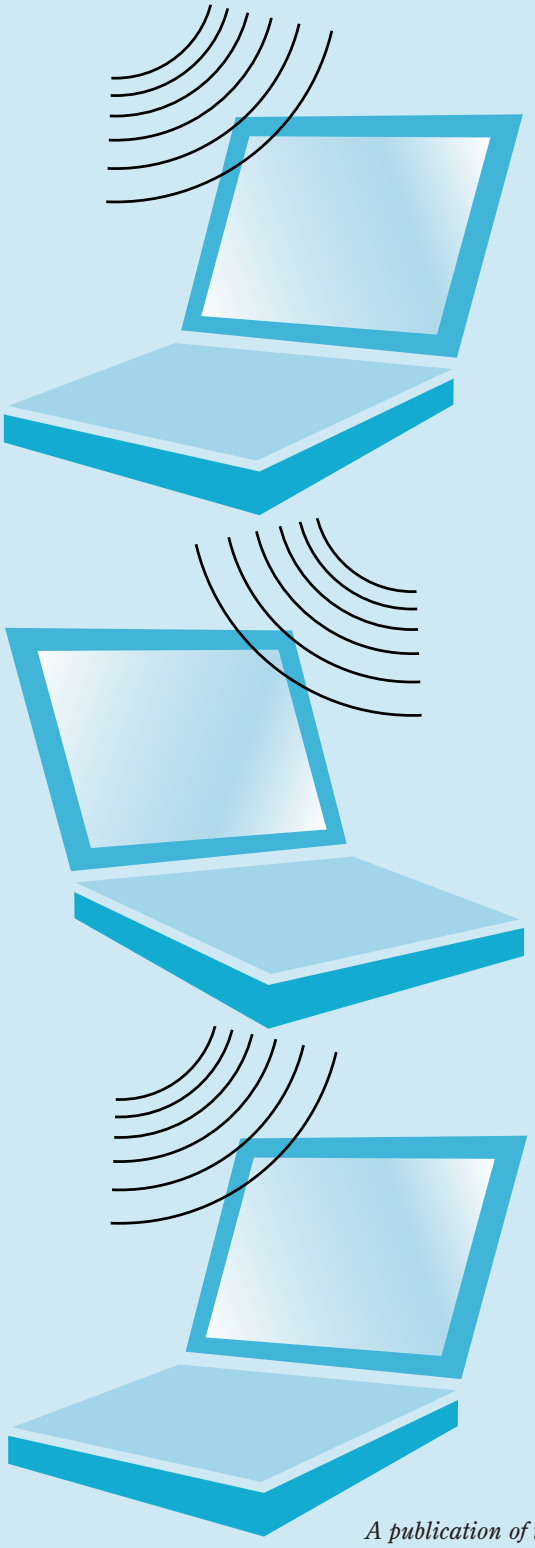

Who will own Minnesota's information highways?

Becca Vargo Daggett
and David Morris
Institute for Local Self-Reliance

June 2005

A publication of the New Rules Project
of the Institute for Local Self-Reliance

ILSR

Other publications from the New Rules Project of the Institute for Local Self-Reliance:

Minnesota's Biomass Mandate: An Assessment
by David Morris, June 2005

A Better Way to Get From Here to There: A Commentary on the Hydrogen Economy and a Proposal for an Alternative Strategy
by David Morris, January 2004 (expanded version forthcoming, August 2005)

Seeing the Light: Regaining Control of Our Electricity System
by David Morris, 2001

The Home Town Advantage: How to Defend Your Main Street Against Chain Stores and Why It Matters
by Stacy Mitchell, 2000

Available at *www.newrules.org*

ILSR

The Institute for Local Self-Reliance is a nonprofit research and educational organization that provides technical assistance and information on humanly-scaled, sustainable economic systems. Since 1974, ILSR has worked with citizen groups, governments and private businesses in developing policies that extract the maximum value from local resources.

Institute for Local Self-Reliance
1313 5th Street SE
Minneapolis, MN 55414
Phone: (612) 379-3815
Fax: (612) 379-3920

www.ilsr.org

Who will own Minnesota's information highways?

Becca Vargo Daggett and David Morris

Contents

The history of great infrastructure developments in this country is a tale of private sector-public sector partnership. In broadband, business will lead the way—as it should. But there is a role for government, too…

—Federal Communications Commissioner Michael J. Copps, 2004

"The very fact that a community can, by vote of the electorate, create a yardstick of its own, will, in most cases, guarantee good service and low rates to its population. I might call the right of the people to own and operate their own utility a 'birch rod in the cupboard,' to be taken out and used only when the child gets beyond the point where more scolding does any good."

—Franklin Delano Roosevelt

Executive Summary

The 21st century has been accurately called the information age. In the near future much of our entertainment, information, and even personal services could be delivered over the Internet (e.g. phone, movies, music, books, news, education, medical consultations, teleconferencing). High-speed communications has become as essential a component of a modern infrastructure as water and sewer pipelines, electric grids, phone wires, and road networks.

The United States has fallen far behind other nations in the delivery of low-cost, high-speed communications services. One reason for this is a lack of competition at the local level. Private companies have been slow to introduce advanced telecommunications technologies. The high prices they charge dissuade many customers from connecting.

Currently, our communities depend on only two telecommunications service providers: the cable company and the phone company. The federal government has dramatically reduced a community's control over the quality and cost of the services provided by these companies. The FCC has also ruled that the networks these companies built as franchisees and regulated monopolies are proprietary; the companies have sole authority to decide who may use their networks, what they will transmit, and what they will refuse to transmit.

A growing number of communities—both to gain access to low-cost, high-speed communications networks, and to enable them to have some influence over the structure and content of their future information systems—are installing their own networks. These community owned systems vary widely in their organizational structure and the range of services they provide. We briefly describe 10 community owned telecommunications networks. Half of these are inside Minnesota; half are in other states.

This report was galvanized by the early 2005 announcements that Minneapolis and Saint Paul are in the process of designing their future information highways. Other cities in Minnesota are in the same situation.

We argue that a community owned system would generate benefits for these cities. It would, for example, provide a yardstick against which to measure the effectiveness of privately owned telecommunications networks. It would allow community services like fire and police and libraries and schools to take advantage of a low-cost, high-speed network. Most importantly, it would allow telecommunications customers a seat at the table as our communities elaborate their information futures.

Introduction

Our quality of life and the economic vitality of our communities depend on a reliable, accessible, inexpensive and modern infrastructure: water and sewer pipelines, electricity and telephone wires, road networks.

In the 21st century, high-speed telecommunications networks have been added to the list of essential infrastructure. An increasing proportion of commerce is e-commerce. The transformation is not yet complete, but already the changes are impressive. Not long ago, the U.S. postal service delivered the mail. The cable company delivered television. The telephone company delivered phone service. The bookstore delivered books. We drove to the movies to see a film, or the video store to rent one. We traveled to meetings.

Today all of these products or services are, or soon will be delivered electronically or photonically.[1]

E-commerce is only the beginning. Telemedicine promises to change how communities, especially rural communities, receive medical care. Telecommuting holds the possibility of reversing the century-long trend of urbanization. Interactive distance education brings the nation's finest professors to remote locations.

This is not the first time the United States has experienced an infrastructure revolution. One hundred years ago, electricity and telephones were just entering our every day lives. Demand soared, but the new networks didn't

reach all potential customers. The private sector willingly offered electricity and phone service to business districts and wealthy neighborhoods in urban centers. But it proved unwilling or incapable of providing reliable, economical, universal service. As a result, the federal government, many state governments, and thousands of communities stepped in to regulate private providers and create community-owned phone and electricity networks.

Perhaps the most visible and direct public involvement in infrastructure development occurred in the 1930s. The Great Depression had revealed massive fraud and mismanagement by the huge interlocking electricity trusts. The plight of farmers was exacerbated by the unwillingness of electricity companies to extend service to rural communities. As a result, Congress passed the National Rural Electrification Act to finance customer-owned electricity companies.

In 1932, Presidential candidate Franklin Delano Roosevelt summed up the rationale behind publicly owned utilities:

> [W]here a community, or a city, or a county, or a district, is not satisfied with the service rendered or the rates charged by the private utility, it has the undeniable right as one of its functions of government . . . to set up . . . its own governmentally owned and operated service . . . (T)he very fact that a community can, by vote of the electorate, create a yardstick of its own, will, in most cases, guarantee good service and low rates to its population. I might call the right of the people to own and operate their own utility a 'birch rod in the cupboard,' to be taken out and used only when the child gets beyond the point where more scolding does any good.

Today the introduction of affordable and accessible high-speed telecommunications networks has sparked a level of urgency, controversy and anxiety similar to that generated by the introduction of electricity services in the early decades of the 20th century.

Yet few politicians today are willing to speak to the need for public ownership. They sound less like FDR and more like his 1932 opponent, incumbent President Herbert Hoover, who insisted, "[t]he majority of men who dominate and control electric utilities belong to a new school of public understanding as to the responsibilities of big business to the people."

Indeed, today policymakers seem eager not only to restrict public ownership but to limit public control. In the 1990s, Congress dramatically reduced its regulation of the telecommunications sector. Since 2001, the Federal Communications Commission (FCC) has issued rules that grant cable and phone companies the right to restrict, burden, or prohibit competitors from using their distribution networks.

At the same time, states have enacted legislation that restricts or bans communities from owning or operating modern telecommunications networks. Today, in Texas and Missouri, scores of municipalities that created their own electricity distribution systems a century ago have been prohibited from adding telecommunications capabilities to those systems today.

In most communities, private sector competition that could drive innovation and development does not exist. The vast majority of our communities are duopolies. They have a single phone company and a single cable company. The FCC has declared this a vibrant level of competition, and the federal courts have supported that view.[2]

Recent mergers threaten to degrade competition even further, from a duopoly to a monopoly.[3]

At the same time that private competition is dwindling, technological developments are accelerating. New communications technologies are spawning new delivery possibilities and lowering the costs of transmission.

