MEMORANDUM

TO: **UTILITY ADVISORY COMMISSION**

FROM: **UTILITIES DEPARTMENT**

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DATE: **DECEMBER 1, 2010**

SUBJECT: **Update on the Development of a Business Plan for the Citywide Ultra High-Speed Broadband System Project and an Overview of Telecommunications Industry Market Factors Affecting Municipal Broadband**

SUMMARY

The purpose of this report is to provide information to the Utilities Advisory Commission (UAC) about the development of a business plan for the Citywide Ultra High-Speed Broadband System Project (Broadband System Project). This information will allow the UAC to provide feedback to staff about the components of the plan.

An appendix is attached to this report which provides information regarding the various business models for municipal broadband projects and market factors in the telecommunications industry that need to be considered if there is a renewed effort to develop a rationale to pursue fiber-to-the-premise (FTTP) options as the ultimate goal of the Broadband System Project. For the purposes of this report, the FTTP acronym will be used to describe fiber connections to homes and businesses.

BACKGROUND

On June 14, 2010, staff provided the City Council with an Informational Report (CMR: 265:10) about the anticipated components of a business plan for the Broadband System Project. The purpose of the business plan is to respond to the Council's directive to explore the use of the Fiber Optics Fund reserves to independently proceed with a phased build-out of the existing fiber backbone to achieve the City's vision of a "universally fiber-connected City."

The City of Palo Alto Utilities (CPAU) Fiber Optics system comprises a 41-mile "dark fiber optics backbone ring" within Palo Alto, to which individual customers are connected via fiber optics "service connections." This network is licensed to companies providing telecommunications services to citizens and businesses in Palo Alto, and to local firms involved in a variety of enterprises such as e-commerce, computer software, education, defense, financial services, legal, medical, multi-media, research and development, social networking and web search. Fiber service connections also support the communication needs of utility infrastructure, information technology systems for City departments at multiple facilities, and other critical municipal infrastructure such as traffic signals.

A capital project exists to extend the dark fiber network around Palo Alto. Included in the project are increases in system capacity, development of fiber sub-rings, and general improvements to

the fiber system. This project promotes the formation of a competitive market for telecommunications in Palo Alto, while limiting the negative impacts on Palo Alto's environment by using pre-existing conduit and poles. A second capital project provides funds for the installation of fiber optic infrastructure for new service connections. New customers licensing dark fiber pay the construction fees required to connect to the fiber optics backbone.

Utility staff monitors the reliability of the fiber network, makes any necessary repairs, and works to increase system utilization and revenues. By providing reliable and competitively priced fiber optic services to commercial customers, the City's economic development efforts are supported with an essential tool for business attraction and retention.

The Fiber Optics Enterprise Fund has been created and this fund has fully repaid the initial loan and operating expenses which were taken from the Electric Enterprise Fund to design and build the dark fiber ring servicing the City. A Fiber Optics Enterprise Fund Rate Stabilization Reserve (RSR) was established in fiscal year 2009 with guidelines for minimum and maximum reserve levels. The Fiber Optics RSR level is projected to be $9.0 million for Fiscal Year 2011. These levels are above the RSR maximum guideline level of $1.5 million for Fiscal Year 2011.

CPAU currently licenses 173 dark fiber service connections to 59 customers (54 commercial and 5 governmental). For fiscal year 2011, projected gross revenues for dark fiber backbone licensing fees ("license fees") are approximately $3.0 million.

As a percentage of gross revenues, the 54 commercial customers account for approximately 73 percent of annual license fee revenues. Among the 54 commercial customers, 10 are classified as "resellers." The definition of a reseller is a broadband service provider that does not own transmission facilities, but licenses dark fiber for the purpose of selling telecommunication services to the public for profit. Reseller customers account for approximately 42 percent of annual gross revenues. Governmental customers account for approximately 27 percent of annual gross revenues.

Staff continues to evaluate the utilization of Fiber Optics Fund reserves to independently proceed with a phased build-out of the existing backbone. To that end, a business plan is being developed for the Broadband System Project.

The components of the business plan outlined in the June 2010 Informational Report to the Council included: (1) an assessment of potential fiber backbone extensions; (2) a conceptual proposal for fiber-to-the-premise deployment; (3) providing dark fiber service connections to Palo Alto Unified School District facilities; and (4) coordination of the Broadband System Project business plan with the development of the Smart Grid Strategic Plan. These four components of the plan are described below:

1. **Assessment of Fiber Backbone Extensions**:

The business plan will include an assessment of potential extensions of the fiber backbone to increase dark fiber license fees and expand the presence of fiber infrastructure in the community. This component of the business plan will be based on market research measuring additional demand for dark fiber service connections within the commercial market in Palo Alto. This market research will also evaluate the demand for commercial retail broadband services and provide an analysis regarding the future market position of the City's dark fiber optics backbone

ring as compared to other available telecommunication service providers in Palo Alto. Other options to leverage the fiber backbone for revenue generating opportunities will also be evaluated.

