CITY OF PORTLAND, OREGON

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TO: Mayor, City Council, and City Auditor

THROUGH: Commissioner Saltzman

RE: Portland Community Fiber Network
Staff Report for City Council Work Session,
November 20, 2007

FROM: David C. Olson, Director
Mary Beth Henry, Deputy Director
Office of Cable Communications and
Franchise Management

Portland Community Fiber Network
Staff Report

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1.1 Introduction and Summary of Conclusions

In connection with reviewing the results of the initial Phase 1 FTTP Study prepared by DynamicCity[1], the City Council in 2006 directed the Office of Cable Communications & Franchise Management ("OCCFM") to develop and complete a Phase 2 business case study as a continuation of a Phase 1 feasibility study, documenting the potential and economic viability of constructing an FTTP system to serve the City under an open network access arrangement, in accordance with longstanding City Policies. The Phase 2 study, which accompanies this staff report as Appendix 1, includes additional detailed local market analysis of the strategic and financial viability of this initiative. The Phase 2 Study findings are supported by extensive local market research, detailed cost analysis, and actual operating results from deployed FTTP systems.[2]

This staff report, together with the Phase 2 Study (Appendix 1) recommends that the City Council continue to take the actions necessary to ensure that the City obtain the critical benefits of FTTP infrastructure --- benefits which cannot and will not be deployed in Portland in a timely manner if the City remains idle and depends on its incumbent cable and telephone providers to provide FTTP here[3]. The lack of access by the City to the high-bandwidth, "big pipe," fiber network enabled by FTTP not only threatens Portland's competitive status with respect to other American cities—and competitor nations and cities in Europe and Asia---but places the City at a distinct competitive disadvantage with respect to Portland's own suburbs to the east and west.

This Report documents the conclusions of staff and our consultants that a sufficient business case continues to exist for a Community Fiber Network to advance to the next stage of action by the City.[4] These conclusions are based on the work of the City's consultants in the areas of market research, engineering, and finance. Based on the data collected to date, the City's consultants have demonstrated the feasibility of both open access/wholesale and single provider/retail business models for the Community Fiber Network. Most importantly, we emphasize that the overall context for the business case for the Portland Community Fiber Network needs to include consideration of critical "off the balance sheet" external community benefits and financial factors including economic development, small business empowerment, job creation, livability, environment protection, education, increased property values, and other factors.

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[1] The Phase 1 Report is linked here: http://www.portlandonline.com/shared/cfm/image.cfm?id=168966

[2] The Phase 2 Business Case Report is included by reference as Appendix 1 to this staff report, and is separately linked on OCCFM's website here: http://www.portlandonline.com/cable/index.cfm?c=45468

[3] Both of the City's incumbent cable and telephone providers have declined to offer any plans to deploy FTTP in Portland anytime in the near future, despite the fact that FTTP infrastructure is being deployed by Verizon in Verizon telephone service territory in Portland's eastern and western suburbs.

[4] Portions of this report were prepared by Columbia Telecommunications Corporation (CTC) for the City and County of San Francisco. They are adapted and used with the permission of San Francisco.

The need for very high-bandwidth communications services is evident. But as the evidence continues to indicate, private-sector networks[5] are not meeting this growing demand for bandwidth and speed in an affordable manner in Portland.[6] Though there are private-sector FTTP deployments underway in some, limited areas of the United States, none is planned or foreseen for Portland.[7]

In this context of private sector disinterest in FTTP, a Community Fiber Network would enable Portland to assume a rank among the world's most far-sighted cities -- by creating an infrastructure asset with a lifetime of decades that is almost endlessly upgradeable and capable of supporting any number of public or private sector communications initiatives—as well as enabling openness, non-discrimination, and democratic discourse.

Table 1 summarizes the capabilities of the existing Qwest and Comcast networks (both existing and postulated technologies), and compares these with Verizon's FTTP networks and the municipal open access FTTP network in Amsterdam—a network that is comparable in its capabilities to the potential Portland Community Fiber Network.

Table 1: Summary of Subscriber Network Technologies

	Technology	Maximum Download Speeds (up to)	Maximum Upload Speeds (up to)	Actual Download Speeds (avg)	Actual Upload Speeds (avg)	Non-discriminatory (network neutral)?	Competitive Platform (open access)?	Future Proof?
Comcast Cable (hybrid fiber/coaxial)	**DOCSIS 2.0**	40 Mbps	30 Mbps	8 Mbps	768 kbps	Currently, no--at discretion of network operator.	No, by operator choice	No, limited by coaxial cable
	DOCSIS 3.0: not yet deployed	postulated at 100 Mbps	postulated at 100 Mbps	30 Mbps	5 Mbps	Currently, no--at discretion of network operator.	No, by operator choice	No, limited by coaxial cable
Qwest (hybrid fiber/copper)	**ADSL**	theoretically up to 24 Mbps	theoretically up to 1 Mbps	2 Mbps	768 kbps	Currently, no--at discretion of network operator.	No, by operator choice	No, limited by copper wire
	VDSL2: not yet deployed	theoretically up to 60 Mbps	theoretically up to 10 Mbps	15 Mbps	3 Mbps	Currently, no--at discretion of network operator.	No, by operator choice	No, limited by copper wire
Verizon FiOS (fiber to the home + businesses)	**GPON**	2.4 Gbps	2.4 Gbps	15 Mbps	2 Mbps	Currently, no--at discretion of network operator.	No, by operator choice	Yes--theoretically unlimited capacity
Amsterdam CityNet (fiber to the home + businesses)	**Active Ethernet**	theoretically unlimited	theoretically unlimited	20 to 100 Mbps	20 to 100 Mbps	Yes, the network is neutral and non-discriminatory	Yes, by choice of City	Yes--theoretically unlimited capacity

Staff concludes that the Community Fiber Network enables not only very high-bandwidth (in both the upstream and downstream directions), but also allows for non-discriminatory access by competitive providers—the opposite of the incumbents' policies.

[5] The networks operated by wireline private-sector providers in Portland are discussed below.

[6] Reuters, "More Internet traffic, new broadband and mobile services, eating up bandwidth, creating need for optical gear," www.cnetnews.com, accessed September 28, 2006.

[7] Neither Comcast nor Qwest currently has plans for deployment of FTTP facilities throughout the City, though they may build FTTP to "Greenfield" developments. The facilities they currently operate or foresee for the future are not comparable to FTTP. Verizon is responsible for the major, private FTTP projects underway in other parts of the country. Portland is not within Verizon's service area and, to our knowledge, Verizon has no plans to expand service, either through FTTP or other technologies, to Portland, though it is building FTTP in many of the surrounding areas.

Staff is encouraged by the data demonstrating the feasibility of a wholesale, or "open access" network – a competition-enhancing, innovative model that is emerging in progressive European nations, but that has been delayed in the US.[8]

In January, FCC Commissioner Michael Copps summarized our national broadband problem in the *Washington Post*:

> America's record in expanding broadband communication is so poor that it should be viewed as an outrage by every consumer and businessperson in the country. Too few of us have broadband connections, and those who do pay too much for service that is too slow. It's hurting our economy, and things are only going to get worse if we don't do something about it.

By contrast, the City of Portland *is* doing something about it. By moving forward on the recommendations of this report and the Phase 2 Study (Appendix 1) the City of Portland will continue to take action steps toward enabling the citizens of Portland to benefit from technologies that private markets have not brought and at this writing have no plans to bring to our City. Other U.S. cities look to Portland for leadership and innovation on issues of technology equity, competitiveness, and sustainability, and the recommendations of this report and the Phase 2 Study are commensurate with the City's leadership in that regard.

1.2 Fiber Facilitates Openness, Innovation, and Inclusion

It is critical to re-emphasize that the Community Fiber Network initiative is not driven by a need for more television channels; on the contrary, the incredible bandwidth possibilities of FTTP facilitate other goals: innovation, economic development, environment protection, education, and community development.

1.2.1 Openness and Democratic Participation

High-bandwidth broadband is widely-recognized as a facilitator of political discourse and activity – the most important medium for communication and expression of political ideas since the advent of television. This is the platform upon which Americans interact, the 21st Century equivalent of the town square, printing press, and backyard fence.

The Portland Community Fiber Network has the potential to facilitate democratic and free market values by providing very high-bandwidth—a massive town square in which the citizens of Portland can develop, share, and stimulate ideas.

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[8] It is no coincidence that Portland leads the nation in considering open access; indeed, as the Council is well aware, Portland first brought to national attention the issue of broadband open access in December, 1998 when the Council voted unanimously in favor of imposing an open access condition on the otherwise-closed cable modem broadband platform.

The incumbents have publicly declared their intention to charge access tolls of third-party innovators and independent IP-based video providers.[9] They have also reserved to themselves the absolute discretion to refuse, block, or degrade communications of which they do not approve (or from which they do not profit). They have demonstrated this intent through actions such as Comcast's degradation of peer-to-peer file transfers,[10] Verizon's initial refusal to allow a text-messaging program by a pro-choice organization, [11] and AT&T's censoring of an anti-war statement by a musician during a performance.[12]

The incumbents' networks do not mandate these practices—rather, it is the choices of the incumbents that results in these practices that undercut participatory democracy in communications. The Portland Community Fiber Network would provide the City a similar choice—one that can be resolved in favor of the public interest, rather than in favor of commercial or narrow interests.

1.2.2 Innovation and Competition

The City can create an open platform for all comers by enabling open access, competition, and non-discriminatory policies -- at the same time as the cable and phone companies are entrenching their closed network models that preclude competitive access to the networks.

The Community Fiber Network opens the door to dramatic innovation and competition of countless companies and individuals—all over the big pipe of fiber. In this way, the Community Fiber Network replicates over big-bandwidth the creativity of the early Internet era that has been reduced by the closing of networks.

In the formative days of the commercial Internet, dial-up modems were used to access the Internet over copper telephone wires. Subscribers had open access to any Internet Service Provider (ISP) simply by dialing their chosen ISP over their computer's modem. Under common carrier rules, the telephone companies (who owned the access network--the telephone wires and equipment in their offices) could not legally control or limit their competitors' traffic, nor could they block or limit access to the phone lines of a particular ISP. This dynamic enabled the Internet to grow into the indispensable information storehouse and innovation engine it is now, because both content creators and users were allowed unhindered connectivity.

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[9] See Lawrence Lessig, "Congress Must Keep Broadband Competition Alive," Financial Times, October 18, 2006, http://www.feetcom/cms/s/a27bdb16-5ecd-11db-afac-0000779e2340.html, accessed December 21, 2006.

[10] Peter Svensson, "Comcast Admits Delaying Some Traffic," Associated Press, Oct 23, 2007, http://ap.google.com/article/ALeqM5gxRiQSVfgK4sLbVRE_X4MOlM9q0A, accessed November 14, 2007

11 Editorial "The Verizon Warning," The New York Times, October 3, 2007, http://www.nytimes.com/2007/10/03/opinion/03wed1.html?_r=1&oref=slogin, accessed November 15, 2007.

12 Manila Ryce "AT&T Censors Pearl Jam's Anti-Bush Lyrics," The Largest Minority, August 12, 2007, http://www.jwharrison.com/blog/2007/08/12/att-censors-pearl-jams-anti-bush-lyrics/, accessed November 15, 2007.

Today, however, bandwidth requirements far exceed the capabilities of a dial-up modem connection. As a result, consumers utilize the higher capacity service offerings of a limited number of broadband networks. However, incumbent broadband networks are generally proprietary, or closed to competitive providers.

Under recent rulings, the owners of DSL, cable broadband, and Fiber-to-the-Premises systems have been permitted to close their networks to competitors – a deviation from the common carrier rules under which the telephone networks have long operated and under which numerous ISPs competed over dial-up modems. As a result, many of these ISPs have gone out of business—because they cannot access the distribution networks, at any price. The dynamic ISP competition of the early commercial Internet era has ceased to exist.

However, advanced networks can allow access to multiple providers of services -- in the same way that all companies have non-discriminatory access to roadways, over which they can compete commercially. Government can facilitate this process by laying the foundation for competition in the form of communications infrastructure, and allowing the free market to drive innovative service development and competitive pricing.

1.2.3 Digital Inclusion and Equity

As it is currently deployed in the United States, fiber dramatically widens the divide between the digitally-privileged and the digitally-underserved. FTTP is the holy grail of broadband: a fat pipe all the way into the home or business--but in the near future only available for a privileged few located in the limited areas of private-sector deployment.