This is the political and technological context within which states, counties, cities, and private firms are making telecommunications decisions.

This report focuses on Minnesota, a state of 4.5 million people that created hundreds of municipal and cooperatively owned electric and telephone utilities in the last century, many of which continue to operate today. To offer guidance to Minnesota policy makers, this report draws on experiences both inside and outside the state.

Minnesota became involved in creating a statewide high-speed telecommunications network development in 1989, with the creation of MNet. MNet provides videoconferencing over leased lines to state and local governments, public and private universities, and some public schools.[4] An initiative begun in 1997 would have installed thousands of miles of conduit and fiber optic in highway right-of-ways, and brought fiber optic connections to within 10 miles of 90 percent of Minnesotans. But the project faced strong opposition from cable and telephone companies, and was eventually scaled back to about 250 miles of conduit.[5]

In Minnesota, the number of people subscribing to Internet service rose rapidly from 1992 to 2002. But since 2002, demand has stabilized. The number of people who subscribe

The vast majority of our communities ... have a single phone company and a single cable company. The FCC has declared this a vibrant level of competition, and the federal courts have supported that view.

One might argue that community ownership is one of the few ways left for communities to foster competition.

What is broadband?

When most people speak of broadband, they are using the term to refer to high-speed Internet connections.[6] But what constitutes high speed? The definitions vary widely. The FCC, for example, defines "advanced telecommunications capabilities" as data transmissions speeds of more than 200 kbps (kilobits per second or thousand bits per second), both up-stream and down-stream.[7] "High-speed", according to the FCC, is more than 200 kbps in at least one direction.

The National Academy of Sciences defines broadband as an access service that enables the creation of applications and content.[8] By this definition, broadband is not a fixed transmission speed. It is the capacity to use existing applications and create new ones. Thus, 1.5 Mbps (megabits per second or million bits per second) downstream and 256 kbps upstream may be considered broadband today, since it meets most people's demand for Internet services. In a few years, the downstream capacity demanded may be much higher to accommodate, for example, video-on-demand. The demand for upstream capacity will increase if more peer-to-peer networking applications are developed.

to high speed Internet service is increasing very slowly, both inside Minnesota and nationwide.

There are two mutually reinforcing reasons for the slowing growth of high-speed telecommunications demand. Service is expensive, causing most people to view it as an unnecessary luxury. And the absence of a market discourages the development of applications that would be found useful by large numbers of people. The relatively small number of customers sharing the cost of service in turn raises the per household cost of services.

Minnesota local governments have entered into the telecommunications arena to accelerate affordable, universal access. In early 2005, several telecommunications-related announcements occurred almost simultaneously in Minnesota:

- Windom, a small city on the Iowa border, launched its municipally owned and operated ultra-high-speed, fiber based telecommunications network that connects all households and businesses in town.
- Minneapolis issued a request for bids on a wireless system that would initially serve its own municipal government needs. The request ruled out public ownership or operation of the system. The city's role will be restricted to that of a large initial customer.
- Saint Paul's City Council launched a formal study of various telecommunications options preparatory to issuing its own request for proposals.

Just a few months earlier, Chaska's city-wide wireless network, among the first of its kind in the country, became fully operational.

These announcements, reflecting the diversity of approaches embraced by Minnesota's local governments, spurred the writing of this report. We hope it will prove useful to policy makers trying to elaborate an information highway that achieves two important objectives: 1) economical and universal service; and 2) direct customer participation in the design and evolution of the system.

Community Ownership

Should government get involved?

> "It's easy to bash city governments as being full of maladroit bureaucrats eager to manhandle a new technology, and even economists who support municipal networks say cities shouldn't rush into them. But well-thought-out city plans could help everyone by acting as a catalyst and shaking up the status quo. Some might even call that competition."—Lee Gomes, *Wall Street Journal*, February 14, 2005

In October 2003, 54.6 percent of U.S. households had Internet connections, but only about 20 percent of households had a connection that provides speeds of at least 200 kbps.[25] By some estimates, DSL or cable modems are not available in 60 percent of U.S. zip codes.[26] In Minnesota, only about one-third of Internet subscribers have a connection of at least 200 kbps, which, as we noted above, should not be considered high speed.[27]

Although thousands of miles of fiber optic backbone cable have been laid by the private sector, there has been no incentive for the private sector to take fiber the "last mile" to homes and businesses. No single service provider could justify the investment based on short-term profitability.

When the private sector has proven unwilling or incapable of providing high speed communications service, and in areas where high-speed communications service is available only at a very high price, local governments have stepped in.

In Minnesota, this has occurred mainly in small- and medium-sized towns not served by private companies. These communities have chosen to own their own systems and also act as a service provider, as have about 200 others throughout the county. When those who use

their networks only for municipal purposes are included, the number of communities that have built their own infrastructure grows to 600.

In most cases these community-based networks develop incrementally. Local governments in cities and towns have installed fiber I-Nets (institutional networks) to meet their own needs for data sharing among municipal offices, video conferencing, traffic monitoring, utility management, etc.[28]

With local fiber networks in place, little extra effort is required to add connections for schools, hospitals and businesses. Citywide wireless networks can utilize this existing fiber loop; indeed, many cities have installed citywide wireless exclusively for municipal and emergency services.

Can government be involved?

As of May 2005, in all but two states, municipalities can own a telecommunications network. Fourteen states either prohibit or create barriers for municipal telecommunications activities. Fourteen others are considering such legislation.[29]

These laws vary widely. For example, Missouri and Texas prohibit municipalities from providing telecommunications services under any circumstances.[30] Pennsylvania allows municipal telecommunications only if the local telephone company will not provide such services. Others, including Washington, Utah, and Wisconsin, allow wholesale municipal networks (publicly owned infrastructure with bandwidth available to private service providers at wholesale prices) but restrict municipal retail systems (publicly owned infrastructure with the city acting as service provider).

Minnesota has no restrictions on either wholesale or retail service, except that it requires a referendum approved by 2/3 of voters for a city to offer telephone services.[31]

Responding to the arguments against community ownership

Those opposed to community ownership raise three main arguments.

1. Public ownership leads to monopoly and stifles competition.

If Minneapolis or Saint Paul were to opt for a municipally owned information network, it would stimulate, not stifle competition. The cable company and the phone company and the electric utility already operate in the two cities, and in cities around the region. Their operations will not disappear simply because there is a city-owned network. But as FDR said over 70 years ago, the city-owned system can operate as a "yardstick" and a "birch rod". It puts the public—that is, the customers—at the table.

Empirical research shows that public investment in communications infrastructure often stimulates competition.[33] One might argue that community ownership is one of the few ways left for communities to foster competition. Here's why.

In 1996, the FCC issued its Local Competition Order. The Order required incumbent phone companies to provide competing carriers with access to their infrastructure at a reasonable cost.[34] Most phone companies stopped investing in infrastructure they would have to make available to competitors.[35]

Cable networks faced no such common carrier requirements. In 2002, the FCC ruled that cable modem service should be classified as an "information service" rather than a "telecommunications service" and thus not subject to the same open access rules as telephone company lines under the Local Competition Order.[36]

If cable modem service is a "telecommunications service" it is more strictly regulated, like telephone service, under the Telecommunications Act of 1996. If it is an "information service" it is not subject to the same regulatory requirements. Those who support this differential treatment argue that information services are a new technology, and minimal regulation of new technologies results in greater innovation.

The phone companies complained that cable companies were given an unfair advantage in the broadband market and challenged the FCC's policies in court.[37] In 2003, the FCC addressed the phone companies' complaint by exempting the telephone companies' fiber optic networks from common carrier requirements.[38]

In 2004, however, the 9th Circuit Court of Appeals overturned the FCC decision on cable modems. A U.S. Supreme Court decision on the matter is expected by July.[39]

If the Supreme Court upholds the 9th Circuit's decision, cable companies would have a statutory duty to provide service to consumers and competing internet service providers (ISPs) at rates that are "just and reasonable". They could also be obligated to interconnect their networks with other networks. Their rates, terms and conditions would be subject to federal review, and they would be subject to the universal service tax.

If the Supreme Court upholds the FCC's position, neither cable companies nor phone companies (if the latter uses fiber optic networks) would have to share their delivery systems at a reasonable cost.

One might argue that the U.S. government, or to be more precise, the FCC has a long history of making decisions that inhibit

Studies consistently find that publicly owned water and sewage and roads and electricity systems are managed at least as effectively as privately owned systems.

National companies that serve hundreds of communities find it most efficient to impose a one-size-fits-all system ... Communities, on the other hand, have different needs. Large cities, for example, have sufficient traffic to justify multiple on-ramps. Small towns may require only one.

competition. In the early 1980s, the FCC carved the U.S. into 734 tiny mobile phone districts and issued two provider licenses for each district—one to the incumbent telephone company, and one drawn by lottery. In the mid-1990s, as the U.S. lagged behind other countries in cellular phone network development, the FCC opened enough spectrum for six nationwide networks and auctioned it off.[42]

Unlike cellular telephone service, however, the national broadband network is in place. Long-haul fiber optic capacity exceeds demand for the foreseeable future. Thus the national infrastructure is already in place for a competitive information highway.

What communities are doing is designing the on-ramp. The current FCC model of "multiplatform competition" leads to communities having a choice only between the cable company's on-ramp and the telephone company's on-ramp.

In Minnesota, some 55 percent of rural Minnesota communities have only one broadband provider; 15 percent have no broadband provider.[43] Most cities have only two telecommunications providers: one telephone and one cable company. For example, Qwest and Comcast serve Minneapolis, Qwest and Comcast serve Saint Paul.[44]

Besides the obvious problem of stifling competition, this also stifles innovation and diversity. National companies that serve hundreds of communities find it most efficient to impose a one-size-fits-all system. The incumbent cable and telephone companies want to offer the same on-ramp in every community. In a short time, all of these on-ramps may consist of fiber optic cables to the neighborhood or the curb, then either copper phone lines or coaxial cable to the home. A small number of communities will have fiber-to-the-home.