2. Conceptual Plan for FTTP

The business plan will include a conceptual plan to extend the fiber backbone deeper into the community as a means of providing an inducement for a private party network builder to form a partnership with the City to design, build and operate a citywide open access FTTP network. This open access network would allow multiple broadband service providers, on a non-discriminatory basis, to have access to the network under competitively neutral terms and conditions and sell services on a wholesale basis.

In a public-private partnership model - also known as the "Infrastructure Participation Model"- the City makes available to a private sector entity, for license/lease, selected assets (e.g., dark fiber strands, rights-of-way, spare conduit and other facilities), that will enable the private entity to more efficiently and expeditiously build and operate a network. The conditions of a partnership agreement between the City and a private network builder would be based on minimizing financial risk to the City and provide eventual City ownership of the network. There would be no upfront capital investment required from the City for the network design, construction and operation.

Under this public-private model a municipality can assist in encouraging a private party to install FTTP by facilitating access to rights-of-way, pole attachments, conduits and reducing make-ready costs. Making municipal facilities and infrastructure available may help encourage a private investment. This is a relatively low-risk approach for the City to facilitate FTTP, but there is some risk associated with regulatory and security concerns. Another significant risk in pursuing this public-private partnership approach to deploy FTTP is the possibility that qualified private network builders would not respond to a Request for Proposal if there is another attempt by the City to follow this approach.

The primary objective of this conceptual plan for FTTP is to identify incremental steps the City can pursue to expand the presence of its fiber asset in the community by investing money accumulated in the Fiber Optics Fund reserve. This additional investment in the fiber asset would have two purposes:

1. Increase the value of the network as a means of developing a viable platform to attract a private network builder to partner with the City to build and operate a FTTP network in Palo Alto; and,
2. Expand the fiber backbone to provide greater access by the commercial market to dark fiber service connections and associated telecommunication services. This expansion of the fiber backbone would generate additional dark fiber license revenues that would increase the Fiber Optics Fund reserve. A larger reserve could possibly be used to make further investments in the existing backbone infrastructure and create an attractive scenario for a private investor to facilitate the deployment of a citywide FTTP network. If viable FTTP partnership opportunities were unavailable, other innovative options to invest the reserve in the existing fiber asset could be explored (e.g. building a Wi-Fi network for public use, to support municipal communication and to support future Smart Meter and Smart Grid deployment).

3. PAUSD Dark Fiber Service Connections

To further the expansion of the fiber backbone, discussions are in progress with the Palo Alto Unified School District (PAUSD) to provide dark fiber service connections to 17 schools and the district office. These dark fiber service connections would replace the Institutional Network (I-Net) currently provided to the school district by Comcast. PAUSD has provided CPAU with a Letter of Intent requesting an advanced engineering study to determine the construction and installation costs to extend fiber service connections to district facilities, in addition to an estimate of the monthly recurring license fees for dark fiber service connections.

4. Smart Grid Strategic Plan

Coordinate the development of the Broadband System Project business plan with the development of the Smart Grid Strategic Plan as it relates to evaluating the communication infrastructure required to enable Smart Meters and a Smart Grid network in the future.

Staff is working with Tellus Venture Associates to conduct market research to evaluate additional commercial demand for dark fiber service connections. Tellus Venture Associates specializes in management, technical and business development for community broadband projects, including creating and implementing fundable business plans. Tellus Venture Associates has experience in primary market research to determine demand and community support for a variety of municipal broadband projects. The scope of work for Tellus Venture Associates includes:

1. Graphic and tabular data regarding dark fiber market potential;
2. Dark fiber market analysis;
3. Assessment of existing and potential services offered to dark fiber customers;
4. Assessment of the City's current market positioning, including brand equity;
5. Cost-benefit analysis of dark fiber market extension;
6. Cost-benefit analysis of commercial retail service options;
7. Case study benchmark analysis of retail service options;
8. Final report, including findings and recommendations;
9. Presentation of findings and recommendations.