With respect to all forms of broadband, incumbent providers exercise unlimited discretion to determine where (and who) they will serve—as a result, less commercially-attractive areas and customers are less likely than “high value” customers to benefit from incumbent investments in broadband technology. In contrast, the Portland Community Fiber Network has the potential to enhance digital inclusion by facilitating affordable access to this incomparable enabling resource for community groups, students, seniors, and communities of need.

1.3 Fiber Facilitates Government Services

Cities, towns, counties, and other localities have always been an essential part of ensuring the benefits of communications infrastructure to communities across the US, including rural, suburban, and urban areas. Localities will, by necessity and by choice, be part of the solution to our national broadband deficit—in keeping with their long history of working to expand utilities (such as electricity and telephony) to their communities—and because communications infrastructure is essential to delivery of government services in the digital age.

As Portland’s IRNE network continues to demonstrate, fiber networking facilitates the services that government provides to the public. The Community Fiber Network has the

potential to extend this enabling technology throughout the City and all the way into homes and businesses, to enable government service in a variety of ways, including:

- Providing a highly-reliable, resilient backbone for existing and future wireless initiatives—improving performance and capacity through fiber "backhaul."
- Providing access from home and office to City e-government services
- Supporting current and future public safety and government communications systems—both saving the City the enormous, unending cost of leasing circuits from telephone companies, and simultaneously providing a higher-quality, higher-capacity, more reliable, more secure transport for key City users such as law enforcement, fire, emergency management, and public health.
- Facilitating interoperable communications between Portland and other jurisdictions--in Oregon, up and down the West Coast, and throughout the world.

1.4 Fiber Facilitates Sustainability

Sustainability is one of the key benefits of fiber networking that is only now being recognized. A recent European Union-commissioned Report notes that communications technology's carbon reduction impact is 10 times more than its direct carbon dioxide reduction.[13]

According to the EU study, the strategic use of communications technologies such as fiber:

> can contribute significantly to energy efficiency, sustainable economic growth as well as job creation. ICT can reduce the need of travel and transportation of goods by bridging distance problems. It can increase efficiency and innovation by allowing people to work in more flexible ways. It can also ensure a shift from products to services and allow for dematerialization of the economy.[14]

In recognition of this connection between communications technology and environmental protection, a number of projects are underway to demonstrate the importance of communications infrastructure to sustainability. The Clinton Global Initiative, for example, is working with Cisco's Connected Urban Development project to partner with local communities, San Francisco, Seoul, and Amsterdam, to demonstrate through pilot projects the potential of FTTP networking to reduce the need for travel and thereby reduce carbon dioxide emissions.[15]

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[13] "Saving the Climate @ the Speed of Light: First Roadmap for Reduced CO2 Emissions in the EU and Beyond," published by European Telecommunications Network Operators' Association and World Wildlife Foundation, 2007.

[14] "Saving the Climate @ the Speed of Light: First Roadmap for Reduced CO2 Emissions in the EU and Beyond," published by European Telecommunications Network Operators' Association and World Wildlife Foundation, 2007.

[15] The National Association of Telecommunications Officers and Advisors recently awarded the Clinton Global Initiative and Cisco Connected Urban Development the 2007 Award for *Community Broadband Organization of the Year*, for their joint initiatives to demonstrate the efficacy of community fiber networking in reducing carbon dioxide emissions.

Cisco's CUD project has noted that, around the world, *cities take up only one percent of the earth's land-mass, but hold 50 percent of the world's population, consume 75 percent of its energy, and produce 80 percent of the world's carbon dioxide emissions*. If city-based FTTP can enable remote work, telecommuting, distributed work, and satellite offices, the reduction in emissions can be dramatic.

Other private sector companies are also realizing the environmental benefits of high bandwidth. NEC's Broadband Solutions Center in Japan demonstrated a 41 percent reduction in CO_2 of a broadband-based office relative to a conventional office. NEC employees at this office "changed their working style using broadband solutions, such as IP telephony, a wireless LAN, and systems for remote access, web conferencing, and document sharing." They also demonstrated a CO_2 reduction effect of 70 percent when documents were digitized and shared electronically to reduce paper use.[16]

1.5 Fiber Facilitates Economic Development

According to a 2005 study by the Massachusetts Institute of Technology and Carnegie-Mellon University:

> We can say unequivocally that broadband access does matter to the economy, just as common sense suggests it should. We estimate that between 1998 and 2002, communities in which mass-market broadband was available by December 1999 experienced more rapid growth in employment, the number of businesses overall, and businesses in IT-intensive sectors.[17]

Broadband communications is increasingly essential to the functioning of the United States' economy and democracy. High speed communications are not only an engine for commerce, but also for integration of the many, diverse areas of the US into an increasingly-global economy. Concern is growing throughout the US that we are losing our competitive broadband advantage to competitor nations and cities in Europe and Asia, and that this disadvantage will grow with time. Even more troubling, the broadband deficit is likely to impact our competitive status with respect to education, economic development, standard of living, and quality of democratic discourse.

High-bandwidth broadband is widely-recognized a key driver of future economic competitiveness. The calls for greater broadband deployment come from organizations as diverse as the U.S. Chamber of Commerce, AARP, the National Association of Chief Information Officers, and major equipment manufacturers such as Intel, Nortel, and Cisco--all of whom recognize that the United States' position as a technological and economic leader require networks that enable growth applications such as teleconferencing, telecommuting, and distance learning.

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[16] NEC "An Environmental Load Assessment Method for Broadband Solutions," http://www.nec.co.jp/rd/rel/english/topics/t36.html, accessed November 5, 2007.

[17] William Lehr, Carlos Osorio, Sharon Gillett, Marvin Sirbu, "Measuring Broadband's Economic Impact," Broadband Properties, December 2005 (reporting on MIT/Carnegie Mellon study), http://www.broadbandproperties.com/2005issues/dec05issues/Measuring%20Broadband%20Eco%20Impact,%20Lehr,%20Gilett,%20Sirbu.pdf, accessed November 12, 2007.

Our competitor nations in Europe and Asia are increasingly recognizing FTTP as a key engine of economic growth and development. Significant fiber deployment projects are underway throughout Northern Europe, including in France, Ireland, Sweden, Holland, and Germany.

Developed Asian countries have also recognized fiber as the inevitable, essential broadband medium. FTTP connections increased nearly 10 percent in Japan in just the second quarter of 2007. FTTP now represents 36 percent of Japanese broadband connections, according to the World Broadband Information Services.[18] In fact, fiber is rapidly displacing DSL in Japan. Japan accounts for more than two-thirds of the global Fiber-to-the-Home market and 48 percent of the entire Fiber-to-the-Premises market, according to WBIS. [19]

Asia, South Korea and Taiwan also have significant FTTP markets, and China is rapidly deploying fiber.[20]

On the municipal side, our competitor cities in Europe and Asia have undertaken forward-thinking FTTP projects. Municipal FTTP projects are underway or under consideration in numerous major European and Asian cities including Paris, Vienna, Amsterdam, Stockholm, Zurich, Milan, Dublin, Singapore, and Hong Kong.[21]

The key driver in all of these projects is the need for economic development in the global economic environment of the 21st Century. These projects recognize that fiber networking:

- Enables small business creation and growth
- Enables job creation and the enhanced, multiplied economic activity that accompanies it
- Supports businesses with very high bandwidth needs, such as digital media and software
- Attracts and retains businesses of all sizes
- Enables workforce education
- Enables telework and distributed work
- Enhances reputation for visionary and pioneering projects
- Promotes major development initiatives such as revitalization zones or event bids

The economic significance of fiber has been recognized in Portland as well. The Portland Development Commission has also already attested to the potential economic development benefits of a Community Fiber Network. For example, PDC's 2006 testimony to the Council noted that very high-speed networking brings to Portland

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[18] http://www.wbisdata.com/newt/l/wbis/index.html, accessed November 14, 2007.
[19] http://www.wbisdata.com/newt/l/wbis/index.html, accessed November 14, 2007.
[20] "FTTH accounts for 36% of Japan broadband," Telecoms.com, http://www.telecoms.com/itmgcontent/tcoms/stats/articles/20017479743.html, accessed November 14, 2007.
[21] These projects span a wide variety of models, ranging from municipal ownership to public/private partnership to municipal attempts to stimulate private fiber builds. A number of these projects and their associated models are presented as case studies below.

residents and businesses "progressive options such as telework, telemedicine, e-learning, e-commerce and access to information from all over the world."[22]

In connection with this Community Fiber evaluation, PDC has noted that:

> [D]rivers of the knowledge economy such as high tech and creative services, as well as more traditional manufacturing industries,….require cutting edge communications technologies to enhance productivity and maintain competitiveness. This is something PDC heard clearly when developing our economic development strategy for the City of Portland, which included input from some 300 local businesses. One of the recommendations that came out of that process was for the City to "support … continued expansion of state-of-the-art communications technologies for Portland businesses." [23]

Even as there is growing consensus nationally that broadband is a key driver of economic competitiveness, the United States is simultaneously falling behind our competitor nations in broadband infrastructure, competition, and availability in individual communities – and, more broadly, in large parts of the United States. Indeed, the US has slipped to 16th in the world in per capita penetration as of May 2007, compared to our ranking as 4th just six years ago.[24]

The economic consequences of falling behind in broadband could be profound. For example, small and medium businesses cannot compete without affordable, high-speed access—and large businesses increasingly refuse to locate in areas without very high speed access. Home-based businesses fail to emerge or grow because of slow Internet speeds. Lack of very high-speed broadband also precludes development of the collaborative, distributed work that is a hallmark of the emerging global economy.

PDC also notes that:

> [W]e know from a number of studies that communities with mass-market broadband services are seeing more rapid growth in employment, new businesses, and businesses in the IT sector than comparable communities without widely-available broadband services. Many companies, including high tech manufacturers, now consider availability of broadband services a prerequisite to site selection. Intel, for example, maintains a list of prerequisites when choosing a site in the US or abroad that includes extensive broadband capacity.

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[22] The Portland Development Commission " Economic Development Strategy for the City of Portland," http://www.pdc.us/programs/ed/strategy/secure/strategy-summary_final_10-28-02.pdf , accessed November 15, 2007.
[23] Ibid
[24] Sonja Reece "Cities and Towns Must Fill the Broadband Void," W2i Digital Cities, June 21, 2007, http://w2i.com/resource_center/the_w2i_report__weekly_newsletter/news/p/id_74, accessed November 15, 2007.

So the evidence that broadband availability promotes economic development remains compelling, with demonstrable benefits.[25]

1.6 The Private Sector is Not Meeting Portland's Fiber Needs

Existing and proposed broadband networks do not meet Portland's needs for affordable, very high-speed broadband.

Despite industry protests, it is increasingly apparent that the current American market has not delivered true broadband competition or ubiquitous very high-speed broadband. While there may be significant competition in provision of programming and services such as telephone, email, and video—there is not significant competition in provision of "pipe" -- the infrastructure over which all of those services operate.

Moreover, to the extent that service competition exists, the market is distorted if the infrastructure provider can manipulate the quality of competing services over the connections the provider controls to the end customer. In a context in which network owners have been permitted by the FCC and the courts to "close" their networks to competition, competitors can reach customers only by building their own facilities—at prohibitive cost that precludes the emergence of multiple competitors.

This situation is akin to a scenario in which the national road network is owned by UPS and closed to competitors--in order to provide service, FedEx, DHL and other package deliverers would be forced to build their own network of roads and highways--a prohibitive bar to competition. The result in the communications context is comparable: a broadband monopoly or duopoly of incumbent cable and telephone companies.[26]

Even using this closed model, the incumbents do not plan to build FTTP throughout Portland's neighborhoods, with the exception of small scale trials in new developments. In fact, neither of Portland's existing wired providers plans significant FTTP rollouts in Portland.

1.6.1 Existing Providers Do Not Have Incentive to Offer Very High-Speed Broadband

Portland's incumbent providers are taking incremental steps to deploy some new technologies, but they are constrained in their investment choices by a number of key factors:

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[25] Jean Underwood with Alison Ault, Philbanyard, Chris Durbin. Mary Hayes, Ian Selwood, Bridget Somekh, Peter Twining & Derek Woodrow "Connecting with Broadband." Delivered December 17, 2003, http://www.becta.org.uk/page_documents/research/broadband_literature_review.pdf, accessed November 15, 2007.

[26] Even less service exists in much of the country. Amazingly, significant areas of rural America have no broadband options other than satellite service, which is costly and cumbersome. Satellite technology has proven itself a competitor for delivery of one-way video and radio, but it is significantly inferior to fiber optics -- and even to cable modem or DSL service -- for Internet and interactive services. Satellite broadband cannot match cable and DSL for bandwidth, it is far more costly, and satellite transmission entails a latency and delay issue that makes widespread Internet use unlikely utilizing existing technologies.