Communities, on the other hand, have different needs. Large cities, for example, have sufficient traffic to justify multiple on-ramps. Small towns may require only one. The latter may be more suited to broadband over power lines or wireless than to DSL or cable.

Given the hands-off federal regulatory environment and the concentration of private ownership of telecommunications networks, community ownership may be the only effective way to guarantee true competition both in services and technology. It is, as FDR said, the "birch rod in the cupboard" to be taken out when private companies have failed to provide access that is universal, affordable, and truly high-speed. One particularly effective way of stimulating competition is a community owned network that offers space for private companies to deliver competitive services to the community's household and businesses.

The U.S. vs. Japan on Telecommunications Competition

Japan's telecommunications policies follow the original philosophy behind the U.S. Telecommunications Act of 1996. Regional phone companies are required to allow competitors to access to their networks for a modest fee. Antitrust authorities monitor the sector to ensure that the companies do not create obstacles for their competitors. The national government not only encourages rural municipalities to set up their own networks, it subsidizes start-up costs.

Japan's regulatory approach has spurred competition to provide faster telecommunications speeds. The result is that today nearly all Japan's 46 million households have access to connection speeds of 26 Mbps for about $22 per month—the lowest price in the world.

As of mid-2004, an ultra-high-speed fiber connection of 100 Mbps or more was available to more than 80 percent of the Japanese population.

In the United States, the FCC currently supports what it calls "multiplatform" competition. It argues that competition between cable and telephone companies is sufficient to create a competitive market. One result is that at the end of 2003, barely more than 600,000 U.S. homes and businesses had fiber connections. That may expand to 3-5 percent of the 115 million US households by the end of 2005.

Since 2000, the U.S. dropped from 4th to 13th place in the global rankings of broadband Internet usage. Internet access available to U.S. households is slower, more expensive, and less reliable than what is available in Canada, Europe, Japan, and South Korea.

2. Publicly owned telecommunications systems will be poorly managed and uncompetitive.

There is over 100 years of empirical research on the comparative efficiencies of public and privately owned infrastructure. The studies consistently find that publicly owned water and sewage and roads and electricity systems are managed at least as effectively as privately owned systems.[45]

The telecommunications sector, while new, so far fits this pattern. Allegations made by private companies and their advocates that specific municipal telecommunications projects are failures have proven unfounded.[46]

In fact, one can argue more persuasively that it is the private telecommunications sector that has been poorly managed. In 2001, 27 telecommunications companies, each with at least $100 million in debt, filed for bankruptcy.

In 2002, 31 telecommunications companies with a total of $130 billion in debt filed for bankruptcy. The industry's default rate was four times higher than the overall rate, and it accounted for half of the $45 billion in bond defaults in 2001. Among those that filed for bankruptcy were WorldCom, Adelphia, Global Crossing and Enron Broadband. The Securities and Exchange Commission has investigated all of these companies for fraud.[47]

One should also point out that publicly owned systems use a different type of cost-benefit analysis than private companies. Private companies strive to maximize the short-term benefit to their stockholders and upper level management. Municipally owned utilities strive to maximize the long-term benefits to their community as a whole. A publicly owned communications utility might reduce its profits (surplus) to extend access to all parts of the community. Or it might reinvest its entire surplus into upgrading the system even though the current demand for improved services comes from only one part of the community.

Glasgow, Kentucky's electric utility offers an example of the difference in public and private cost-benefit perspectives. The utility has offered cable since 1989 and didn't begin posting positive net income in 1998. But the benefits to the local economy began immediately. The utility estimates that in each year since it began operation, customers have saved $800,000 to $1 million in cable fees.[48] This keeps more money circulating in the local economy both because community residents pay less than is charged by private providers in neighboring communities, and because a much higher proportion of the money paid to the utility remains in the community than would be the case with an outside company. Glasgow, a rural town of 14,000, has also offered broadband at speeds of 4 Mbps since 1995. Until recently, Minneapolis and St. Paul customers have had access to only half the speed at twice the price.

3. Local governments have the tools to influence the development telecommunications systems (e.g. franchise agreements). They need not own the system.

This criticism had some validity 20 years ago. It is far less true today. The reach of franchise agreements has been severely circumscribed so that today its only authority appears to be on establishing the franchise fee and the original design of the telecommunications system.

A few years ago, AT&T purchased TCI, and thus its Portland, Oregon cable franchise. Portland agreed to transfer the franchise but under the condition that AT&T allow independent internet service providers to sell their service over its cable. AT&T refused. The 9th Circuit Court of Appeals backed the company, and said that only the FCC has authority to decide whether or not to impose open access rules on cable companies.[49] Thus it came to be that cities had no right, even as part of franchise agreements, to require companies to allow access to their networks. And, as mentioned above, the FCC has declined to impose such a requirement.

In late May, Minneapolis filed a lawsuit against Time Warner for $4.5 million in unpaid franchise fees and penalties. The suit is just the latest skirmish in a ten year battle with Time Warner over the city's principal complaint: the company's refusal to make 25 percent of its network capacity available for city use, as set forth in the franchise agreement. The company maintains that cities have no right to regulate Internet or telephone services carried over cable networks.

Texas is currently considering legislation that would allow local phone companies to raise rates, eliminate local franchise rules, and prohibit municipal competition.[50] Telecommunications companies see the proposed Texas law as a model for the rest of the states, and for rewriting the 1996 Telecommunications Act.

Some telecommunications companies have announced their intention to seek changes at the federal level that would restrict state and local regulatory authority over their industry. After San Francisco announced its plan to build a municipal Wi-Fi network, Verizon CEO Ivan Seidenberg set forth his highest priority for a Congressional rewrite of the Telecommunications Act. "The first thing we'd do is pre-empt the states. That's priority No. 1, No. 2 and No. 3."[51]

4. Government should not decide what we can and cannot do with our information network.

The question is not whether local government should decide what is carried on the telecommunications network, but whether those decisions are better vested in local government than in the federal government or private companies. In the 1980s, the federal government abandoned its 60-year-old public interest requirements for radio and television broadcasters. Recently it has focused on restricting the sexual content of broadcast shows. Private cable companies frequently exercise their right to drop popular cable stations because they can increase their revenue by substituting another channel. Privately owned systems have, and will continue to, censor shows, especially for political content.

When people use a cable modem they are

The question is not whether local government should decide what is carried on the telecommunications network, but whether those decisions are better vested in local government than in the federal government or private companies.

Companies can interfere with and monitor online activity in a variety of ways.

connecting to the Internet through the cable provider's gateway. The American Civil Liberties Union charges that cable networks, and by extension fiber optic networks and any other proprietary networks, "lack the Internet's open and nondiscriminatory design on the technical level."[52] This allows the company to interfere with and monitor online activity in a variety of ways:

- Providers can control the overall speed and reliability of the connection.
- Providers can block customers from using particular applications (e.g. video conferencing, VOIP, and virtual private networks), or require customer's to use the provider's own proprietary application.
- Providers can slow or block access to certain sites on the Internet, whether because the content is deemed objectionable or because the site does not have financial arrangements with the provider. Conversely, providers can speed transmissions to and from sites with which they have financial arrangements.
- Providers can force customers to access the Internet through a particular home page. This is similar to what AOL has done with its "welcome screen", which contains both news stories and paid promotions.
- Providers can monitor online activities. In February 2002, Comcast began to track customers web browsing without their knowledge. The practice was discontinued after it became public. Information on web browsing habits is viewed as a valuable resource for marketing purposes, however, and efforts to protect copyrighted materials also create strong pressures to monitor online activities.

Of course, local governments may attempt to exercise similar controls, but it is ultimately responsible to its citizens in a far more direct way than a global corporation is responsible to its local customers. Local elections occur, on average, every two years.

Information Delivery Technologies

Information can be delivered via a wide array of technologies that can be divided into two broad categories: wired or wireless. Wired, or land line, connections include copper telephone lines, cable television lines (coaxial cable), optical fiber, and electric power lines.

Land Lines (Wired)

Copper phone lines Currently copper phone lines deliver very low speeds when using a dial-up connection (56 kbps), but are capable of offering speeds 500 times greater.

ADSL (asymmetric DSL) typically provides speeds of about 1.5 Mbps downstream to subscribers in the U.S. However, it is technically capable of delivering at speeds of at least 8 Mbps, and that delivery capacity may increase still further in the near future. ADSL is limited by distance; customers must be close to a central office of the provider (within 18,000 feet or about 3.5 miles).

High-speed DSL technologies (VDSL) are not widely used but can deliver speeds of 52 Mbps over a very short distance (4000 feet, about 4/5 of a mile). The high speeds of VDSL are possible in part because, unlike ADSL, it can be used in conjunction with fiber optic networks.[10]

In Japan, communications are routinely delivered at speeds of 26 Mbps over copper wire.

Coaxial cable Coaxial cable, used to transmit video (TV) signals, also utilizes copper wire. U.S. cable companies typically provide speeds of 3 to 5 Mbps downstream and up to 1 Mbps upstream. Speeds of up to 10 Mbps are possible using current technology. As with DSL, they may increase substantially in the future.

More than two-thirds of households with broadband in 2001 had cable modems; this dropped slightly to 56 percent in 2003 as DSL gained subscribers relative to cable.[11]

Electric power lines Broadband over power lines (BPL) is an emerging technology that can be used either as a wired technology that brings data directly into the home over power lines, or a wireless technology that carries data over power lines then broadcasts a wireless signal from utility poles into homes. BPL's development was slowed by the fact that the use of power lines to carry communications traffic can interfere with Ham radio and other emergency radio signals.[12] In October 2004, the FCC ruled that it would tolerate a small amount of radio interference in certain areas in exchange for making broadband services more competitive.[13] Only a small number of BPL systems have been installed.[14] Maximum speeds are comparable to DSL (in the range of 1 to 4 Mbps), but may be many times higher when broadcast as a wireless signal from utility poles.