The expected outcome for this market research is to identify commercial and industrial areas within Palo Alto where there is concentrated demand for dark fiber service connections. This research will guide the identification of prospective Capital Improvement Projects to extend the fiber backbone, in addition to identifying commercial multi-tenant buildings that could be pre-wired with dark fiber service connections to support business retention, business attraction and economic development efforts in Palo Alto that would be enhanced by robust fiber infrastructure. Some of these commercial and industrial areas may be at a significant distance from the fiber backbone splice points that make an extension to a particular premise cost prohibitive for a business that needs, but cannot afford, dark fiber service connections to improve their access to telecommunication services.

To develop the Smart Grid Strategic Plan, staff is working with EnerNex Corporation. A component of the scope of work for the strategic plan is to do an evaluation of communication system approaches to deploy Smart Meters and Smart Grid Networks. This evaluation will look at existing fiber communications infrastructure and where wireless communications could be deployed on that network to implement Smart Meters and Smart Grid. The deployment of Smart Meters is considered a viable initial step in implementation of the Smart Grid. There are several

communication "backhaul" platforms to deploy Smart Meters and Smart Grid. Backhaul is a term used to describe the transmission of customer usage data from a collection point back to a central point or network backbone.

A FTTP network can be used for a Smart Meter backhaul platform and for a Smart Grid network; however, it is difficult to justify the cost because most Smart Grid applications do not require high bandwidth capacity. More practical and economical communication platforms for Smart Meters and Smart Grid implementations include:

1. Wide Area Network (WAN) Wi-Fi combined with a wireless mesh network which could augment the base AMI system. This WAN Wi-Fi network platform could also be used for public safety, public works and citywide public access. Citywide public access, public safety and public works traffic could flow through the same network as Smart Meter data and use the same communications path. Public access, public safety, public works and Smart Meter data would be transmitted to the WAN devices which in turn will connect to the existing traffic hubs currently connected to the existing utility fiber network.
2. Outsourcing the communication backhaul platform over a third-party cellular carrier using 3G technologies, or emerging 4G Wi-MAX technology. 4G is the short name for fourth-generation wireless, the next stage of broadband mobile communications that will progressively supersede third generation (3G) wireless technology.

To assist in the preparation of the Broadband System Project business plan, staff is working with a telecommunications engineering firm (Columbia Telecommunications Corporation – CTC). CTC has provided telecommunications engineering consulting services to the City for several years.

CTC's scope of work for the business plan is as follows:

1. Evaluate the feasibility of using the existing fiber backbone and CPAU facilities such as electric substations for telecommunications related revenue generating opportunities. For example, use CPAU facilities to locate wireless access points for collocation of third party communication infrastructure such as antennas for wireless services that require fiber for communication backhaul purposes.
2. Develop a conceptual network design and deployment strategy for the purpose of expanding the fiber asset to create a citywide FTTP service area. This network design would evaluate using each electric substation as a distribution point to expand the presence of the fiber beyond the existing ring infrastructure and identify strategically positioned network access locations to connect residential premises with fiber. Under this concept, the nine substations may provide optimal locations as prospective handoff points for FTTP deployment. Network access points would be constructed in a way that is secure and independent of power utility plant and accessible to a potential private partner. The substations are well distributed in the community. At these sites the network owner and service providers could be provided with full accommodations. These accommodations include: fiber access, bulk rate commercial power, and where feasible, mount equipment to interface with the fiber ring and termination equipment to connect FTTP feed lines. To develop cost estimates and specifications for a suggested interface arrangement at a typical substation, a Request for information (RFI) may be issued to acquire this information from potential partners.
3. Provide engineering support for the extension of dark fiber service connections to PAUSD facilities.

4. Evaluate fiber capacity and facilities to accommodate Smart Meters and Smart Grid communication approaches recommended in the Smart Grid Strategic Plan.
5. Identify potential options to pursue FTTP including an evaluation of business models and new developments in technology for FTTP deployment.

DISCUSSION

In response to the Council's directive to explore the use of the Fiber Optics Fund reserves to independently proceed with a phased build-out of the existing fiber backbone, it is important to re-examine the various business models used by municipalities to provide FTTP, in addition to understanding the rapidly changing competitive landscape for the delivery of telecommunication services. With bandwidth consumption rising, evolving broadband network architectures and shifting market forces, the telecommunication industry is very complex. A business plan for an open access FTTP network in an urban market competing against multiple broadband providers needs to be carefully evaluated in terms of the feasibility of attracting enough customers to provide an acceptable return on investment to build the network.

The delivery of telecommunication services is a highly competitive enterprise. The industry is dominated by a few large companies, especially in urban areas of the country. Many of the existing municipal broadband providers continue to succeed in their communities; however, others are under increasing pressure to remain financially viable against the multiple options available for broadband connectivity, more aggressive competitive strategies from the incumbent carriers (i.e. regional bell operating companies and cable TV companies) and evolving technology that may disrupt business plans that appeared to be sustainable only a few years ago.