- The capital markets
- The high cost of infrastructure investment
- The advent of competitive services over data connections that threaten "triple play" service revenues

1.6.1.1 Capital Markets Constrain Incumbent Investment Choices

The capital markets reward short-term profits and punish long-term expense for investments like FTTP. As was noted in a 2006 Strategy Analytics study:

> Unlike local governments, which can justify investing in expensive FTTH technology on the grounds that it may benefit the public or stimulate economic growth, telcos and other shareholder-owned companies face intense pressure to limit costs and show near-term returns on investment. This financial pressure will continue to make FTTH difficult to rationalize in the near term.[27]

1.6.1.2 The High Cost of Infrastructure Investment Constrains Incumbent Investment Choices

The existing broadband market precludes true broadband competition because of the impracticability of construction of numerous broadband physical networks.

The cost of building fiber all the way to the home or business constrains incumbent investment choices—and, under current law, building their own network is the only way competitive providers can reach consumers. With the "overbuild" model, each provider must build out competing networks in each neighborhood they want to serve. The required infrastructure and investment to serve one consumer is quite similar to the investment to pass all potential customers in the community. In other words, the required investment must be repeated for each provider, double the providers, double the network costs, double the investment.[28] As a result, each incumbent can justify major investments only by increasing revenues per household by selling many services, rather than just one or two.

To increase revenues, incumbents attempt to sell consumers "triple play" services--bundled voice, video, and data. Their goal by offering "triple play" is to increase both the market size and the net contribution margins.

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[27] Jim Penhune and Martin Olausson, "Fiber To The Home in Europe: Will Municipalities or Markets Drive Growth?," Strategy Analytics, November 10, 2006.

[28] The alternative, "open access" model separates the network itself (provided by a "wholesaler") from the services (provided by "retailers" who compete over the single network). A single infrastructure provider (either private or public) sells wholesale access on a non-discriminatory basis to any private service provider. This model eliminates duplicate network infrastructure investment and reduces market-entry barriers to new and innovative service providers. This model enables the same creativity, innovation, and competition over new networks as existed over open dial-up networks in the 1990s.

1.6.1.3 The Risk of Losing Voice and Video Revenues Over Very High-Bandwidth Data Connections Constrains Incumbent Investment Choices

The incumbents are even more constrained by the fact that very high-bandwidth threatens their business models of selling multiple services over their networks. Incumbents are not incentivized to build big pipes because, where high bandwidth is available, consumers are likely not to purchase incumbent services, but rather to use Internet-based voice and video services

Current incumbent business models call for selling voice, video, and data services, the famous "triple play" or "bundle" that represents significant revenues. This business model is threatened by very high-bandwidth because, in a "big pipe" world, consumers may purchase only the high-bandwidth data connection and then get voice and video services from a web-based provider—a significant loss of revenue for incumbents, but a great savings for consumers and a great incentive for web-based innovation by thousands of competing companies.

The incumbents are justifiably concerned that competitive Internet-based applications over a big pipe will erode the market power they enjoy today. They are incentivized to mitigate this risk and retain market power by controlling and limiting data connections and thereby the ability of consumers to buy (or get for free) competitive voice and video services over data connections. Such services have the potential to turn their business models upside down.

For example, Internet-based Voice over Internet Protocol (VoIP) is a threat to incumbent voice revenues. VoIP, combined with high-speed Internet access, transforms voice communication from a service to an application.[29] Consumers can get VoIP as a free service (from companies such as Skype) or as a paid service (from companies such as Vonage).

Similarly, video multicasting and video streaming is a threat to incumbent video revenues. Current incumbent networks limit the functionality of video over the Internet. But very high-bandwidth will enable quality video multicasting and streaming. Consumers will not have to purchase a package, or "tier" of video channels, many of which they never watch. Rather, consumers will simply acquire programming over their data connections from Internet-based distributors (such as Akimbo or Cinemanow) or directly from the content producer (such as Comedy Central or a production studio).

Incumbents are therefore well-served by limited-bandwidth rather than high-bandwidth—scarcity protects their business model and revenues and enables them to discourage or degrade Internet-based applications that compete with their own service offerings. So

[29] Services are bundled with the connectivity infrastructure. The voice telephone service acquired from AT&T is an example of a service. Applications separate the traditional service from the infrastructure. For example a VoIP telephone application can follow the user, and is not tied to a particular infrastructure.

long as data capacity is a scarce resource, consumers will continue to purchase services from incumbents rather than accessing them as applications over the Internet.

But scarcity does not serve the public interest goals that are facilitated by very high-bandwidth because it fails to deliver the big pipe for innovation and creativity; new capabilities; opportunities for competitive and innovative service providers; enhanced customer alternatives; and consumer choice.

1.6.1.4 Existing Networks are Not Technically Capable of Speeds Enabled by Fiber[30]

The incumbent communications carriers offer many products in Portland that they describe as "broadband." Perhaps these products are broadband under the (widely rejected) definitions accepted by the Federal Communications Commission (FCC). But the FCC accepts as "high-speed"[31] connections that are only marginally better than dial-up, and that offer insignificant fractions of the speed that fiber can deliver using current technologies.[32]

The networks operated by cable and telephone companies are limited in their technological capabilities and do not offer the kinds of speeds and capacity possible with FTTP.[33] Both industries are further limited in their reach: cable serving primarily the residential market and Qwest serving some business and residential areas but limited by its technology[34].

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[30] The City asked both Qwest and Comcast to outline their plans for FTTP deployment in Portland. Both companies responded that they do not have plans to extend fiber to the home.

[31] The FCC defines "high-speed" as "connections that deliver services at speeds exceeding 200 kilobits per second (Kbps) in at least one direction" and defines "advanced services" as "connections that deliver services at speeds exceeding 200 Kbps in both directions." "Federal Communications Commission Releases Data on High-Speed Services for Internet Access," FCC Website, http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/IAD/hspd0705.pdf, accessed October 3, 2005.

[32] In Europe and Asia, significant fiber projects are underway to offer worst-case symmetrical speeds of 100 Mbps—500 times the speed the FCC considers satisfactory. In some areas of Asia, a gigbit of connectivity is not unusual—5,000 times the speed the FCC currently approves.

[33] Even advertised speeds may be illusory or inconsistent. The New York Times noted that some "customers do not get the maximum promised speed, or anywhere near it, from their cable and digital subscriber line connections. Instead, the phrase 'up to' refers to speeds attainable under ideal conditions, like when a DSL user is near the phone company's central switching office." Matt Richtel and Ken Belson, "Not Always Full Speed Ahead," The New York Times, November 18, 2006.

[34] The providers frequently make the argument that new electronic technologies will enable them to boost their network speeds to rival fiber. It is important to know that their technologies cannot truly rival the capacity of fiber—for simple reasons of engineering and physics. The performance difference between fiber optic and copper-based communications is not one of incremental or subtle distinctions; rather, fiber provides vastly enhanced transmission distance and capacity on the order of 100 times to literally immeasurably greater magnitudes. The physical properties of copper transmission media drastically limit the distances and capacity of the communications services they can support, which can be characterized by the two primary limiting attributes: signal attenuation and noise rejection.

Communications signals over any type of communications line must stay above a certain power level to be received properly, dictated by the specific type of hardware used. All forms of copper wiring attenuate the high frequency signals necessary for a high speed data connection greater than lower frequency signals

1.6.1.5 Comcast Hybrid Fiber/Coaxial Cable

Portland's cable television operator is Comcast Cable, whose "footprint" includes all residences and some business areas of the City. Comcast offers broadband at speeds defined by the FCC as "high speed."[35] It operates a high-quality, reliable hybrid fiber/coaxial systems that can compete against other offerings in today's marketplace. Its system, however is limited by its lack of fiber—even with advanced electronics and software, hybrid fiber/coaxial systems cannot keep pace with the potential speeds of fully-fiber networks such as those being deployed by Verizon in exclusive areas of the country, including the communities surrounding Portland. The cable system is limited by the inherent shortcomings of the coaxial cable that runs from the nodes into the home. An additional limitation arises from the shared nature of cable modem service—bandwidth within a neighborhood is shared rather than dedicated. As a result, speeds may be significantly decreased by one's neighbors' simultaneous use of their cable modems.

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over a given distance. Thus, the faster the connection speeds, the shorter the links must be to ensure adequate high frequency signal levels are delivered at the receiving end when using copper wires. As an example, a low frequency telephone voice signal (4 KHz) will only be reduced in power by one half over a kilometer of typical telephone wiring, whereas the power of a higher frequency DSL signal (1 MHz) will be reduced in half five times over, or to only 1/32 of the transmitted power over this same kilometer of wire. Compare this to singlemode fiber, which can carry the equivalent capacity of thousands of DSL signals or millions of telephone calls over a range of more than 10 kilometers while only attenuating the signal by half.

Not only is signal attenuation a factor over copper wiring, but communications signals must stay at a suitably high ratio relative to the levels of unwanted signals ("noise"). This is analogous to trying to participate in a conversation in a very noisy room; at some high level of ambient noise, such as at a rock concert, it is impossible to hold a conversation even when speaking very loudly. All types of copper wiring are prone to electromagnetic interference from outside sources, which increase the ratio of noise signals to the actual communications signal level. This is particularly true for unshielded copper wire, such as those used for telephone and DSL services, though even shield coaxial cable is susceptible. Fiber optics are immune to this type of noise problem because the cables are not electrical conductors and cannot carry induced electrical currents from any outside sources.

Although most limiting effects of copper transmission can be mitigated by regular regeneration of communications signals, this is typically impractical due to cost constraints or the ability to physically place the necessary communications electronics at regular intervals. For example, unshielded twisted pair (UTP) wires can carry a gigabit per second of data in a typical local area network (LAN), but the signal must be regenerated every few hundred feet. Coaxial cable can carry a gigahertz of video and data transmissions, but must be amplified every couple thousand feet. Only fiber allows long range transmission over distances spanning Cities without regenerating or amplifying the signals, and moreover, providing its vastly greater capacity that copper wiring can not match under any circumstances.

[35] Subscribers may be able to get cable modem speeds in Portland of "up to" three to six Mbps and, under ideal circumstances (none of one's neighbors using cable modem service at the same time), a couple of Mbps upstream. Fractions of those speeds would not be unusual at peak hours. Using current technologies, cable modem can theoretically provide as much as 20 or 30 Mbps downstream and 10 Mbps upstream under ideal circumstances but these circumstances are rare and the product, if available, is likely to be pricey.

Cable companies traditionally have serviced the residential market and they have limited footprints in business areas of most communities – this is generally true throughout the United States. The limited availability of cable modem services in business areas has not made an appreciable competitive impact on the price of higher quality and speed broadband products for business.

1.6.1.6 Qwest Hybrid Fiber/Copper

Qwest is the incumbent local exchange carrier in Portland, where it offers Digital Subscriber Line (DSL) services to most of the City and leases enhanced circuits to government and businesses at higher prices. Small and medium sized businesses may have difficulty affording these circuits.

DSL represents a relatively low-bandwidth form of broadband -- a network of roads, not superhighways. DSL does not even have the capabilities of a cable modem network because it is based on lower-bandwidth infrastructure. DSL runs on telephone network copper wires, which simply cannot handle the same capacity as fiber or even as Comcast's hybrid fiber/coaxial (HFC) network.[36] As capacity requirements increase, DSL is likely to fall further behind cable.[37]

Qwest does not plan to build FTTP, other than perhaps in new "greenfield" developments.

Qwest has announced a strategy for upgrading some of its existing copper systems to fiber-to-the node (FTTN), a technology that brings fiber deeper into the neighborhoods, but still attempts to use aging copper plant to cover "the last mile" to the home or business. This technology is widely regarded among communications engineers as extremely limited in capacity – even for today's existing applications.[38]

Under Qwest's current plans, fiber will be deployed to the node—but the old copper will be retained for some of the plant--the architecture calls for retaining up to one mile of existing copper lines from the node to the home or business. The reason for implementing VDSL is clear—Qwest is avoiding the enormous expense (and time) to construct fiber down the majority of rights-of-way and to the premises. The actual fiber construction contemplated is a fraction of what Verizon is doing in its FTTP builds.

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[36] Even in the best of circumstances, DSL coverage is difficult to project for a given location. A residence or business could be in an area where DSL is offered but is not available at their location due to the quality of the existing circuit or the fact that the system is tapped out--all DSL equipped circuits are already in use.

[37] The limitations of DSL are demonstrated by the efforts of Verizon to supplement its old copper phone networks with new FTTP networks in limited metropolitan areas within its existing footprint, which does not include Portland.