Optical fiber cables Optical fibers, or fiber optics, are long, thin strands of glass or plastic surrounded by optical material and an outer covering. The Internet "backbone" is made up of fiber optic cables that run from coast to coast, as well as across the Atlantic and Pacific oceans. Fiber-to-the-premises (FTTP, or to-the-home, FTTH, sometimes also written as FTTx) networks utilize fiber in every segment of the Internet connection, from the backbone to the home. Fiber can

transmit data at speeds of 10 to 1000 Mbps or more, depending on fiber used and the technology used to route traffic through the lines.

Wireless

Wi-Fi In the U.S., wireless technologies are sometimes referred to by their IEEE (Institute of Electrical and Electronics Engineers) standard numbers. Wi-Fi, for wireless fidelity, and WLAN, for wireless local area network, are names for IEEE standard 802.11.[15]

Wi-Fi uses unlicensed radio spectrum to transmit signals.[16] It is what your local library or coffee shop uses to create a "hot spot". Maximum range is about 300 feet, and speed for individual users is around 1 Mbps. The coffee shop (or library, or your home network) connects a wireless access point to its wired Internet connection.

But Wi-Fi can also be deployed as a cluster of hot spots, sometimes called a "hot zone", which can cover a downtown zone or a whole city. This can be done by mounting the access points (also called nodes) on streetlights and other infrastructure and connecting them to wired broadband connections. In places that want to minimize the need to install additional wired broadband connections, Wi-Fi hot zones can also be built using either using directional antennas or mesh networking. Directional antennas create a relay path from one to another. Mesh networks are more like the Internet itself—a grid of access points, all of which can communicate with each other. The data travels on the best path to or from the service provider.[17]

WiMAX IEEE standard 802.16, called WiMAX (Worldwide Interoperability for Microwave Access), will be officially certified sometime in 2005. WiMAX is a technology, but it is also a seal of approval—WiMAX products are guaranteed to work with all other WiMAX products, so a network can be built from the best available devices from any combination of vendors. Wi-Fi products do not currently have the same guarantee.[18]

WiMAX has a range of 1 to 6 miles, depending on the technology. These longer distances are possible because WiMAX will use licensed as well as unlicensed frequencies.

Wi-Fi installations will not necessarily become obsolete when WiMAX comes in. Intel and the WiMAX Forum are promoting WiMAX as a complement to rather than a substitute for Wi-Fi.[19] In many places, WiMAX may be more cost-effective than fiber to deliver bandwidth to Wi-Fi access points and Wi-Fi access points are more cost-effective at delivering bandwidth to the ultimate customer than WiMAX.[20]

Two other wireless technologies are available but not widely used.[21]

Satellite, along with other forms of fixed wireless, represents only one to two percent of household Internet connections. Satellite connections are cost prohibitive under most circumstances.

On the other end of the scale, **ultra short-range** connections are possible with IEEE 802.15.1, called Bluetooth, and IEEE 802.15.3, called ultra-wide band. These are most commonly used to connect devices within a home or office. Maximum range is about 30 feet, and maximum speeds are 1 Mbps for Bluetooth and 400 Mbps for ultra-wide band.

Technological Lessons Learned

For those looking to establish a citywide system, the choice of technologies can be daunting. And for communities wanting to become involved in the ownership or operation of the system, there is the fear of technological obsolescence.

Here are a few things decision makers should keep in mind.

1. Fiber-to-the-home is currently viewed as the only "future-proof" technology; you'll never have to worry about outgrowing the system's capacity. However, it is also the most expensive type of information highway, in part because of the cost of the fiber and associated routing technologies, but also because of the cost of digging up streets.

About 200 U.S. communities have fiber-to-home networks, including several in Minnesota.[22]

Fiber-to-the-home costs about $1200 to $2000 per connected building, depending on the networking technologies employed and the distance between homes. The cost can be cut in half or more if the underground conduits already exist. Communities planning to dig up their streets for other purposes (e.g. undergrounding electricity wires, separating water and sewage pipelines, etc.) should install "dark fiber" (optical fiber without the systems needed to transmit traffic) or con-

Time to download a 2-hour movie in digital format[9]

56 kbps dialup modem	13 days
1 Mbps DSL connection	17 hours
3 Mbps cable modem	5 hours
100 Mbps fiber connection	10.4 minutes
1 Gbps fiber connection	1 minute

Fiber-to-the-home

is currently viewed as the only "future-proof" techology; you'll never have to worry about outgrowing the system's capacity.

As traffic management, compression, and wireless data transmission technologies evolve, it is possible that wireless will be able to achieve the same capacity as fiber by the time 100 Mbps or more is demanded for residential service.

duits to facilitate future fiber optic networks.

Most cities and many smaller communities have at least partial fiber networks, installed for university or municipal use. Some communities have access to dark fiber that was installed by companies that subsequently went bankrupt. In the aftermath of the telecommunications boom and bust of the late 1990s, the price of fiber plummeted. Universities, companies not involved in the telecommunications business, and in some cases cities purchased miles of dark fiber at very low prices.[23]

As the ability to deliver high speeds over copper and coaxial cables increases, more networks are utilizing fiber-to-the-neighborhood or fiber-to-the-curb, both of which then use existing copper connections from the street into the home.

2. Wi-Fi has the lowest capacity but also the lowest cost, and the greatest speed of installation for citywide networks. Currently wireless is most often used in conjunction with wired systems. Wireless access points are connected to a fiber optic network that circles a city or neighborhood. The fiber network is in turn connected to the Internet backbone also by fiber optics. In this configuration, cost per home can be about $200, but it varies according to residential density and whether or not new fiber is being installed. A public hot spot serving 60 users in a 300-foot radius can cost about $4,000.[24]

Wireless mesh networking can further reduce the cost of broadband per home, and make network expansion even easier. Using this system, wireless access points can be added to an area without the need to extend fiber optic connections to all the access points. This can be particularly useful in densely populated areas, where a large concentration of access points is desirable, resulting in a cost per home in the range of $30 to $100.

Similarly, broadband over power lines offers the possibility of transmitting bandwidth over power lines to utility poles, then using wireless to transmit from the utility pole to the home. Costs for BPL are currently unknown, but may be as low as $50 to $150 per home in high-density areas. However, BPL at present can carry a signal only a moderate distance (1000 to 3000 feet) without using repeaters (at $200-500 each). Therefore it is more economical on lines that service a number of homes rather than long rural lines that serve one or two.

WiMAX offers the possibility of wireless connections directly to the Internet backbone over distances of one to six miles without the need for intermediary fiber optic cables. This is useful in less densely populated areas, where fiber installation would be cost prohibitive. But it may also be used in conjunction with Wi-Fi, with WiMAX transmitters rather than fiber optic cables delivering bandwidth to Wi-Fi access points, or as a means of delivering bandwidth for BPL distribution. WiMAX may reduce cost per home to as little as $30.

3. Channels can be carved out in DSL, wireless, and fiber optic systems to allow competing service providers to use the same network. The same is not true for BPL. All BPL systems that serve the general public currently are franchises to private firms that lease the lines from the utility and sells retail services.

4. Engineers are learning to increase the speed and capacity of all types of delivery systems. These improvements will, in all likelihood, continue. Copper telephone lines, for example, are being used in other countries to transmit information at speeds of 26 Mbps or more, even though most current DSL customers in the U.S. receive information at 1 or 1.5 Mbps. Wireless communications speeds have been pushed to 54 Mbps in a relatively short period of time.

Transmission speeds depend both on the medium (e.g. copper wires or fiber optic cables) and the technology used to compress bits and route traffic on the network. At this point, investment in a fiber optic network virtually ensures access to enough capacity to meet business and residential needs for the next two decades or more. However, as traffic management, compression, and wireless data transmission technologies evolve, it is possible that wireless will be able to achieve the same capacity as fiber by the time 100 Mbps or more is demanded for residential service. In the meantime, high-speed DSL technologies can meet the demand for more capacity over existing copper lines to homes, and BPL may be able to do the same.

Community Ownership Case Studies

On the following pages are 10 case studies of community-owned telecommunications systems. They reveal a wide array of ownership structures and technological delivery systems.

In the state of Washington, two cities with municipally owned electric utility systems offer different structures. Tacoma is involved with telecommunications systems at the retail level; Chelan PUD offers service at the wholesale level.

Minnesota's Windom has the highest speed telecommunications network in the country and sells phone, cable, and other services directly to residents and businesses. Saint Peter, on the other hand, has installed conduits under the streets, which has enabled competing companies to lay in competing fiber networks, including a locally owned firm.

In Utah, a consortium of 18 cities with one third of the state's population is developing a fiber-based wholesale communications network. Philadelphia has established a nonprofit corporation to oversee the installation of a citywide high-speed wireless network.

Which of these systems and ownership structures is best? Only time will tell. Our sense is that there is no single best model. Communities need to decide what is right for them.

But communities can only decide if they have the information, and if their political leaders allow community ownership to be included in the range of possibilities examined.

MINNESOTA

Buffalo—Buffalo Wireless Internet Group (BWIG)

Model:	**Municipal utility, retail service provider**
Population: 1	**3,000**
Location:	**40 miles northwest of Minneapolis**
Date of First Service Offering:	**1997 business service, 2001 wireless service**
System Type:	**Fiber loop with non-line-of-sight wireless**
Services Offered:	**Internet**
To Whom:	**government, business and residential service**
Alternative Providers:	**none preexisting; subsequent Charter Communications**

Buffalo is an excellent example of incremental growth in a municipal network. Buffalo's network began in 1996 with a city fiber backbone for municipal use. The city began considering network upgrades in 2000, both to increase network capacity and to improve utility monitoring. It considered both adding more fiber optic cables and point-to-point wireless, and determined wireless would be more cost effective.