[38] The City of Portland has granted Qwest a video franchise to offer cable services over this platform, though it's not yet clear when Qwest plans to offer video services.

It's important to note that, even under the best of circumstances and assuming that Qwest's technology works as advertised, FTTN cannot, under any circumstances, offer comparable capacity or speed to FTTP.[39]

Theoretically, Qwest's new technology may provide as much as 20 Mbps downstream and a few Mbps upstream under ideal circumstances (such as close proximity to Qwest's central office) but these circumstances are rare and the product is likely to be pricey. Qwest has told investors that it is considering deploying "bonding" variations of DSL that would bond copper pairs and thereby boost speeds,[40] but such plans are, to our knowledge, aspirational only thus far, and assume the existence of sufficient copper "pairs" to bond to each other.

Qwest has not committed to a date certain by which even this limited technology will be widely-deployed in Portland and, during cable franchise negotiations, refused to agree to deployment throughout the entire City.

At its best, Qwest's century-old copper can carry only a few video channels at once—and no more than one High Definition cable channel at a time. Even if Qwest's hoped-for technology does turn out to work on a large scale, Qwest's century-old copper plant inevitably runs up against the realities of physics—this technology, at best, can barely support the high-bandwidth applications of today, and certainly not the higher-bandwidth requirements of tomorrow.

The limitations of this technology are likely to be reached quickly--even assuming that the technology does turn out to work on a large scale, and assuming that Qwest does upgrade quickly to this architecture in Portland. From a technical standpoint, FTTN is a short-term solution in a market where bandwidth needs are growing exponentially and high, symmetrical capacity is increasingly needed for small businesses and for popular emerging applications like gaming, video-gaming, video-downloads, and video-conferencing. Qwest's 100 year-old copper plant is not capable of meeting these needs in the medium or long-run.[41]

1.6.1.7 Contrast: Verizon FTTP in Surrounding Areas

Verizon is deploying FTTP in limited parts of the US – in other areas, like Qwest, it has chosen to rely on its current copper plant and DSL technology.

Verizon's FTTP networks are flexible and capable. Compared to other forms of communications transmission, FTTP boasts the highest theoretical capacity per user. It makes possible a wide range of potential applications and services, and enables the phone

[39] Ed Gubbins, "Qwest Greenlights $300 million FTTN Rollout," Telephony Online, October 30, 2007, http://telephonyonline.com/fttp/news/qwest_fttn_deployment_103007/, accessed November 11, 2007.
[40] Ed Gubbins, "Qwest Greenlights $300 million FTTN Rollout," Telephony Online, October 30, 2007, http://telephonyonline.com/fttp/news/qwest_fttn_deployment_103007/, accessed November 11, 2007.

[41] Andrew Afflerbach, Ph.D., "Fiber to the Premises and the Node," Journal of Municipal Telecommunications Policy, Fall 2006.

company to constantly upgrade capability and capacity simply by upgrading end equipment and software, while using the same fiber cable.

Verizon's network design calls for expanding its existing backbone fiber throughout the system, replacing existing copper all the way to the curb (and into the homes of those customers who subscribe).

FTTP systems are theoretically capable of virtually unlimited speeds for data, though current Verizon plans call for five to 30 Mbps downstream and two to five Mbps upstream.[42] Electronics and software changes make possible great increases in throughput without modification of outdoor fiber plant. In this way, fiber is considered a "future-proof" technology.

1.6.1.8 WiFi and 4G Wireless

Portland's Fiber and Wireless Projects are Complementary, Not Competitive

This fiber project is sometimes equated with the Portland WiFi network owned by MetroFi. Despite the obvious similarity—both projects seek to enhance broadband availability throughout the City—it is important to note the significant differences between the two projects, because they do not supplant or compete with each other; rather, ***these technologies inherently serve to enhance and complement each other***.

- Bandwidth: fiber optics offer theoretically infinite bandwidth (also known as throughput, speed, capacity) while wireless offers far lower speeds that, though impressive, cannot support some of the ultra-high speed applications made possible by fiber.

- Mobility: the key advantage of wireless cannot be mirrored by fiber; wireless offers mobility and connectivity during movement. As has been noted, one can't build fiber to the ambulance, to the bus, or to every laptop in a public park.

- Speed to deployment and related cost: wireless can be deployed far faster than fiber given the significantly lesser volume of infrastructure necessary and the relatively small amount of construction necessary in the public rights-of-way, if any. Fiber construction is burdensome and time-consuming because it involves building a physical asset down every right-of-way in the City, either on utility poles or underground. For these same reasons, the initial capital costs for wireless networking are far lower than those for FTTP.

The obvious flip-side of this distinction is that fiber is a long-term asset with a life of decades (and, as a result, is very cost-effective in the long-run) while wireless is a short-term technology. Existing WiFi radios, for example, will likely have to be replaced in three to five years as technology changes and components age.

[42] Verizon Press Release "Verizon Brings Blazing_Fast Connections to more Westchester - Rockland Customers," Released April 11, 2005, http://newscenter.verizon.com/press releases/verizon/2005/page.jsp?itemID=29709269, accessed November 15, 2007.

4G is the term applied to promising new wireless technologies, many of which offer sustained data speeds of a few Mbps or more per user. These include technologies with standards developed by working groups of the Institute of Electrical and Electronics Engineers (IEEE) and known by IEEE standards numbers 802.11 (WiFi), 802.16 (WiMAX), and 802.20. 4G also includes new generations of wireless technologies planned by the current cellular providers.

4G receives significant cultural and press attention, but the excitement over this technology should not blur the fact that 4G, no matter how promising, does not currently represent a broadband technology that is comparable to fiber. 4G does not have comparable capacity to fiber, versions of 4G using unlicensed spectrum may be limited in range and subject to interference, and 4G is largely untested as a widespread broadband medium – a technology still in development.

2. Users and Stakeholders: How Might the Community Fiber Network be Used?

How might the network be used? A few brief case studies illustrate FTTP's inexhaustible possibilities for innovation and public benefit.

- **Economic Development:** Economic development planners here and elsewhere envision attracting new businesses to the City by offering state-of-the-art communications infrastructure. Very high-bandwidth is increasingly a key criterion for companies deciding where to locate new offices and other facilities.[43] Fiber could draw software companies, video production houses, and companies that need access to their satellite facilities across the US and the world. In the national and global competition for businesses, fiber would add incomparable bandwidth to the City's existing attractions that make it a famously-attractive place to work and live.

  Fiber could also enable redevelopment or revitalization of areas and attract and retain workers. Indeed, affordable, very high-bandwidth connectivity could benefit a range of areas, including Airport Way, Lents Town Center, North Macadam, River District, Central Eastside, and the Interstate Corridor. The Community Fiber Network would build on the success of the Downtown Waterfront area and assist the Gateway Regional Corridor in promoting new mixed-uses.

- **Small and High-Tech Business:** Fiber would benefit one of the Portland area's most innovative new businesses. Versis Online is a small, entrepreneurial, local firm that, since 2006, has operated Versis Videogame Center, which offers a next generation, innovative gaming experience. The Center offers video game consoles, high-definition TVs, comfortable chairs, and food. The gaming lounges target people looking for a positive social networking experience to complement video game entertainment. The company has a goal of raising $2 million to finance new stores in 2008. Portland Community Fiber connections from Versis stores to the Internet open up the possibility of an international gaming experience over an affordable, robust, and stable connection. High-speed, high-capacity connections bring out-of-the-area gamers, including international players, into the centers without lost connections and other disruptions in service so commonly associated with a lower speed connection. To Versis, the Community Fiber network means the opportunity to grow by opening more centers because it lowers operational costs and creates a more attractive gaming experience.[44]

  Indeed, community fiber could dramatically grow Portland's fledgling digital media/gaming industry, which is already strongly established in San Francisco and Seattle. Fiber could also benefit the larger Portland software development industry. Software (educational and entertainment games in particular) is

[43] Testimony of Portland Development Commission, November 20, 2007.
[44] CTC interview with Jasjit Singh, President and Founder, Versis Online, November 12, 2007.

increasingly developed in an online, collaborative, distributed environment. To be successful, developers have to share enormous files online with their remote collaborators, with other studios or companies, and with users—the repository of files that goes into developing software is higher than the size of the software itself, sometimes in the range of thousands of gigabytes. Without sufficient bandwidth, Portland developers may be hindered in this environment.

To be viable, a game or piece of software has to be tested online and adjusted based on data gathered from the tests—it can take thousands of high-bandwidth transfers for such tests—and this bandwidth is essential if the developer is to compete with other applications in development. Software is also increasingly distributed online rather than through stores—in this way, the Internet has become the primary market for many applications and games. Finally, games and applications are increasingly used online in a shared environment—in some cases, hundreds of users simultaneously interact over broadband connections in the same application—and high bandwidth enables this unprecedented collaboration.[45]

- **Education:** Fiber enables heretofore-unthinkable means of educating and inspiring students. Not only could the Community Fiber Network give students and parents access to high-bandwidth school resources and learning tools, but it can also give them access to dynamic learning tools from around the world, unhindered by distance or capacity. Creative educational tools can leverage the power of fiber bandwidth. For example, the emerging "Brainstormer" gaming program uses the motifs, aesthetics, and attractions of video gaming to expose young people and other users to a "game" dedicated to sharing of ideas over high-bandwidth connections. Brainstormer is an educational video-game about sharing ideas—it enables collaborative passing of multiple ideas in visual form in a shared environment. Users share ideas (in voice, video, and data form) with others in a virtual reality world—on their computer screen, their digital representation (or "avatar") visually thinks, holds, creates, and shares ideas with avatars of other users. Brainstormer's potential is limited only by the bandwidth over which its users interact.[46]

- **Next Generation Network Development:** Technologists around the United States have noted the emergence of a Next Generation Internet. This chrysalis-stage project leverages next generation fiber networks to enable reliable, high-bandwidth peering over short and long distances in the service of public, educational, and community goals. Using national, university-based fiber networks, these visionaries are working to create collaborative production and distribution tools over high-bandwidth connections. The Portland Community Fiber Network would enable connection to this national network from numerous Portland sites (such as high-tech non-profit/community organizations, homes of interested residents, public broadcasting facilities, and technology businesses).[47]

[45] Interview with Barrett Fox, Director of Brainstormer Project, Connect & Collaborate (CoCo), Inc., November 15, 2007.
[46] Interview with Barrett Fox, Director of Brainstormer Project, Connect & Collaborate (CoCo), Inc., November 15, 2007.
[47] Presentation of Joaquin Alvarado, Director, Institute for Next Generation Internet, San Francisco State University, NATOA conference, Portland, OR, October 5, 2007.

- **Public Health**: The City's hospitals would benefit greatly from broadband connections between public and private health care locations throughout the City. Dr. Douglas Perednia, director of Advanced Telemedicine Research at OHSU and president of the Association of Telemedicine Service Providers, a national organization based in Portland, has noted that "[t]telemedicine is a tool that allows us to expand the reach of the care we provide to areas where providing service in person might not be economical."[48]

  Portland is already incubating new and innovative telemedicine projects that could benefit from the Community Fiber Network. In April 2007, Sacred Heart Medical Center in Eugene, initiated a pilot project to create a telemedicine link between its pediatric department and specialists at Doernbecher Children's Hospital in Portland. The goal of the project is to reduce the number of children transferred to Doernbecher. The project is the first link between the children's hospital at Oregon Health & Science University and any of the state's hospitals. Pediatricians at Sacred Heart will conduct video consultations with pediatric internists at Doernbecher to determine if a child needs to be transferred to its pediatric intensive care unit.[49]

  Community Fiber can also connect rural areas to Portland medical facilities in another practical use of telemedicine. The Director of One Sky Center recently testified before the US Senate that there exists "room for continued involvement and use of telemedicine throughout Indian Country. Telemedicine is a powerful means of delivering consultation and education to the front lines from centers of expertise."[50]

  The proposed Portland Community Fiber Network could offer such connections—in a secure manner that ensures patient privacy and contains this aspect of the increasing cost of health care.

- **Sustainable Development**: The Portland-Multnomah County Sustainable Development Commission is a volunteer, citizen body that is charged with advising the City and County on issues that relate to the overall health of the community, the preservation of the environment and to encourage the growth of a sustainable economy.

  How does an FTTP network support the Commission's goals? As the Commission sees it, FTTP allows citizens to use a robust, stable, high-capacity electronic communications channel to conduct business--reducing vehicle miles traveled, improving air quality and reducing greenhouse gas emissions. It promotes telecommuting, by enabling small- to medium-sized businesses to

[48] David Raths, "Serving Rural Oregon," Portland Business Journal, August 14, 1998, http://www.bizjournals.com/Portland/stories/1998/08/17/focus1.html, accessed November 14, 2007.
[49] News Release, "New Technology Links Eugene Hospital to Experts in Doernbecher Pediatric Intensive Care Unit," released April 16, 2007 http://www.ohsu.edu_ohsuedu_newspub_releases_041607dch.pdf accessed November 15, 2007
[50] Dr. R. Dale Walker, Written Testimony before the U.S. Senate Committee on Indian Affairs, Oversight Hearing on Suicide Prevention Programs and their Application in Indian Country, May 17, 2006.

efficiently participate in the global marketplace through use of video conferencing and electronic file transfers. For individual citizens, it provides electronic access as way to avoid driving (for instance, using online banking, using the internet to take a class or telecommuting to work). Finally, a robust communications infrastructure would reduce the use of paper by allowing people to transfer large data files over the internet.

In the Commission's vision, Portland's economy is made up largely of small businesses and these businesses need a robust and stable communication infrastructure in order to grow. FTTP will assist these businesses to remain sustainable, profitable and support them in their ability to provide jobs and contribute to the livability of our city.[51]

3. Staff Recommendations for Portland's Fiber Future

Staff offers the following recommendations as a result of the work done to date in evaluating a Community Fiber Network:

3.1 Adopt City Council Policy on FTTP

The City should adopt a Resolution urging prompt steps toward obtaining FTTP infrastructure in Portland as a matter of City policy. City ownership of a Community Fiber Network is feasible and merits further analysis. The City's consultants conclude that both a "retail" and a wholesale or "open access"[52] model have the capability to generate revenues sufficient to cover expenses, including financing costs. The data available suggest that both models can maintain a positive cash flow. The City's consultant has concluded that the City can expect to obtain and sustain the market share numbers necessary under either a retail or a wholesale model.

Staff also believes, based on emerging international projects, that an open access model is most likely to facilitate the goals and values of Portland by providing encouragement for private sector efforts as well as an open, nondiscriminatory platform for innovation. Specifically:

- The model is likely to stimulate private efforts to offer diverse, cost-competitive services to residents and businesses. The strategy creates a platform for broadband competition and innovation by separating network ownership from service-provision.

[51] Interview with Leslie Carlson, Co-Chair, Portland-Multnomah County Sustainable Development Commission, November 15, 2007.

[52] This Report uses the terms "open platform" and "open access" to refer to networks that allow competing service providers to compete over network infrastructure at competitive prices, assuming: (1) the technical architecture or its configuration enable competing providers to operate without constraints imposed by the network owner for non-technical reasons; and (2) the technical architecture or its configuration precludes the network owner from manipulating or monitoring the content of the data transmissions sent and received by the providers' customers.

- This model requires less City involvement in operations than does a retail model because it does not require the City to go into the business of providing communications services itself.

- The model leverages the City's considerable skills and experience in the following areas:

  - fiber network operations
  - right-of-way management
  - utility maintenance

- This model allows the customer to select the provider of their choice. In addition, by separating the service from the infrastructure, the current communications monopoly/duopoly is ended and incentives are reduced to limit available capacity and restrict access to and performance of Internet-based applications. In today's model, providers have incentives to discourage or encumber Internet based applications that are alternatives to traditional voice and video services.

- This model is also emerging as the preferred choice for major City FTTP projects in the United States and Europe. [53]

3.2 RFI Seeking Potential Private Sector and Community Partners

Staff recommends that the City undertake a next-step process to determine the interest of the private sector in a Portland Community Fiber Network—the goal is to encourage creative proposals and expressions of interest from a wide variety of potential partners, including financiers, equipment manufacturers, construction firms, systems integrators, Internet service providers, and the public.

Specifically, we recommend exploring partnering opportunities in a number of areas, ranging from financing, to leasing of City-owned fiber, or other potential participation in the process of expanding fiber networking throughout the City. Significant data could be elicited through a formal information request such as a Request for Information, supplemented by an interview process, and followed by comprehensive documentation of results.

Among other areas, such a process could elicit such information as:

- Availability in the current market of financing for municipal fiber construction, including potential terms and conditions
- Specific pricing for construction, equipment, and integration services

[53] This model is preferred, for example, among many of the major cities that are implementing or considering FTTP, including Stockholm, Amsterdam, the Danish TRE-FOR Network, UTOPIA (a consortium of communities in rural and suburban Utah), Seattle, and San Francisco. An endorsement by many of these cities and others was signed in November, 2006 in the context of the International Network of E-Communities (INEC) Declaration on Open Networks. See www.i-nec.com.

- Creative business plans that could serve both the public interest and commercial interests of potential partners
- Interest in leasing dark fiber on the part of existing and potential service providers, both facilities-based and not, as well as financial parameters
- Public and community group interest in FTTP

The RFI can help to document and understand the significant interest on the private sector side regarding local broadband initiatives. Significantly for Portland, Silicon Valley and Wall Street have identified community broadband as an important mechanism for broadband network expansion.

3.3 Conduct Pilot FTTP Projects

Staff also recommends that the City pursue selected FTTP pilot projects. One possibility is a project to tie West Coast cities together with fiber--thereby maximizing economies of scale and negotiation leverage by collaborating on FTTP. Staff have initiated contacts with the Cities of San Francisco and Seattle, in order to explore the possibility of multi-jurisdictional fiber projects, in light of the possibilities of realizing economies of scale with respect to equipment, construction, operations, and services. Seattle and San Francisco[54] have both expressed interest in exploring collaborative approaches with Portland--both note the potential leverage a combined approach would give this group of cities in negotiations with potential providers or vendors.[55]

A comparable effort is underway in Europe, where some of the major cities planning FTTP projects have undertaken an effort through Eurocities to link "smart" cities throughout Europe.[56]

Both Seattle and San Francisco have expressed interest in such a model on the West Coast of the United States, and potentially beyond. Seattle's Broadband Director presented that vision in a speech to the Washington, DC metropolitan area Council of Governments: "we should consider what it would take to connect Seattle to Portland and Portland to San Francisco and San Francisco to the Washington, DC area, and from there to the world."[57]

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[54] Specifically, the Seattle Office of Broadband and the San Francisco Department of Telecommunications and Information Services, both of which are lead agencies on their cities' FTTP project.

[55] The perspectives of these cities are presented below.

[56] Eurocities is a consortium of 123 major cities in 32 European countries. Eurocities' "Broadband Manifesto" calls for widespread deployment of fiber and for "Trans-National, Interconnected Open Broadband Networks." Eurocities Broadband Manifesto: Ensuring the Infrastructure for the Knowledge Economy, http://www.telecities-prague.cz/download/prezentace/broadband_manifesto_eurocities_eplanatory_notes.pdf, accessed December 13, 2006.

[57] Tony Perez, Director, Office of Broadband, City of Seattle, speech presented to the Metropolitan Washington Council of Governments Broadband Regional Forum, Washington, DC, October 30, 2006.

3.4 Investigate other Potential Ways the City can Leverage FTTP

Opportunities for cost-effective installation of fiber arise each day as City bureaus carry out routine operations and City crews work in the right-of-way. Portland should explore adopting future-focused FTTP policies in applicable bureaus and City projects, to add to existing fiber and conduit infrastructure at every opportunity to build up critical mass. Every municipal project has the potential to provide long term cost savings on communications infrastructure.

Conduit and fiber are the key for future-proofing the City's infrastructure. There is a low incremental cost to install fiber or conduit during any capital improvement project or repair. Staff therefore recommends that the City develop policies, in cooperation with relevant City bureaus, that would consider installation of fiber optics during any relevant capital improvement project or repair, including:

- Road construction or repair
- Sewer or water line replacement or repair
- Electrical work
- Sidewalk repair and replacement
- Relocation to underground of aerial utilities by utilities
- Other open trenching opportunities initiated by private utilities
- Any other circumstance under which any City department is working in the right-of-way

Similarly, the City should consider uniform requirements and procedures for using commercial carrier construction to simultaneously install fiber or conduit, or negotiate conduit or dark fiber during permitting. Every private sector project in the right-of-way offers an opportunity for partnerships.

For example, the City is already undertaking a massive sewer replacement project; such projects can offer great opportunities for simultaneous deployment of fiber and conduit. Portland has already evaluated the potential for using sewers for collocations of fiber optics, and this potential should continue to be considered.[58]

[58]W&H Pacific, "The Feasibility of Using Sewer Lines for Fiber Optic Conduit," report prepared for the City of Portland, June 2001.

4. Community Fiber-to-the-Premises Case Studies

This Section of the Report presents a number of case studies of existing municipal FTTP initiatives and operational FTTP networks based on CTC's work for the City of San Francisco. It is important to note that these experiences should not necessarily be interpreted as "best practices." The municipal FTTP movement is still in its infancy and there is limited empirical data on which to rely for purposes of understanding how processes and business plans have worked. In addition, there are dramatic differences in circumstances between Portland and each of the existing municipal FTTP networks in the United States and elsewhere. We caution against simple comparisons and note instead that these municipalities face major differences in financing, topography, technology evolution, market, customer base, competitive situation, and other factors.

4.1 Seattle

Seattle is evaluating the feasibility of a Public/Private Partnership to build and own an FTTP network as a means to reducing the City's risk.[59] The city has engaged in a feasibility and exploratory process that is the first in the United States for a city of Seattle's size.

Population:	563,374
Households:	270,524
Median Household Income:	$45,736
Per Capita Income:	$30,306
Area:	83.87 square miles[60]

Initiation Dates: In 2004, the city's Mayor and Council convened a Task Force to evaluate the city's "technology future." In 2005, the Task Force adopted a goal that would bring true broadband to the entire city by the year 2015.

On the basis of these findings, in the spring of 2006, Seattle issued a Request for Interest (RFI) to attempt to ascertain the interests and ideas of private sector entities interested in partnering with the city on an FTTP network.[61]

The city received more than 30 responses to the RFI, of which at least 10 were sufficiently interesting and responsive that city stakeholders interviewed the respondents during the fall of 2006.[62] The City concluded its discussions with 10 of the RFI

[59] Bill Schrier, "Bustin' the Myths," presentation delivered at NATOA national conference, August 25, 2006; CTC interview of Tony Perez, Director, Office of Broadband, City of Seattle, October 5, 2006.
[60] 2000 Census, http://factfinder.census.gov/home/saff/main.html?_lang=en, accessed December 22, 2006.
[61] The City of Seattle Fiber to the Premises Broadband Network Request for Interest, issued May 2006, www.seattle.gov/cable, accessed November 2, 2006.
[62] Seattle has not yet released copies of the responses. The respondents who were interviewed by the city include: ACI Communications; Bechtel Telecommunications; Ericsson; iTown Communications; Lucent Technologies; Nextnet Investments; PacketFront Inc.; Qwest; US MetroNets; Verizon; and Vulcan. The broad and unexpected range of respondents suggests that there is some interest in such projects among financiers, manufacturers, non-incumbent carriers, and other parties.

respondents in October 2006. As of this writing they are still in the process of reviewing information and conducting additional research before presenting the information to the Mayor and City Council for further consideration.

Business Model: On the basis of the conclusions of the Task Force, the RFI notes that the city will "be an infrastructure partner," not a service provider or network operator. [63]

Perceived Benefits: The Taskforce articulated its vision in this way:

> *Within a decade all of Seattle will have affordable access to an interactive, open, broadband network capable of supporting applications and services using integrated layers of voice, video and data, with sufficient capacity to meet the ongoing information, communications and entertainment needs of the city's citizens, businesses, institutions and municipal government.*[64]

The Taskforce Report concluded that Seattle would require speeds of 20 to 25 mbps in the short run and 100 mbps and more in the longer run—speeds that are not now offered by incumbent providers and are not likely to be offered by those companies in the foreseeable future. Despite the mobility benefits of wireless technologies, the Task Force found that only FTTP could deliver the bandwidth and security necessary "to ensure Seattle's broadband future," though it recognized an important complementary role for wireless.[65]

Significantly, Seattle noted the dramatic impact technology has had on that city's development and nature. It further noted that a lack of true broadband competition could relegate the city "to second tier status in terms of its technological sophistication and [the city could] lose its edge to cities that are better positioned to compete in the emerging global economy."[66] As one Seattle stakeholder put it, "If we don't have true broadband, where will the research and development money go? Where will the software developers move?"[67]

Service Offerings: The city's RFI requires that the network be "capable of providing any combination of voice, video and data services to residents, businesses, institutions and city government."