Businesses asked the city to include their requirements in considering network upgrades. The local telephone company offered only dial-up connections or very expensive T-153 service, and the cable company offered no Internet service at all. The final system includes wireless point-to-point service for business and residential customers, and some businesses purchase a connection directly to the city's fiber network.

The city spent $750,000 on five wireless towers in 2001, with anticipation that the investment would pay itself off in four years. The non-line-of-sight54 technology it chose provides slower speeds than line-of-sight wireless, but offers easier installation and fewer problems with obstructions. By 2004, the Buffalo Wireless Internet Group(BWIG) had enough subscribers to run a monthly operating surplus of $7700, which it reinvests in the system.55

In late 2004 the city installed a wireless mesh network covering its 26 square miles. The mobile mesh network is only for municipal use; subscribers do not have access to the mesh network. The city will consider offering roaming access56 if it determines its has excess capacity after its emergency services needs are met.

The city charges $10 per month for 128 kbps and $34 per month for 384 kbps bi-directional. The fastest available speed is 1.5 Mbps, for $50 per month. After the city government announced its plan to offer business and residential service, Charter Communications introduced cable modem service for $45 per month for 384 kbps, bi-directional. For 3 Mbps downstream/256 kbps upstream, the price is $55 per month.

Chaska—Chaska.net

Model:	**Municipal utility, retail service provider**
Population:	**18,000**
Location:	**20 miles southwest of Minneapolis**
Date of First Service Offering:	**October 2004**
System Type:	**Wi-Fi (wireless mesh and fiber backhaul)**
Services Offered:	**Internet only**
To Whom:	**business and residential**
Alternative Providers:	**preexisting Time Warner cable, Sprint DSL (limited availability)**

In 2004, Chaska spent $600,000 to set up more than 200 transmitters (about $2,200 each) on utility poles throughout the 16 square mile city. It also had existing infrastructure from providing Internet service to businesses and schools for several years, which would have added $300,000 to $400,000 to the price if purchased with the rest of the system.

Chaska charges $16 per month for 1 Mbps. The service already has 2300 subscribers (about one-third of the city's households), surpassing its requirement of 1700 to operate, pay back the capital investment, and generate a small profit to be used for future system enhancements. Time Warner offers cable modem service at 3 Mpbs for $45 per month, and Qwest offers DSL at 1 Mbps to some homes at $40 per month.

Moorhead—GoMoorhead!

Model:	**Municipal utility, retail service provider**
Population:	**33,000**
Location:	**Northeastern Minnesota**
Date of First Service Offering:	**anticipated July 2005**
System Type:	**Wi-Fi (wireless mesh and fiber backhaul)**
Services Offered:	**Fiber and wireless Internet access (fixed location and roaming)**
To Whom:	**government, business, residential**
Alternative Providers:	**preexisting Cable One cable, DSL**

In December 2004 the Moorhead City Council authorized the formation and operation of a new telecommunications utility by Moorhead Public Service (MPS). In March 2005 the City Council authorized the city to loan MPS enough money to pay for the new utility from revenues generated by the electric and water utilities that would normally go to the city's general, capital, and economic development funds (about $4 million in 2002).

The utility already has a fiber optic ring around the city, completed in 2000. Some 300 wireless access points will be connected to the fiber ring, mounted on streetlights and utility poles throughout the city. The wireless access points and other technology needed for the utility to become an ISP will cost about $2.3 million.

Moorhead's citywide wireless (13 square miles) will go live in July 2005. The broadband division is a separate division of the municipal electric and water utility, Moorhead Public Service (MPS). It will offer 1 Mbps for $20 per month to residents and $25 per month to businesses. The lowest price competitor, Cable One, offers 1.5 Mbps for $40 per month.

Saint Peter

Model:	**Municipal conduit**
Population:	**10,000**
Location:	**60 miles southwest of Minneapolis**
Date of First Service Offering:	
System Type:	**municipally owned conduit**
Services Offered:	**conduit leasing**
To Whom:	**private telecommunications companies**
Alternative Providers:	**preexisting Mediacom cable; subsequent Hickory Tech fiber-based DSL, Qwest DSL, Mediacom cable**

As part of the rebuilding effort following the 1998 tornadoes in Saint Peter (pop. 10,000), the city-owned electric utility decided to replace above ground electric wires with underground wires. At the same time, the city installed conduit that makes it easier to install fiber optic cables, at a cost of about $500,000. It considered building its own fiber optic network, but chose conduit because it reduces the cost of installing fiber by about half without forcing the city to choose among technologies.

The city reached an agreement with Hickory Tech, a local competitor to incumbent telephone and cable companies, to install a fiber network. The system uses fiber loop and fiber to the curb, with copper connections to the home. Hickory Tech offers voice, data, and video service over its fiber optic network. Internet service of 1 Mbps is $40, and a full package including phone, cable and 1 Mbps is $95. Qwest and Mediacom upgraded their networks as a result of competition from Hickory Tech.57 Mediacom now offers 3 Mbps for $30 per month, and basic cable packages start at $40 per month.

Windom—WindomNet

Model:	**Municipal utility, retail service provider**
Population:	**4500**
Location:	**Southwest Minnesota**
Date of First Service Offering:	**April 2005**
System Type:	**fiber-to-the-premises**
Services Offered:	**phone, Internet, video**
To Whom:	**government, business, residential**
Alternative Providers:	**preexisting Southwest Wireless; subsequent Southwest Wireless, Qwest DSL, Comcast cable**

Windom is a small town of 4500 people that has a history of taking the lead in telecommunications. It started its own municipal cable television service 20 years ago because cable companies had similarly bypassed the town. In 1993, it was host to the country's first teleconference town meeting, with Rep. David Minge connecting from Capitol Hill to a fiber optic connected studio in Windom. The studio was already in use for an interactive class with Hamline University.

In April 2005, the city began offering services through its fiber optic network, can deliver 100 Mbps to every home and business. City officials saw fiber optics as a way to "future-proof" their telecommunications infrastructure. The system will be able to meet telephone, internet, and video demands for the foreseeable future.

The city tried to pass a referendum to establish its own telephone company in 1999. Under Minnesota law, municipalities may own and operate their own telephone systems, but such an enterprise must be approved by a two-thirds majority in a referendum if there is an existing telephone service provider. In Windom's case, the existing company was Qwest, which offered only dial-up internet service in town. In 2000, Qwest promised to extend DSL services to 13 rural Minnesota communities other than Windom. The same year, a referendum passed with 70 percent of the vote. Qwest announced its intention to provide DSL to Windom in 2003, but by that time the municipal system was underway.

In May 2004 the city issued $9.4 million in revenue bonds to fund the network and the first two years of interest payments. The city plans to retire the bonds over 20 years with revenues from the services provided. As of May 2005, take rates are exceeding the targets set out in the business plan.

WindomNet's first customer was Toro Co.'s manufacturing plant, which moved there from Indiana in 2002. The city also has other industrial development and a hospital, all of which needed access to high-speed telecommunications.

Prices are $30 for 750 k up/512 k down, $36 for 1.5 Mbps/512 kbps, and $66 for 1.5 Mbps bi-directional. Faster speeds are available for higher prices. "Triple play" (phone, internet, and cable) packages are also available.

Qwest now offers DSL in Windom. Prices are $40 per month ($45 if you don't have phone service with them), plus $60 for modem, for 1.5 Mbps/896 kbps, $32 for 256 kbps. Southwest Wireless Net, part of New Vision Coop, offers fixed wireless service. It began in 2001, and is available only to those with a clear line of sight to a tower. They offer 256 kbps for $30 and 512 k for $40.

OTHER STATES

Chelan County, Washington—Chelan County Public Utility District

Model:	**Public Utility District, wholesale access**
Population:	**67,800**
Location:	**North central Washington State**
Date of First Service Offering:	**2003**
System Type:	**fiber-to-the-premises**
Services Offered:	**Internet and telephone (television available in 2005)**
To Whom:	**private service providers**
Alternative Providers:	**preexisting telephone incumbent; subsequent 14 ISPs, including telephone incumbent**

Chelan County Public Utility District has a functioning municipally owned fiber-to-the-home system that sells wholesale access to service providers. Currently, more than 2000 end-users receive service through one of the fourteen competing Internet service providers. Most of the ISPs are locally owned. There is only one conventional telephone providers, but all of the ISPs offer VOIP either through their own system or a third party such as Vonage. Television service will begin later this year.

The cost per location is about $1,000. Chelan County PUD expects to reach 75 percent of the county (30,000 homes and businesses) by 2008, at a total system cost of about $70 million. Revenues generated by the sale of surplus hydroelectric power finance the investment. The system is projected to have positive cash flow in 2013, assuming that about one-third of homes subscribe to each service. It expects a full return on investment in 2020. So far, take rates are on target.

BPL and fixed wireless are being tested for hard-to-reach areas. Wireless hotspots connected to fiber backhaul are being installed in several areas.

Nelson County, Virginia—Central Virginia Electric Cooperative

Model:	**Cooperative Utility**
Population:	**15,000**
Location:	**Rural central Virginia**
Date of First Service Offering:	**April 2004**
System Type:	**BPL**
Services Offered:	**Internet**
To Whom:	**electric utility customers**
Alternative Providers:	**satellite**

The Central Virginia Electric Cooperative (CVEC) was the first cooperative utility to commercially deploy a BPL network. The system is entirely power line based, but in the future it could incorporate wireless to deliver signals to homes.

CVEC has an agreement with IBEC (International Broadband Electric Communications), which is building the BPL network using CVEC's infrastructure and provides Internet service. The first phase reaches 4000 homes and was completed in November 2004. The second phase is scheduled for completion in spring 2005. IBEC offers 256 kpbs bi-directional speeds for $30. The only other Internet service available is via satellite.

Philadelphia—Wireless Philadelphia

Model:	**Non-profit corporation, wholesale access**
Population:	**1.5 million**
Date of First Service Offering:	**anticipated 2006**
System Type:	**Wi-Fi (wireless mesh and fiber backhaul)**
Services Offered:	**Internet**
Alternative Providers:	**cable, DSL**

Under the terms of Philadelphia's "public/private partnership", the city created a non-profit corporation ("Wireless Philadelphia") that will handle the design, construction and management of the network.

The total estimated cost is $60,000 per square mile over the city's 135 square miles. Total startup cost is estimated at $7 to $10 million, with an additional $500,000 annually over the first 3 years. Startup funds will come from taxable bonds, foundation grants, and low-interest bank loans. The city projects the investment will be recouped in five years.

Access will be available at wholesale rates to private service providers. Basic service is expected to cost $16 to $20 per month, with discounts for low-income subscribers. The non-profit will not sell access directly to individuals or businesses. Its mission does, however, include providing discounted computers and instruction in use to low-income residents of the city. Free access (nodes that are not password protected) will be provided in public spaces.

The city expects to decide on a vendor by early July, and begin the project in early August.

Tacoma—Click! Network

Model:	**Municipal utility, overbuilder**
Population:	**200,000**
Date of First Service Offering:	**1998**
System Type:	**fiber-to-the-curb, hybrid coaxial cable to the home**
Services Offered:	**Retail provider of cable television, wholesale access to ISPs**
To Whom:	**government, business, residential**
Alternative Providers:	**preexisting TCI cable (purchased by AT&T); subsequent Comcast (purchased AT&T), Qwest DSL, three local ISPs using Click! Network infrastructure**

Tacoma Power decided in 1994 that a fiber network could help the utility maintain its quality of service by helping to pinpoint problems in its 180 square mile network. It began construction on its network in 1997, utilizing fiber optics to the street, and coaxial cable to the home. Funding came from surplus revenue generated by energy sales. According to Tacoma Power officials, no tax dollars have been dedicated to the project and no electric rate increases have been attributable to it.

Click! Network is an overbuilder—a term that refers to companies that build networks to offer services already offered in the area, generally by a monopoly company. Before municipal competition was introduced, the incumbent provided poor service, as measured by complaints filed with the city and time to install new service, and had a bad reputation. It did not provide service in all areas of the city, and did not offer comparable television packages to those in neighboring communities.

In 1998, it began offering cable television service in competition with the local franchisee (TCI), as well as communications between Tacoma Power facilities and residential power meter reading. In 1999 it became the first city on the West Coast to offer cable modem service through three competing, local ISPs. Click! Network maintains a second fiber optic I-Net under contract with the city.

In 1999, TCI was purchased by AT&T, which sold the network to Comcast in 2003. Now all residences have access to cable, and Click! Network has expanded to cover neighboring cities. Tacoma power has about 148,000 customers. One-third of those who have access to Click! Network are subscribers. Comcast and Qwest also have customers in the market.

In the places where Click! is available, prices for cable TV and high-speed internet are 20 to 25 percent lower than areas where competition does not exist. Tacoma even has lower prices than Seattle. Customers pay about $64 per month for 125 television channels and high-speed Internet.

Tacoma is one of the few markets in the country to have video-on-demand (at a cost of $3 to $5 per movie), which Comcast launched in April 2004, and Click! in February 2005.

Tempe, Arizona—WazTempe

Model:	**Private ownership, wholesale access**
Population:	**160,000**
Date of First Service Offering:	**2002 (downtown hot zone), anticipated 2006**
System Type:	**Wireless (Wi-Fi with WiMAX and fiber backhaul)**
Services Offered:	**Internet**
To Whom:	**government, business, residential**
Alternative Providers:	**preexisting cable, DSL**

On April 21, 2005 the Tempe City Council approved a 5-year contract for citywide wireless broadband service to MobilePro Corporation, which is a network systems vendor but not a service provider. Competing Internet service providers will have access to the network.

Tandem networks running on different frequencies will be deployed using the same infrastructure, one for public use and one for municipal use. In exchange for access to the city street light network and existing fiber backhaul (connections from access points to the Internet), the city will not be charged for municipal use of the wireless network.

The City of Tempe and Arizona State University already offer free wireless service in downtown Tempe.58 The Tempe WiFi Community Alliance has been a motivating factor in both the downtown and new citywide networks. Free access will be continued in the downtown zone, and access to city and ASU sites are available free of charge to those without a subscription.

The network will cover 40 square miles. It will reach approximately 65,000 households, 1,100 businesses, and 50,000 students, and provide municipal services to Tempe police, fire, emergency, city, and ASU personnel. Customers will be able to subscribe to services ranging from low-cost Internet services to high-speed services capable of handling VOIP and video.

Western Utah—UTOPIA

Model:	**Intergovernmental agency, wholesale access**
Population:	**724,000**
Location:	**Western Utah**
Date of First Service Offering:	**anticipated 2006**
System Type:	**fiber-to-the-premises**
Services Offered:	**telephone, Internet, video**
To Whom:	**government, business, residential**
Alternative Providers:	**none preexisting; multiple providers anticipated, including large telecommunications and cable companies**

Utah Telecommunication Open Infrastructure Agency (UTOPIA) is an inter-governmental agency, founded in 2002 and made up of 18 Utah cities comprising one-third of the state's population. UTOPIA plans to install fiber with speeds of at least 100 Mbps to every home and business in each member city, at prices comparable to cable or DSL.59 UTOPIA will own, operate, and maintain the infrastructure.

The total cost for the system is $470 million. Each municipality will issue revenue bonds for its portion of the overall investment. Service will be installed in cities in the order in which they approve funds. Access to the fiber optic network will be sold to private service providers. Proceeds will be used to pay operating expenses and retire the bonds. It anticipates positive cash flow in the first ten years, possibly reaching the break-even point for operations and debt service by year 7.

The anticipated take rate of 40 percent is lower than the actual take rates of more than 60 percent in Provo and Spanish Fork.60 At this rate there would be 270,000 residential and 34,500 business subscribers. Over 20 million feet (about 3788 miles) of above- and below-ground fiber optic cable will be installed.

UTOPIA expects private service providers will use its network to offer high-speed Internet access, HDTV, video on demand, medical monitoring, teleconferencing, and phone services. Community services will include community programming on demand, traffic monitoring, meter-reading, and advanced communications for emergency services.

Comparing Community Owned Networks

Community and System Name	Starting date	Technology	Population	Coverage	Speeds	Rates	Private Services	Competition	Structure
Chaska Chaska.net	October 2004	Wi-Fi (wireless mesh and fiber backhaul)	18,000	16 square miles	1 to 3 Mbps symmetric	$16 residential, $25 business (including city-wide roaming access)	Wireless (with roaming) and fiber internet service	Time Warner Cable $45; Qwest DSL (limited availability) $40	Municipal utility, retail service provider
Buffalo Buffalo Wireless Internet Group (BWIG)	2001	Wi-Fi (fiber backhaul)	13,000	26 square miles	1.5 Mbps	$10/128 kbps; $34/384 kbps; $50/1.5 Mbps	Wireless (no roaming) and fiber internet service	Charter $45/384 kbps; $55/3 Mbps	Municipal utility, retail service provider
Moorehead Go Moorhead!	July 2005	Wi-Fi (wireless mesh and fiber backhaul)	33,000	13 square miles	1 Mbps	$20 residential, $25 business	Wireless (with roaming) and fiber internet service	Cable One $40 1.5 Mbps/200 kbps, $50 3 Mbps/300 kbps; Quest DSL	Municipal utility, retail service provider
St. Peter	1999	Conduit	10,000	citywide			Leased conduit	Hickory Tech, Mediacom, Qwest	Municipal conduit
Windom WindomNet	February 2005	Fiber-to-the-premises	4,500	all homes & businesses	100 Mbps		Internet, television, phone	Qwest DSL $32 256 kbps, $45 1.5 Mbps/512 kbps; Southwest wireless $30 256 kbps, $40 512 kbps	Municipal utility
Chelan County Public Utility District, Washington		Fiber-to-the-premises, BPL and satellite in remote locations	67,800	75 percent of homes by 2008	100 Mbps		Internet, television, phone	14 ISPs, most locally owned—typical price $28 3 Mbps, $50 6 Mbps	Public utility district, wholesale access
Nelson County, Virginia Central Virginia Electric Cooperative	November 2004	BPL	15,000	4,000 homes in first phase, remaining homes in 2005	256 kbps	$30	Internet	Satellite, 256 kbps $50	Cooperative utility
Philadelphia Wireless Philadephia	est. 2006	Wi-Fi (wireless mesh and fiber backhaul)		135 square miles	1 to 3 Mbps	$16 to $20, some free access	Infrastructure for Internet		Nonprofit corporation, wholesale access
Tacoma, Washington Click! Network	1998	Fiber-to-the-curb,coaxial cable to the home	200,000	citywide and some neighboring communities		Digital cable, standard package $40	Cable, Internet	1 Mbps $30	Municipal utility, retail and wholesale access
Tempe, Arizona WazTempe		Wi-Fi (WiMAX and fiber backhaul)	160,000	40 square miles	1 to 3 Mbps	As yet unkown, some free acces	Infrastructure for internet		For-proft corporation, wholesale access
Western Utah UTOPIA	Est. 2006	Fiber-to-the-premises	724,000	all homes & businesses	100 Mbps		Infrastructure for internet, television, phone		Municipal consortium, wholesale access

Resources

Blandin Foundation – Get Broadband
www.blandinfoundation.org/bsite/bbsite.swf
Encourages greater broadband use in rural Minnesota, as well as public and private investment in broadband infrastructure.

League of Minnesota Cities
www.lmnc.org
Works to promote telecommunications competition in Minnesota cities of all sizes.

Minnesota Association for Rural Telecommunications
www.mnart.org
Represents rural telecom providers at the state level and promotes a competitive telecommunications marketplace in rural areas.