On the basis of the conclusions of the Task Force, the RFI notes that the city requires that the network have "very high bandwidth with maximum scalability." The city also requires that the network be non-discriminatory in its treatment of providers of similar

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[63] The City of Seattle Fiber to the Premises Broadband Network Request for Interest, issued May 2006, www.seattle.gov/cable, accessed November 2, 2006.
[64] CTC interview of Tony Perez, Director, Office of Broadband, City of Seattle, October 5, 2006; Report of the Task Force on Telecommunications Innovation, May 2005, www.seattle.gov/cable, accessed November 28, 2006.
[65] Ibid.
[66] Ibid.
[67] Tony Perez, Director, Office of Broadband, City of Seattle, speech presented to the Metropolitan Washington Council of Governments Broadband Regional Forum, Washington, DC, October 30, 2006.

services as well as in its treatment of customers.[68] Such an approach is directly contrary to the tiering and pricing options the incumbent providers have explicitly reserved for themselves[69] despite the efforts of "network neutrality" advocates.[70] The city also requires that privacy rights be respected.[71]

Residences and Businesses Passed: The city's intention is that the network serve all homes and businesses throughout Seattle. The RFI requires Citywide coverage, even if that is achieved in a phased manner.[72]

Competitive Providers on the Network: The city's RFI establishes some key technical requirements relative to competition, most significantly that the bidders endeavor to build an open platform. Specifically, the city asks that the private partner endeavor to offer an open access platform for multiple service competitors, which, in the words of the city, "will fuel experimentation and innovation, lead to new applications and services, lower prices and create more choices for consumers." [73]

The RFI also requires that customers have the option of attaching any non-impairing device to the network (not only those sold or rented by the operator). [74]

Financing: Given the preliminary nature of this project, the source of financing has not been determined. According to the Director of Seattle's Broadband Office, however, there has been significant interest on the part of the capital markets and it is the city's perception that in the current environment, financing is available for such projects.[75]

In addition, the city has signaled some willingness to participate financially in the project. The RFI provided a brief inventory of city assets that could be offered to a private sector partner as an incentive and to maximize efficiency in construction. Such assets include city-owned utility poles, fiber conduit and cable, real estate, and the support of city staff.

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[68] Specifically, the city notes that is "vital to the future of the Internet that network owners not discriminate in terms of bit transport or unnecessarily mediate between users and content or application providers….We believe that preferential treatment by network owners or operators of data streams will distort the evolutionary path of the Internet, stifle creativity and innovation and ultimately abridge the ability of the Internet to be a medium for the free dissemination of diverse thought and opinion." The City of Seattle Fiber to the Premises Broadband Network Request for Interest, issued May 2006, www.seattle.gov/cable, accessed November 2, 2006.

[69] AT&T CEO Ed Whitacre, for example, has publicly stated that "what they would like to do is use my pipes free, but I ain't going to let them do that because we have spent this capital and we have to have a return on it. So there's going to have to be some mechanism for these people who use these pipes to pay for the portion they're using. Why should they be allowed to use my pipes?," Business Week, November 7, 2005, http://www.businessweek.com/@@n34h*IUQu7KtOwgA/magazine/content/05_45/_b3958092.htm, accessed December 22, 2006.

[70] See, for example, Lawrence Lessig and Robert W. McChesney, "No Tolls on the Internet," Washington Post, page A23, June 8, 2006.

[71] The City of Seattle Fiber to the Premises Broadband Network Request for Interest, issued May 2006, www.seattle.gov/cable, accessed November 2, 2006.

[72] Ibid.

[73] Ibid.

[74] Ibid.

[75] "What Seattle Learned in Europe," eNATOA Community Broadband Seminar presentation, Tony Perez, Director, Office of Broadband, City of Seattle, November 20, 2006.

The city also held out the potential for "additional investments to aid the partnership" as well as the prospect of significant fees for service in the form of an anchor tenancy.[76]

Governance: As it evaluates the responses to the RFI, the city is evaluating possibilities for ownership by an independent non-profit. Under such an arrangement, the city would sit on the Board of the non-profit and would represent a major network stakeholder.[77]

4.2 San Francisco

Population: 776,733[78]
Households: 346,527
Median Household Income in 1999 (dollars): 55,221
Per Capita Income in 1999 (dollars): 34,556[79]
Area: 47 square miles

Initiation Dates:

The San Francisco Board of Supervisors initiated the City's FTTP analysis in 2004. Board Resolution No. 617-04 was authored by Supervisor Tom Ammiano and unanimously adopted by the Board of Supervisors on October 5, 2004. Among other things, the resolution urges the Department of Technology and Information Services (DTIS) to analyze and report on:

- Other local governments that own and/or operate broadband facilities
- "The feasibility of the City providing services directly, as well as leasing facilities to independent providers"
- The City's existing broadband resources
- A potential plan for "a City-owned high-speed communications system, including recommendations for the types of facilities and the amount of bandwidth the City should install, and the timing and placement of such facilities" and associated costs and business models
- Use of strategies to maximize existing City broadband resources and construction including sewer replacement projects and other "construction and excavation activities"

[76] The City of Seattle Fiber to the Premises Broadband Network Request for Interest, issued May 2006, www.seattle.gov/cable, accessed November 2, 2006.
[77] CTC interview of Tony Perez, Director, Office of Broadband, City of Seattle, October 5, 2006.
[78] 2000 Census, http://factfinder.census.gov/servlet/SAFFFacts?_event=&geo_id=16000US0667000&_geoContext=01000US%7C04000US06%7C16000US0667000&_street=&_county=San+Francisco&_cityTown=San+Francisco&_state=04000US06&_zip=&_lang=en&_sse=on&ActiveGeoDiv=&_useEV=&pctxt=fph&pgsl=160&_submenuId=factsheet_1&ds_name=ACS_2006_SAFF&_ci_nbr=null&qr_name=null&reg=null%3Anull&_keyword=&_industry=, accessed 11/08/07.
[79] San Francisco At A Glance, http://www.sfgov.org/site/mainpages_page.asp?id=15216, accessed 11/08/07.

In 2006, DTIS commissioned a feasibility study to address these issues. The study was prepared by Columbia Telecommunications Corporation (CTC) and released for six months of public comment in January 2007. A final draft was released in July 2007.

The study notes that:

> San Francisco leads the nation in innovative municipal public service and in private-sector technology innovation. These two phenomena intersect in the path-breaking potential to network every home and business with fiber optics. Fiber represents the holy grail of communications networking: unlimited capacity, long life, and global reach.

The San Francisco Board of Supervisors and DTIS are currently evaluating the report and have not yet announced a time table for further public action on the report.

Business Model:

The City's feasibility study recommends that a wholesale or "open access" model offers the best balance of technology advancement, infrastructure, future proofing, and encouragement for private sector innovation-- and is thereby most likely to facilitate the goals of the City. Specifically the study notes that:

- The model is likely to stimulate private efforts to offer diverse, cost-competitive services to residents and businesses.
- This model requires less City involvement in operations than does a retail model because it does not require the City to go into the business of providing communications services itself.
- The model leverages the considerable City's right-of-way knowledge and utility maintenance capabilities.
- The model is practical and entails less political risk as well as less financial risk.
- This model allows the customer to select the provider of their choice. In addition, by separating the service from the infrastructure, the current communications monopoly/duopoly is ended and incentives are reduced to limit available capacity and restrict access to and performance of Internet based applications.
- This model is also emerging as the preferred choice for major City FTTP projects in the United States and Europe.
- This strategy also fits well with the technical model proposed (Ethernet over home run fiber).
- Finally, the wholesale model requires a smaller capital investment than does the retail model and the limited data available suggest that the wholesale model is more likely to maintain a positive cash flow.

Technical Model:

San Francisco's feasibility study recommends Ethernet over a "Home Run" fiber topology. According to the study, this technology enables the standard mass-produced Ethernet equipment used in homes and businesses to be used in a citywide network. Home Run Ethernet is being deployed by the Amsterdam FTTP network and other

municipal service providers. It is particularly attractive for a wholesale deployment, because it enables individual retail service providers to directly reach customers over dedicated fiber optic strands from FTTP hub facilities in each neighborhood.

The study notes that Ethernet technology has increased in speed by a factor of more than 100 over the past ten years and remained approximately constant in cost. It has been widely-deployed in home networks, business networks of all sizes, and carrier networks. Its wide adoption at all levels of the industry and well-matured standards have resulted in low hardware costs, widespread availability of related expertise, and continued development of faster and more functional versions. According to the study, it is likely to continue to improve in quality, decline in price, and be eminently upgradeable as bandwidth needs increase in the coming years. Ethernet supports a wide range of deployment architectures, including the Home Run fiber topology, which offers the greatest flexibility for technology selection, models for open access, and overall greater capacity. It also minimizes the practical and aesthetic impact on the public right-of-way relative to other communications technologies.

Financing:

San Francisco's initial feasibility study assumes bond financing.

Additional Benefits:

The feasibility study notes that the business case for FTTP in San Francisco is not limited to such easily-quantified matters as cash flow and capital investment—rather, the business case for such a network also includes the less quantifiable financial factors, including economic development, sustainability, small business empowerment, job creation, livability, environment protection, education, increased sales tax and real estate tax revenues, increased property values and other factors that measure the overall benefit of a next generation communications infrastructure such as FTTP.

4.3 Amsterdam

Population: 743,027[80]
Households: 406,720[81]
Average Household Income: 26,300 Euros[82]
Area: 64 square miles[83]

Project Origin and Initiation Dates: According to city stakeholders, the city learned even before the advent of the Internet--during a phone crisis in 1987--that existing networks could not scale to meet growing future telecommunications needs. In 2000, a few low-income housing developments in the city received fiber-to-the-home connections from a private, Swedish company. The city then noted that these buildings,

[80] City Research and Statistics Department, http://www.os.amsterdam.nl/tabel/5000/, accessed December 22, 2006.
[81] Ibid.
[82] City Research and Statistics Department, http://www.os.amsterdam.nl/tabel/5012/, accessed December 22, 2006.
[83] Beijing-International Website, Sister Cities information, http://www.ebeijing.gov.cn/ying/t95204.htm, accessed December 22, 2006.

which had previously housed almost exclusively Moroccan immigrants, were attracting young, professional, white residents of the city—a racial and economic integration success that the city had aspired to but had not achieved at such a level through other projects.[84]

This demonstration of the potential power of fiber led to negotiations with existing providers, which were not successful, and then to formation of a blue-ribbon commission to advise the city about next generation networking. The commission concluded that the city could attract investment if it were willing to take a minority stake in the passive layer of the project (the fiber). The city in turn was willing to invest the money if there were already in place a contract with a network operator. Through a tendering process, BBNed, a division of Telecom Italia, was identified as the operator and the project was eventually approved by the Amsterdam city council in 2006.[85]

Construction began in October 2006 in parts of Zeeburg. Zeeburg has 42,243 residents and is 19.31 km. Households can choose from TV, telephone and Internet services. [86]

Business Model: Glasvezelnetamsterdam (GNA) represents a public/private partnership between the City of Amsterdam, five housing corporations and pension fund investors, and ING Real Estate and Reggelfiber. Under this partnership, the city will build and own a portion of the passive elements of the network only: the fiber optics, but not the active elements, the electronics.[87] The city never even considered providing services on the network.[88] A service provider partner (Telecom Italia unit BBNed—identified through a competitive tendering process that resulted in 10 bids) will serve as operator, provide electronics, and will provide 10 years of (non-exclusive) services in an arrangement under which other service providers can lease access to the network at competitive prices. All participants in GNA support this open access architecture.[89]

According to city representatives, the city's private partners have significant stakes in the project because they are invested in the city: for example, the five local housing cooperatives that are partners in GNA own approximately 70 percent of the housing in Amsterdam. They have a long-term interest in the value of those properties that is enhanced by fiber connectivity. They, like ING Bank, also have a long-term interest in the economic vitality and competitiveness of the entire City of Amsterdam, which they reportedly believe is facilitated by the fiber.[90]

The city's limited ownership percentage is designed, in part, to insulate the project from political fluctuations and to facilitate private-sector investment.[91]

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[84] CTC interview with Dirk van der Woude, GNA, Amsterdam, December 29, 2006.
[85] Ibid.
[86] http://www.glasvezelamsterdam.nl/gna_algemeen/
[87] Gordon Cook, "Financing Amsterdam's Huge FTTH Build," Broadband Properties Magazine, page 69, September 2006.
[88] CTC interview with Dirk van der Woude, GNA, Amsterdam, December 29, 2006.
[89] Gordon Cook, "Financing Amsterdam's Huge FTTH Build," Broadband Properties Magazine, page 69, September 2006.
[90] Ibid.
[91] Ibid.

Technical Model and Architecture: GNA represents 100 percent underground construction. Given the complexity of underground construction, the network contains large amounts of fiber and is designed to be future-proof, such that there will be no need to lay fiber again.[92]

According to GNA staff, the passive fiber-owner has only a few obligations under the model developed in Amsterdam: first, to roll out fiber universally; second, to make sure the contract with the operator precludes discrimination against any service provider (in other words, open access); and third, to provide for conflict resolution between the operator and the service providers.[93]

Financing: The city provided 20 percent of the capital for the first phase of fiber construction in the amount of E6 million (the city's ownership percentage of GNA is 33 percent). The balance of the fiber funding came from the city's partners: ING Bank, five local housing cooperatives, and a fiber company. As of the current date, the project is financed and approved for only the first 10 percent of the city, with the intent to expand the project in the future.[94]

Financing for operations and service-provision is the responsibility of the vendors and the city is not involved other than in the selection of those vendors through the tendering process.[95]

The city hopes that, ideally, the market will respond to the project with additional investment money for later stages of construction. According to city staff, the city would be willing to dilute its ownership percentage in the passive layer so long as there is universal build-out of the fiber.[96]

Service Offerings: GNA will not set retail prices because it controls the passive layer of the network only. Each retail provider will determine the pricing and characteristics of their respective voice, video, and data services.[97]

Residences and Businesses Passed: GNA is intended to reach all 420,000 residences in the city[98] as well as all businesses—the network is designed to connect to each of approximately 450,000 meter box in the city.[99] The fiber will be built not only to individual residences, but to all apartment units within multi-dwelling units as well.[100]

Competitive Providers on the Network: The GNA project is designed for open access—a key goal of the City of Amsterdam. BBNet's contract for service-provision is

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[92] Ibid.
[93] Ibid.
[94] Ibid.
[95] Ibid.
[96] Ibid.
[97] Ibid.
[98] "Old Networks Not Enough," Dugie Standeford, Communications Daily, November 6, 2006, pages 5-7.
[99] CTC interview with Dirk van der Woude, GNA, Amsterdam, December 29, 2006.
[100] Gordon Cook, "Financing Amsterdam's Huge FTTH Build," Broadband Properties Magazine, p. 68, September 2006; CTC interview with Dirk van der Woude, GNA, Amsterdam, December 29, 2006.

non-exclusive and all service providers may use the fiber under network terms and conditions.

4.4 Suburban Utah ("UTOPIA")

The Utah Telecommunication Open Infrastructure Agency (UTOPIA) is a consortium of Utah cities that are deploying and operating a FTTP network which connects every business and household in its member communities. The FTTP network is known as the UTOPIA Community MetroNet.[101]

Communities: Fourteen Utah communities are participating in three successive phases of UTOPIA. Brigham City (Group II) Cedar City (Group III) Cedar Hills (Group III) Centerville (Group II) Layton (Group II) Lindon(Group I) Midvale (Group I) Murray (Group I) Orem (Group I) Payson (Group I) Perry City (Group II) Riverton Cedar City (Group III) Tremonton (Group II) West Valley City (Group I)

Population: Approximately 17 percent of Utah's population can potentially be served directly by UTOPIA's planned network

Governance: UTOPIA operates as a political subdivision of the State of Utah and is governed by an Interlocal Agreement.

Initiation Dates: The planning cycle lasted approximately two and a half years and included a city-by-city evaluation of the demand, service gaps, market potential, FTTP technology, anticipated implementation and operating costs, and the projected revenues.

Construction for Group I cities is underway with an anticipated completion date in the summer of 2007. Construction has started for Group II with completion estimated within three years. Group III construction will follow.

Service Offerings: Internet, high-speed data transport, cable, and telephone. All services are IP based.

Technology: The hardware vendor is Allied Telesyn for the residential gateway. The platform is based on a Layer 2, Multi-Protocol Label Switching (MPLS) active electronics architecture.

Business Model: The business model is an open access/wholesale model. UTOPIA-approved service providers include AT&T (Internet), MSTAR (Internet, cable and telephone), Veracity (Internet and telephone), and Xmission (Internet). UTOPIA is actively seeking other providers to use the network to deliver retail services.

Economics: The network's anticipated life is 20 years. UTOPIA financed the Community MetroNet through a construction loan secured with a pledge of revenue from

[101] Unless otherwise noted, all data in this case study are based on CTC's interview with Paul Morris, Executive Director, UTOPIA, December 1, 2006.

municipally-backed general obligation (GO) bonds in case that revenues are insufficient (as construction for a phase is completed, the construction loan is converted into a 20 year municipal bond). Eleven of the 14 participating communities opted to back the bond. The communities guaranteeing bond repayment will be built in the first two phases. The total construction loan required to build FTTP in the 11 communities is $340 million.

Additional Benefits: Economic development and long-term economic viability of the region.

Service Offerings: UTOPIA does not set retail prices, it is a wholesale provider. Each retail provider determines the pricing and characteristics of their respective voice, video, and data services. As a minimum, UTOPIA Community MetroNet will deliver 100 Mbps of bandwidth to every connected home and 1 Gbps of bandwidth to every business. If desired, all of the bandwidth can be allocated to Internet connectivity.

Homes Passed: With construction still is in process, the following passings are planned:

Lessons Learned: In UTOPIA's experience, the financial community is not prepared to support broadband projects based upon projected revenue streams. The financing needs to be secured with general obligation pledges or with existing utility revenues such as gas, electric, or water.

4.5 Palo Alto

The City of Palo Alto Utilities (CPAU) has provided dark fiber connectivity to businesses in Palo Alto since 2000.[102] In addition, CPAU conducted a technical FTTP pilot for over 48 months. The pilot was terminated in December of 2005. Rather than the city pursuing an investment in FTTP and becoming a service-provider itself, the city has initiated efforts to encourage a private provider to build the FTTP facilities. The RFP for the private FTTP build out is issued and responses were due on January 9, 2007. Palo Alto received one responsive bid from a consortium led by 180 Connect and PacketFront. Staff is currently negotiating with the group and has sought guidance from the City Counsel as to how to proceed.

Population:	58,600
Households:	25,200
Median Household Income:	$90,400
Per Capita Income:	$56,260
Area:	25.6 square miles[103]

Governance: CPAU provides electric, fiber optic, natural gas, water, and wastewater services. The Utilities Advisory Commission oversees and manages the CPAU, and

[102] Unless otherwise noted, all data in this case study are based on CTC's interview with Josh Wallace, Key Account Manager for Commercial Fiber, City of Palo Alto Utilities, November 30, 2006.
[103] 2000 Census, US Census Bureau American Fact Finder, http://factfinder.census.gov/home/saff/main.html?_lang=en, accessed December 22, 2006.

makes recommendations to the City Council regarding policies, legislative activities, budgets, and rates upon such other matters as the City Council may from time to time assign.

The Utilities Advisory Commission is composed of five members who are not Council Members, officers or employees of the city. Each of the Commission members is a utility customer or the authorized representative of a utility customer. At least four members of the Commission must be residents of Palo Alto.

Initiation Dates: Fiber planning started in 1996, and resulted in a Backbone ring implementation to support dark fiber services. The backbone consists of 33 route miles (over 4,750 fiber-miles), with 144 or more strands of single mode fiber along most routes.

In 2000, the City Council approved a FTTP trial to determine the feasibility of providing citywide FTTP in Palo Alto. The trial consisted of offering video and data services to 66 homes. The trial proved successful from the technical perspective.

The City Council approved the engagement of a consultant in 2002 to complete a FTTP business case. As part of the business case development, Palo Alto residents were surveyed to determine potential market interest in the project. In September, 2002, the business case was completed, and Council agreed both to extend the timeframe for trial participants and to fund the development of a business plan.

In the business plan, the consultant assumed the Electric Fund would issue (tax-exempt) revenue bonds to fund the FTTP build-out. However, in 2004, it was determined that in fact, the Electric Utility could not fund the FTTP project with revenue bonds; as a result, financing costs would be greater than previously assumed.

In January 2006, City Council recommended that CPAU staff develop a Request for Proposal to assess whether any private entities would be interested in pursuing or partnering in, citywide deployment of FTTP. The RFP for the FTTP build out was issued in September of 2006.

Business Model: CPAU provides dark fiber connectivity. Customers are responsible to provide and maintain equipment to light-up or provision the leased fiber strands. Fiber connections are owned, operated, and maintained by CPAU.

The FTTP trial was for a technical evaluation, not market acceptance. During the trial, data and video services were supported. The FTTP business plan for retail voice, video, and data services was not pursued because of legal and economic questions.

The primary goals for the system requested in the RFP are:

- Capability of providing to each customer a minimum bandwidth of 100 megabits per second symmetrical service
- Provision of at least data, video, and telephony services
- Eventual city ownership of the physical system

A secondary goal for the system is to promote competition between multiple service providers. In addition, the following features are preferred:

- An open system
- Network neutrality
- Minimal financial risk to the city [104]

Financing: The fiber ring was financed with an internal loan of $2,000,000 from the Electric Utility for a period of 20 years at zero percent interest rate. The financing included the initial build out and working capital for the first four years of operation.

The FTTP pilot was operated for over 48 months served a total of 70 residents. The cost of the FTTP pilot was $600,000 which was funded via electric utility reserves.

Additional Benefits: Economic development for retention and attraction of residents and businesses. By leveraging the dark fiber, businesses have access to connectivity services within Palo Alto that far out-perform cable modem and DSL services and are considerably more affordable than T3 or other high end connectivity services.

Service Offerings: Dark fiber backbone lease fees are based on the number of fiber miles per month. The base lease price is $272.25 per fiber mile per month. Quantity, route length, topology, and other discounts are available. The minimum backbone lease fee is $425 per month. Lateral connection (premises to backbone) fees are based on the length and type of the lateral, with a minimum fee of $210 per month. Available configurations include point-to-point, ring, and diverse ring.

Businesses Passed: The majority of business parks and commercial properties are served by the fiber optic backbone.

Competitive Providers on the Network: In addition to supporting city and utility needs, the fiber ring serves four wholesale customers (who lease dark fiber, add electronics and then provide a retail service) and 24 business customers. This customer base is projected to provide $1.9 million in net revenues in 2007.

Lessons Learned: CPAU notes the need to keep pricing structures simple. Some potential network participants did not originally consider lease of dark fiber because of the complexity of the rate structure at the time.

4.6 Jackson, Tennessee

Jackson Energy Authority has implemented a hybrid of retail and open access business model with their FTTP network.[105] Cable television services are provided directly by

[104] City of Palo Alto RFP FTTH01.
[105] Unless otherwise noted, all data in this case study is based on CTC's interviews with Kim Kersey, Senior Vice President for Telecommunications, Jackson Energy Authority, November 21, 2006.

Jackson Energy while telephone and Internet services are directly available from other providers. Jackson Energy has also added other vertical serves such as remote data backup and other Information Technology (IT) services.

Population:	59,700
Households:	27,000 residential and 4,300 business premises
Median Household Income:	$33,194
Per Capita Income:	$18,495
Area:	49.5 square miles[106]

Governance: The Board of Directors of Jackson Energy Authority oversees and manages the water, wastewater, natural gas, propane gas, electrical, and broadband services. The five-person board is appointed by the mayor of Jackson and approved by the City Council, and each board member serves a five-year term. The Jackson Energy Authority operates as a stand-alone enterprise. Unlike many municipal utilities, Jackson Energy Authority operates under authorization of the State of Tennessee, rather than the city. This allows Jackson Energy Authority more flexibility in delivering services beyond the city limits.

Initiation Dates: Planning began in early 2002, included business plan development, design, legislative approvals, and obtaining financing. Construction started in January, 2004. Services include voice, video, and data.

Technology Deployed: The hardware vendor is Wave7 and the platform is active.

Business Model: The business plan is to offer retail services and to wholesale the network over an open platform. Video services are offered directly by Jackson Energy Authority and telephone and Internet services are wholesaled to qualified third party providers. The FTTP network is owned, operated, and maintained by Jackson Energy Authority. Back office support and service hosting are done by the retail provider.

Two providers offer retail telephone and Internet services. Aeneas Communications keeps a degree of separation while Cinergy Communications jointly markets the services with Jackson Energy. With Cinergy, Jackson Energy receives a commission for sales and marketing efforts. Back office support and service hosting are contracted with Cinergy Communications.

Economics: The anticipated life is 25 years for fiber, 20 years for field electronics, and 10 years for the cable television headend.

The breakeven point for cash flow is projected at year six or seven.