Other

American Public Power Association (APPA)
www.appanet.org
Extensive resources in support of public power, and guidance for power and broadband system operators. The Community Broadband section includes updates on FCC and FERC decisions, a chronicle of legal challenges, and sample leases and requests for proposals for members.

Baller Herbst Law Group
www.baller.com
Represents the APPA, regional and state municipal electric associations, state municipal leagues, local governments, and public power systems in regulatory, legal, and legislative matters involving telecommunications. Offers an excellent collection of writings on public sector participation in telecommunications.

Broadband Reports
www.broadbandreports.com
Updated daily with the most important news stories in the broadband world.

Fiber to the Home Council
www.ftthcouncil.org
Supported by companies and organizations in the broadband industries at all levels, including municipalities.

Free Press—Internet and Broadband
www.freepress.net/issues/internet
Emphasizes the importance of community ownership in maintaining free speech and independent media. Also concerned with disadvantaged communities and universal access.

Friends of the Commons—Airwaves
www.friendsofthecommons.org
An overview of broadcast spectrum policy, and why it matters.

Lessig.org
www.lessig.org
Website of Stanford Law Professor Lawrence Lessig, author of *Code and Other Laws of Cyberspace*.

MuniWireless.com
www.muniwireless.com
The Community Wireless section details community undertakings in the U.S. and around the world. Don't miss the Reports and Guest Commentary sections.

United Power Line Council
www.uplc.org
Supported by electric utilities and companies working on broadband over power line.

Wi-Fi Alliance
www.wi-fi.org
Supported by companies that produce Wi-Fi equipment and provide Wi-Fi services.

WiMAX Forum
www.wimaxforum.org
Supported by companies that produce WiMAX equipment.

Notes

1. In the computer and Internet age, data is delivered in the form of bits, which are represented within the system by fluctuations in the flow of electrons or photons (light particles). Since light travels faster than electricity, photonic switching and delivery systems are replacing electronic systems. An excellent, accessible discussion of this can be found in Howstuffworks.com, "How Bits and Bytes Work".

2. U.S. Telecom Association (USTA) v. FCC, U.S. Court of Appeals, District of Columbia, May 24, 2002. See also Thomas Bleha, "Down to the Wire", Foreign Affairs, May/June 2005.

3. AT&T's divisions were split among Comcast, Cingular, and SBC. Either Verizon or Qwest will soon acquire MCI in 2005. Comcast and Time Warner recently announced a deal to jointly purchase Adelphia. After the two companies divvy up the new customers and swap some markets between them, Time Warner will have 14.4 million customers – 85 percent of its customers in five large clusters, with more than a third of its overall customer base in either the New York or Los Angeles metropolitan areas–and an additional 1.5 million in a partnership with Comcast. Comcast will have about 23.3 million basic cable customers of its own and an additional 3.5 million subscribers held in various partnerships. Much of its customer base is concentrated in the Boston to Washington corridor, as well as the upper Midwest. Industry analysts predict there will be further rounds of consolidation as cable companies buy their way into the wireless business.

4. MNet contracted for the use of privately owned infrastructure. In the mid-1990s, the state was criticized for lacking a coherent plan to prevent duplication and minimize costs. The legislature wanted MNet to be self-sustaining, and while departments were given funds to purchase services, the network received no direct subsidies until 1995. South Dakota's Rural Dakota Telecommunications Network (RDTN), on the other hand, received state subsidies to start up and was permitted to sell services to the public and private sector alike. RDTN's videoconferencing rates were half those of MNet and its public sector counterpart, Minnesota Equal Access Network Systems.

5. In December 1997, Governor Arne Carlson announced "Connecting Minnesota", a public-private partnership to create a statewide fiber-optic backbone to bring fiber optic connections to within 10 miles of 90 percent of Minnesotans. Two companies were to install and maintain the network and lease capacity to telecommunications providers. The state control 20 percent of the capacity in exchange for allowing the companies use of public right-of-ways. Construction began in November 1998, and was scheduled for completion in 2001, but faced legal, regulatory and legislative challenges. The Minnesota Telephone Association (MTA), the trade group for the state's phone companies, argued that no telecom provider should have exclusive building rights along state roadways, even if the provider did not sell retail services over the network. MTA also questioned the need for the project, noting that its members had deployed over 21,000 miles of fiber-optic network throughout the state. The FCC and courts found in favor of the state, but the challenges impeded progress. In February 2001 the contract was cancelled for lack of private financing. Later that year a portion of the project was salvaged as a contract to install conduits in the Twin Cities and along I-94 to Wisconsin. With the work that was done before the contract was cancelled, about 250 miles of Connecting Minnesota was completed, including a stretch from Moorhead to St. Cloud.

6. In the 1980s and early 1990s, broadband was used to describe rates greater than 45 Mbps, while "wideband" referred to rates of 1.5 Mbps to 45 Mbps. In the mid-1990s, broadband came into use to describe anything 1.5 Mbps or higher.

7. Down-stream refers to the speed at which data comes into one's computer, such as incoming emails or visiting Internet sites. Up-stream refers to the speed at which information goes out of one's computer, such as sending email, posting information to an Internet site, or peer-to-peer networking.

8. The National Academies Committee on Broadband Last Mile Technology offers two definitions for broadband: 1. Local access link performance should not be the limiting factor in a user's capability for running today's applications. 2. Broadband services should provide sufficient performance—and wide enough penetration of services reaching that performance level—to encourage the development of new applications.

9. You can go online and estimate downloading time using various communications connections at Speed and Bandwidth of the UTOPIA Network, from M&I Partners, FiberSpeed program.

10. For a more detailed explanation of DSL and a chart comparing ADSL, VDSL, and other types of DSL, see Jeff Tyson, How DSL Works, at HowStuffWorks.com.

11. This is in part because cable companies went to greater lengths to invest in technologies using unregulated cable networks than in regulated telephone networks. For more information see the discussion below, or Robert X. Cringely, "Why Your Phone Company Hates DSL," I, Cringely, PBS, February 22, 2001; U.S. Department of Commerce, National Telecommunication and Information Administration, *A Nation Online: Entering the Broadband Age*, September 2004.

12. Ham radio operators say the Cinergy BPL roll-out has not created the interference they expected. Mike Boyer, "Cinergy wired for expansion", *Cincinnati Enquirer*, April 17, 2005.

13. Federal Communications Commission, FCC-04-245, October 14, 2004.

14. These include the Manassas, VA Department of Public Works, Cinergy Corp in Cincinnati, and Idacorp in Boise. Ambient Corporation is currently testing BPL in a high-rise residential building in Manhattan.

Before investor owned utilities enter the retail or wholesale telecommunications field state regulatory agencies will have to decide how to address the issue of ratepayer financing of such a venture. Some states already have pole-attachment and conduit fees in place. This is the case in Ohio, where Cinergy created a non-regulated unit called Cinergy Broadband, which pays the regulated utility for the right to use its infrastructure. Texas is the only legislature so far that is considering BPL enabling legislation for investor owned utilities. Senate Bill 1748 passed in early May and a version is now being considered in the Texas House. For more information on regulatory issues in BPL see The National Association of Regulatory Utility Commissioners, *Report of the Broadband Over Power Lines Task Force*, February 2005.

15. Versions are indicated with letters, for example 802.11b or 802.11g. For more information, see the Wi-Fi Alliance.

16. There is no interference protection in these unlicensed bands, which represent a small part of the spectrum that has been set aside as open for public use. The federal government has auctioned spectrum licenses since the 1920s. Broadcasters pay a fee for the right to transmit on certain frequencies in certain geographic areas without interference. The auction is seen as the most efficient way to allocate scarce radio spectrum, but it creates a cost barrier to access, limiting free speech, and adds to the cost of broadcast services. Licensed spectrum was appropriate to the technology at the time it was created. However, technological advances in transmission and receiving now make it possible to share spectrum without interference. Open spectrum policy, with a phase-out of spectrum licensing, would make more efficient use of radio spectrum, increase the frequencies available to wireless networking, and allow for higher quality of service. For a more detailed discussion of open spectrum and an explanation of why it is technically possible, see Kevin Werbach, *Open Spectrum: The New Wireless Paradigm*, New America Foundation, Spectrum Series Working Paper No. 6, October 2002.

17. For a good explanation of how mesh networks work, see Brad Grimes, "Wireless gets connected," *Washington Technology*, January 26, 2004.

18. Some products already on the market are being sold as "WiMAX compliant" because the manufacturers expect that their products will be certified when certification is available. It is expected that an interoperable standard for 802.11 will be certified by 2007.

19. Kevin Suitor, "What WiMAX Certified products will bring to Wi-Fi," Business White Paper, Broadband Wireless Access, Redline Communications and WiMAX Forum.

20. The first citywide deployment of pre-WiMAX was launched by Speakeasy in Seattle in May 2005. The service area includes nearly every building in the business district, and access requires a receptor in the office window or on the roof. Speakeasy will charge businesses $500 per month for 1.5 Mbps, and $800 per month for 3 Mbps. The same speeds are currently being offered in Wi-Fi systems, including some in the case studies below, for less than half that price.

21. G3 technologies currently target hand-held devices and are not discussed here.

22. Alberta, entire community, Incumbent Local Exchange Carrier (ILEC, or incumbent local exchange carrier, a term used to describe the existing telephone companies when local markets were opened to competition after the 1996 Telecommunications Act); Baxter, entire community, Competitive Local Exchange Carrier (CLEC, or competitive local exchange carrier, used to describe the companies that offered services in competition with ILECs); Brainerd, entire community (CLEC); Brandon, entire community (ILEC); Chokio, entire community (ILEC), Evermoor, Rosemount Development (CLEC); Holloway, entire community (ILEC), Lonsdale, entire community (ILEC); Milaca, entire community (CLEC); Morris, entire community (CLEC); New York Mills, entire community (ILEC); Nisswa, entire community (CLEC); Rice, entire community (ILEC); Town Lakes, Albertville Development (CLEC); Victor Gardens, Hugo Development (CLEC); Victoria, Minneapolis Development (ILEC); Windom, entire community (Municipal).