Financing: The system was financed through bonds primarily secured by Telecommunications Division revenues. The Telecommunications Division may borrow up to $34 Million from the Electric Division for debt service repayment. Any requirements beyond that are backed by city obligation.

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[106] 2000 Census, US Census Bureau American Fact Finder, http://factfinder.census.gov/home/saff/main.html?_lang=en, accessed December 22, 2006.

Additional Benefits: The FTTP network provides a foundation to support a variety of automation and customer contact needs for the range of utility service provided by the energy authority. In addition, Jackson Energy Authority is a leader in economic development efforts in the region. The broadband services enabled with the FTTP network are a key foundation for economic development efforts.

Service Offerings: Internet: Cinergy Communications offers asymmetrical 512 Kbps/256 Kbps, four Mbps/384 Kbps, six Mbps/512 Kbps, and 10 Mbps/1 Mbps ranging from $25 per month to $55 per month. Discounts are offered when video and telephone services are bundled.

Cable: Jackson Energy Authority offers a full range of analog, digital, premium, pay-for-view, and music channels. Jackson Energy offers all of its 290 channels in a digital simulcast format. Packages range for $16 per month for 24 channels to $52 per month for 128 channels. Eleven HDTV channels are available for an additional $6 per month, and all four premium channels are also available in high definition with subscription and HD converter.

Telephone: Cinergy Communications offers a range of packages from basic local service for $16 per month to full-feature service with unlimited long distance for $39.90 a month. Vertical services such as voicemail, email notification, and call forwarding are available for additional fees.

Homes Passed: 27,000 residential passings.

Residential Penetration: 12,800 cable customers today, of which 6,571 have Internet service and 5,192 have telephone service.

Businesses Passed: 4,300 business passings.

Business Penetration: 900 total business accounts, of which 650 have cable service; 419 have Internet service, and 303 have telephone service, all in various combinations.

Lessons Learned: Jackson Energy points to a number of lessons learned through its experience to date. First, it notes the advantages a municipal utility has in deploying and offering broadband, in part because customers generally have a high level of confidence and support for municipal utility providers. Second, Jackson Energy notes that working with service providers in an open access environment proved more difficult than anticipated, in part because administration and coordination became very complex where the outside providers are competitors. Jackson also notes that outside providers may have growth goals that do not align with the needs of the network

Another difficulty that Jackson notes about working with service providers is that those providers may not offer the same quality of customer service and technical support as the host network. The lower standards of these service providers can adversely impact customer confidence in the network.

Contribution margins would be greater if Jackson Energy was the retail provider for telephone and data service.

With respect to cable television, Jackson notes that programming costs are one of the highest expenses.

4.7 Reedsburg, Wisconsin

Reedsburg Utility Commission is a leader in municipal broadband offerings. Reedsburg was one of the first FTTP deployments in the country and has successfully defended municipal rights against legal attacks from AT&T and other providers.[107] Reedsburg was an earlier adopter of FTTP. The total implementation costs today would be lower, and vendor products are more mature and leverage more industry standards.

Population:	7,800
Households:	4,400
Median Household Income:	$39,152
Per Capita Income:	$18,828
Area:	5.2 square miles[108]

Governance: The Utility Commission oversees and manages the water, electrical and telecommunication utility. The five-person commission is appointed by the City Council, and each committee member serves a three-year term. The Utility Commission operates as a stand-alone enterprise. The city has also created a seven-person Broadband Communications Advisory Committee to provide guidance on business development and advancement of the communications utility.

Initiation Dates: Planning began in 1999 and implementation was phased. Reedsburg Utilities' first step towards a FTTP deployment was implementation of a fiber internal network that connected key Utility Commission assets and area schools. The second phase of the deployment was expansion of the fiber infrastructure to selected businesses and industrial parks. The third phase was the implementation of a FTTP network that supports voice, video, and data services.

Technology Deployed: The hardware vendor is Calix (formally OSI) and the platform is PON, with two fiber strands to each household, the first for voice and data, the second for video.

Business Model: The business model is retail. The network is owned, operated, and maintained by Reedsburg Utilities. Sales, marketing, back office support, and service hosting are done by Reedsburg Utilities.

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[107] Unless otherwise noted, all data in this case study is based on CTC's interviews with Dave Mikonowicz, General Manager, Reedsburg Utility Commission, November 14, 2006.

[108] 2000 Census, US Census Bureau American Fact Finder, http://factfinder.census.gov/home/saff/main.html?_lang=en, accessed December 22, 2006.

Economics: The anticipated life is 20 plus years. The breakeven point for cash flow was successfully reached in less than four years.

Financing: To finance the network, two bonds were issued: one was unsecured, the other was a revenue bond secured by electric and water utility revenues. To date, approximately $13 million in network and customer installation costs have been expended.

Additional Benefits: A key benefit of the network is economic development for retention and attraction of residents and businesses. At the time Reedsburg Utilities decided to pursue the FTTP network, no other high-speed alternatives existed in the community. Today, Reedsburg citizens and businesses have available and affordable connectivity services that far out-perform cable modem and DSL services.

Service Offerings: Internet: the system offers symmetrical services of 1 Mbps, five Mbps, and 10 Mbps ranging from $30 per month to $50 per month. A $5 per month discount is offered if subscriber also receives cable and telephone service. In addition, business customers have a variety of point-to-point connectivity options.

Cable: Reedsburg Utilities offers a full range of analog, digital, premium, pay-for-view, and music channels. Packages range from $14 per month for 18 channels to $51 per month for 100 channels.

Telephone: the network offers a range of packages including unlimited local service for $21.95 per month and unlimited and long-distance local calling for $39 per month.

Homes Passed: 4,400

Residential Penetration: Approximately 50 percent of homes passed subscribe to at least one voice, video, or data service.

Lessons Learned: Planning and detailed engineering is critical to avoid acquisition of material and equipment that is either not required or has early obsolescence.

Marketing plans are important; however need adjustment on the fly to meet changing market conditions and customer expectations.

Market entry timing is critical. If Reedsburg Utilities was to enter the marketplace today, cable television services might not be pursued due to the required payback time on the headend and the evolution of IP based video services.

Cable television is a difficult market for a small market because of the headend investments. Add-on services are also a challenge; Reedsburg Utilities have looked at Video-on-Demand, but feel they would need 5,000 subscribers to break-even (600 more than total homes passed).

Have back-up plans. Initially, Reedsburg Utilities partnered with a regional telephone company to deliver voice products. The partnership did not work out for a variety of

business philosophical reasons. As an alternative, Reedsburg Utilities acquired a soft-switch and is offering phone services without the partnership. Having a CLEC certification in-hand allowed Reedsburg Utilities to pursue the stand-alone option.

4.8 Brief Descriptions of Selected International FTTP Initiatives

The following are brief summaries of a few of the many municipal FTTP initiatives underway throughout the world. The activity in this area has been concentrated primarily in Europe and Asia.

4.8.1 Stockholm

Stockholm's municipal utility, StokAB, has operated a backbone fiber network for over a decade, as do more than 200 of Sweden's municipalities. In 2005, StokAB began extending its fiber-to-the-premises of approximately 100,000 social housing apartments, in a model that is expected to be followed throughout Sweden.

4.8.2 Denmark

The national electric utility in Denmark plans an FTTP buildout to nearly a million homes representing fully one-third of all Danish homes. The construction portion of the project is budgeted at 1.3 billion Euros.

4.8.3 Vienna

The City of Vienna's project, constructed and operated through its municipal utility, will bring open architecture FTTP to nearly a million households. The network will offer symmetrical connection speeds of up to 1 Gbps.

4.8.4 Paris

The French government has undertaken an ambitious national strategy to spur FTTP deployment throughout the country, providing financial incentives and affordable financing.

The City of Paris has embraced these FTTP goals and has announced a goal of fiber connectivity to 80 percent of buildings within the city by 2010. The city has also offered tax incentives to companies that install fiber in sewers and other city assets.[109]

The city is working with a local private entity to facilitate buildout of FTTP in Paris and surrounding areas. Provider Free plans to invest in excess of a billion Euros over the next

[109] "Old Networks Not Enough," Dugie Standeford, Communications Daily, November 6, 2006, pages 5-7.

six years, with the intention of passing four million homes with fiber in that time-period. Parts of the network are planned to be operational by second quarter 2007.[110]

Free's corporate parent, Iliad SA, announced the following products:

- Data: symmetrical upload/download speeds of 50 mbps, with unlimited use
- Voice: unlimited voice calls to fixed lines in France and 28 countries
- Video: 40 channels including some high definition channels[111]

This package will be offered at a monthly fee of around 30 Euros. [112]

Iliad also plans to lease capacity to competitors in an open manner. The company has represented that it believes it can recoup its construction costs in approximately four years, assuming market share of 25 percent and approximate revenue per user of 33.50 Euros per month. [113]

The City of Paris has also released an RFP for city-wide wireless service. Responses to the RFP are pending as of the date of this Report.

4.8.5 Cologne

NetCologne is a competitive FTTP network developed as an alternative to incumbent Deutsche Telekom by the subsidiary of a local gas and electric utility partially owned by the City of Cologne. While the city does not own the network, it does own a portion of the parent utility. The network began construction in July 2006 and anticipates providing service to its first customers shortly.[114]

4.8.6 Brisbane

The Australian state of Queensland recently announced an FTTP plan to spend A$550 million to deploy FTTP to the state's largest city, Brisbane. The state plans for government ownership of the network, which will be put out to tender. Minimum speeds are envisioned at 100 mbps.[115]

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[110] CTC interview of Tony Perez, Director, Office of Broadband, City of Seattle, October 5, 2006; "What Seattle Learned in Europe," eNATOA Community Broadband Seminar presentation, Tony Perez, Director, Office of Broadband, City of Seattle, November 20, 2006.
[111] Ibid.
[112] Ibid.
[113] Ibid.
[114] "Old Networks Not Enough," Dugie Standeford, Communications Daily, November 6, 2006, pages 5-7.
[115] Emma Alberici, "Qld plans for super fast broadband," Australian Broadcast Corporation transcript, October 24, 2006, http://www.abc.net.au/pm/content/2006/s1772689.htm, accessed December 4, 2006.

Appendix 1: See Phase 2 Business Case for a Community Fiber Network, Uptown Services, LLC

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Appendix 2: Statement of Portland Development Commission in Support of Community Fiber Network

The Portland Development Commission (PDC) has been pleased to participate in the Phase 1 and Phase 2 studies examining the potential of a Fiber to the Premises (FTTP) network available to Portland homes and businesses.

As PDC has previously testified to the Council, the economic benefits to the City of an FTTP network could be significant. By bringing world-class high speed broadband access to small businesses and residents, progressive options such as telework, telemedicine, e-learning, e-commerce and access to information from all over the world is facilitated. Moreover, a citywide FTTP system means that every household and business could have more affordable choices to address their communication needs.

To reiterate what PDC told the Council in connection with the Phase 1 study:

- Portland Businesses Demand High Speed Broadband Services
- Broadband infrastructure serves PDC's identified target industries
- Local Companies Rely on Broadband Services for Day-To-Day Business Needs

PDC's Economic Development Strategy for the City of Portland since 2002 has recommended that "The City should support, with investment if necessary, continued expansion of state-of-the-art communications technologies for Portland businesses"

PDC's target industries include drivers of the knowledge economy such as high tech and creative services, as well as more traditional manufacturing industries. All these businesses require cutting edge communications technologies to enhance productivity and maintain competitiveness. This is something PDC heard clearly when developing our economic development strategy for the City of Portland, which included input from some 300 local businesses. One of the recommendations that came out of that process was for the City to "support … continued expansion of state-of-the-art communications technologies for Portland businesses."

There are many ways in which businesses can benefit from high speed broadband capabilities and offer innovative services to Portland resident, including:

- Telework
- Call Centers
- Tele-Medicine or Tele-Health
- Tele-Education or E-Learning
- Video Conferencing

Finally, we know from a number of studies that communities with mass-market broadband services are seeing more rapid grow in employment, new businesses, and businesses in the IT sector than comparable communities widely-available broadband services. Many companies, including high tech manufacturers, now consider availability of broadband services a prerequisite to site selection. Intel, for example, maintains a list of prerequisites when choosing a site in the US or abroad that includes extensive broadband capacity

So the evidence that broadband availability promotes economic development remains compelling, with demonstrable benefits including:

- Growth in new businesses and jobs, particularly in the IT sector;
- Higher residential property values; and
- Critical to Company Site Selection

In conclusion, adequate communications infrastructure remains a vital component of any business development plan. High Tech industries rely heavily on access to high-bandwidth, high-capacity Internet access. Participants in the global marketplace cannot survive without robust, reliable communications infrastructure.