23. In the late-1990s, enthusiasm for all things Internet made it possible for startup telecom companies to obtain financing for fiber optic infrastructure. This financing came in the form of high yield debt—essentially equity financing with the prospect of high returns for lenders, or ownership of the asset if the borrowers cannot generate returns to pay back the debt. Manufacturers that wanted to encourage installation of their products also provided vendor financing. The transmission capacity in the U.S. increased 500-fold, due to the amount of fiber laid and advances in transmission technologies while demand only quadrupled. Similar to the private electric utilities in the 1920s, there were too many firms expanding parallel networks. Far more capacity—especially long-distance capacity—was installed than demanded. Most of these companies went bust. Unused fiber optic capacity became so common it was given its own name—"dark fiber", referring to fiber that is installed but not used to carry traffic. It has been a tremendous resource for universities and the research community. A mile of fiber that sold for $1,200 before the telecom bust could be purchased for $200 after, putting universities in the position to buy their own networks for less than the cost of long term leases. For more on universities and dark fiber, see Florence Olson, "Lighting Up Dark Fiber", *The Chronicle of Higher Education*, March 14, 2003.

24. Florida Public Service Commission, Office of Market Monitoring and Strategic Analysis, *Broadband Services in the United States: An Analysis of Availability and Demand*, October 2002.

25. Of those households that do not have an Internet connection of at least 200 kbps, the most common reason cited is "not interested" (44 percent). "Too expensive" runs a close second, however, at 39 percent, and another 10 percent say service is not available where they live. Income is the best predictor of whether or not a household has broadband: households with incomes of $75,000 or more are two to three times more likely to have broadband than those with incomes of $35,000 to $50,000. U.S. Department of Commerce, National Telecommunication and Information Administration, A Nation Online: Entering the Broadband Age, September 2004.

26. Sanford Nowlin, "Castroville and other towns trying electric lines for a faster web", *San Antonio Express-News*, March 24, 2005.

27. Nearly two-thirds of American households with Internet access use a dial-up connection, even though broadband technology has been available for two decades. BellSouth deployed its first FTTH network in Florida in 1986. Speeds of 1.5 Mbps over copper lines—the speeds offered by most DSL providers today—were possible in 1990.

28. For an overview of I-Nets see Baller Herbst Law Group, *The FAQs About Institutional Networks*.

29. MuniWireless.com maintains a list of pending broadband bills that restrict municipal ownership and/or operation of telecommunications systems.

30. The FCC denied a challenge to the law by the Missouri Municipal League. The U.S. Supreme Court upheld the FCC decision in Nixon v. Missouri Municipal League in March 2004.

31. For a complete list of state restrictions see the American Public Power Association's list of state barriers to community broadband service.

32. Minn. Stat. Ann. § 237.19 states: "Any municipality shall have the right to own and operate a telephone exchange within its own borders, subject to the provisions of this chapter…if the proposal is to construct a new exchange where an exchange already exists, it shall not be authorized to do so unless 65 percent of those voting thereon vote in favor of the undertaking."

33. See George S. Ford, "Does Municipal Supply of Communications Crowd-Out Private Communications Investment? An Empirical Study", *Applied Economics Studies*, February 2005.

34. In exchange for this requirement, Congress reduced federal regulation of the cable and telephone industry and allowed companies to enter new geographic and product markets. The regional bells were allowed to operate local telephone exchange services and to offer long distance as well as cable TV service, and become involved in equipment manufacturing.

35. Terrence P. McGarty, Ravi Bhagavan, *Municipal Broadband Networks: A Revised Paradigm of Ownership*, MIT Internet and Telephony Consortium Group, August 2002.

36. Federal Communications Commission, News Release, March 14, 2002.

37. In effect, this resulted in their holding back the implementation of the regulatory aspects of the 1996 Act while allowing them to take advantage of the deregulatory aspects.

38. In August 2003, the FCC ruled that ILECs do not have to share new fiber optic networks with competitors. John Borland and Ben Charny, "New broadband rules draw criticism", CNET News, August 21, 2003. In 2004, the FCC extended this ruling to include fiber optic cables installed as part of existing copper networks. Marguerite Reardon, "Baby Bells win another FCC victory", CNET News, August 5, 2004.

39. The cases of National Cable Telecommunications Association v. Brand X and FCC v. Brand X, Nos. 04-277 and 04-281, were consolidated The underlying dispute is over the classification of cable modem service under the 1996 Telecommunications Act. In March 2002, the FCC ruled that Internet access through a cable modem should be classified as an information service. The 9th Circuit Court of Appeals had ruled in 2000 that it should be regulated as a telecommunications service. In Brand X, the court noted that cable modem service consists of two elements: a transmission pipeline and the Internet service transmitted over that pipeline. The court found that it was bound by its previous decision, and gave no deference to the FCC rule because it could have taken a position earlier than it did, but chose not to. The decision in the case may hinge on whether or not the court should have deferred to the FCC decision, rather than classification.

40. Thomas Bleha, "Down to the Wire", *Foreign Affairs*, May/June 2005.

41. Ibid.

42. Bleha, op cit.

43. Center for Rural Policy and Development, Broadband Access in Rural Minnesota, April 2004. It is difficult to offer precise figures on broadband accessibility. The FCC reports the number of providers by zip code, but it does not report the number of providers when three or fewer providers report having subscribers in a zip code. The percentage of broadband subscribers that have service through the regional Bells, cable television companies, or competitive carriers cannot be discerned from the FCC's reporting, because some data is "withheld to maintain confidentiality." FCC, Local Telephone Competition and Broadband Deployment, High Speed Services for Internet Access, 12/04 Release.

44. Competing providers do have access to Qwest's telephone infrastructure. But they are charged almost as much to access Qwest's phone lines as Qwest charges its residential customers for DSL Internet access. Thus their rates are not competitive. For example, Visi.com, the number one reseller of Qwest DSL services, charges $20 per month for their ISP service plus $28 per month for Qwest's line charge, while Qwest charges $40 per month for the same package.

45. For a summary and discussion of studies see S. Renzetti and D. Dupont, "Ownership and Performance of Water Utilities", *Greener Management International*, No. 42, 2003.

46. See John M. Kelly, *Paying the Bills, Measuring the Savings*, American Public Power Association, March 2005; and Jim Baller, *Responses to SBC's examples of supposed municipal "failures"*, Baller Herbst Law Group, April 3, 2005. For example, Marietta, Georgia is often cited as a failed public system because it was sold to a private company before the city fully recouped its $35 million investment. The Marietta network had posted positive earnings before interest, taxes, depreciation and amortization (EBITDA, a common industry accounting measure) since it began operation in 2001, and was on track to post net positive earnings beginning in 2006. The private company that purchased the system has made no changes in its management or operations.

47. In May 2003, WorldCom paid a $1.51 billion, which paid investors about 30 cents on the dollar. Adelphia paid a $715 million settlement to settle a federal fraud investigation in April 2005. The Global Crossing investigation was settled with an administrative agreement. Criminal charges for conspiracy and fraud are currently being pursued in the case of Enron Broadband.

48. William J. Ray, "Infotricity: Why Muni Electrics Like Cable TV", *Public Utilities Fortnightly*, November 15, 2000.

49. AT&T v. Portland, Ninth Circuit Court of Appeals, June 22, 2000.

50. In late May 2005, Texas House Bill 789 died when House and Senate conference committee members could not agree on a compromise between the House bill, which banned municipal telecommunications networks, and the Senate bill that promotes community Internet services. As of early June, telecommunications industry lobbyists pressuring state legislators to add the House bill to the special session agenda. For more information see www.savemuniwireless.org.

51. Todd Wallach, "Verizon CEO sounds off on Wi-Fi, customer gripes," *San Francisco Chronicle*, April 16, 2005.

52. No Competition: How Monopoly Control of the Broadband Internet Threatens Free Speech, ACLU White Paper, 2002.

53. "*T1* is a term coined by AT&T for a system that transfers digital signals at 1.544 megabits per second (as opposed to ISDN's mere 64 kilobits per second). Of course, if T1 doesn't cut it, there's always T3. (T2 seems to have been bypassed altogether." CNET Glossary.

54. At some frequencies, radio waves travel in a straight line and do not follow the curve of the earth's surface. Line-of-sight technology requires that the transmitter and receiver can "see" each other; that is, they must be high enough that they are not obstructed by objects on the ground (or the ground itself). Non-line-of-sight technologies get around this problem by sending an array of elements, the signals of which can move through the air separately before reassembling at the receiving end. For a more detailed explanation see Brad Schrick and Michael J. Riezenman, "Wireless Broadband in a Box", *IEEE Spectrum Online*, June 2002.

55. Phil Davies, Broadband.gov, *FedGazette*, Federal Reserve Bank of Minneapolis, November 2004.

56. In a roaming access system, users can fire up their laptop or PDA anywhere in town and be able to log in to the network with the same password they use at home. They can also move from one place to another without losing the signal, provided they remain within the network coverage area. This is useful for police and, for example, municipal inspectors, who may need to access information from anywhere in the city.

57. Gerry Blackwell, "CLECs Selling Cable TV. Marketing Suicide?", *ISP Planet*, 2001.

58. Coverage map

59. Residential service requirements are now 64 kbps for voice, 1 Mbps for data, and 10 Mbps for video. They are expected to grow to 128 kbps voice, 5 Mbps data, and 54 Mbps video in the near future, so the available bandwidth of 100 Mbps per subscriber is expected to be adequate to service demands.

60. Provo, Utah Mayor Lewis Billings testified before the U.S. House Telecommunications and Internet Subcommittee in favor of municipal broadband on April 27, 2005.