The goal of the Broadband System Project business plan is to define practical, incremental, low-risk options to fully leverage the existing fiber backbone asset and determine if these options provide new opportunities for the City to pursue an open access FTTP operating model that would be attractive to a potential private partner willing to invest in a network in Palo Alto. This network and associated service providers would be an alternative to the broadband and multichannel video services provided by AT&T, Comcast and competitive local exchange carriers (CLEC), in addition to the satellite services (DirecTV and DISH Network).

Attached to this report is an appendix which describes the status of municipal FTTP projects, business models for municipal broadband, technology deployed to provision broadband services, emerging new applications delivered over broadband networks, changes in the competitive landscape and consumer trends in the telecommunications industry.

NEXT STEPS

Staff anticipates providing the final Broadband System Project business plan to the City Council in March 2011. To do so, staff plans to complete the following steps:

1. December 2010: analyze the market research provided by Tellus Venture Associates.
2. December 2010 and January 2011: complete the engineering work provided by Columbia Telecommunications Corporation and link this work to the research findings provided by Tellus Venture Associates and the evaluation of communication infrastructure provided by EnerNex Corporation for the Smart Grid Strategic Plan.
3. February 2011: Provide a draft business plan to the UAC for review and discussion.

ATTACHMENT:
Appendix A: Overview of Telecommunications Industry Market Factors Affecting Municipal Broadband

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APPENDIX A

Overview of Telecommunications Industry Market Factors Affecting Municipal Broadband:

There are numerous "cautionary tales" about municipalities involved in projects to build fiber networks and deliver broadband services on a competitive basis. The selection of an appropriate business model by a municipality to build a financially sustainable FTTP network is critical. It is even more critical for municipal FTTP projects located in metropolitan areas where the incumbent carriers are engaged in fierce competition for market share which may make it difficult for a small community-based network to enter the market and acquire enough customers for an adequate return on investment.

Future challenges related to the increasingly competitive telecommunications landscape are primarily related to rapidly changing market conditions, evolving Internet Protocol (IP) technologies, the development of advanced applications delivered over high-capacity "Next Generation Access" (NGA) fiber-based networks and the migration of access to broadband services from wire-based to wireless delivery platforms. These changing market conditions may disrupt the long established facilities-based business models broadband service providers are using to deliver voice, video and data services, commonly known as the "triple-play" (voice, video and data) or "quad-play" if mobile phones are part of the service package.

Mobile broadband access isn't a niche service anymore – it's a mainstream way for "on-the-go" consumers to access broadband services. Facilities-based delivery of broadband over all-fiber networks is the preferred communication architecture to deliver voice, video and data services, but services and applications delivered over wireless platforms (which depend on fiber networks for backhaul communication purposes) will be increasingly important, especially to the younger demographic of consumers that do not want or need a monthly subscription to the traditional triple-play or quad-play combination of services. It's important to note that wireless communications is not separate from wire-based communications. Most wireless communication rides over wired networks at some point, so both platforms are co-dependent on the other and play an integral role in the expansion of fixed and mobile broadband services.

An article published in the June 2010 edition of Broadband Properties magazine ("*The Resurgence of Municipal Fiber*") reports that since 2008, the number of municipal FTTP systems in the United States has risen to 88 from 66, an increase of 25 percent. These new systems use a variety of business models and provide an assortment of commercial and residential broadband services. Supporters of municipal broadband projects view these systems as essential infrastructure for a community's long-term economic survival and by opponents as evidence of government overreaching by entering into a business best left to the incumbent carriers and other private-sector telecom companies due to the high level of financial risk for the community and the ever-changing competitive landscape.

Municipal FTTP broadband projects launched in recent years are generally located in communities underserved by the incumbent carriers and have unique market conditions and changing local economies that make a strong business case for an alternative public or private broadband provider, commonly known as "overbuilders." Some of these projects include a

partnership of public and private entities willing to provide broadband access to underserved communities. Most municipal FTTP networks are located in small to mid-sized cities or groups of cities outside major metropolitan areas that are underserved by the incumbent carriers.

In March 2010, the Federal Communications Commission's (FCC) released its National Broadband Plan. A fundamental goal of the plan is to ensure that every American has "access to broadband capability", especially in areas of the country that are "underserved" or "unserved" by incumbent providers. The federal broadband stimulus program (part of the American Recovery and Reinvestment Act of 2009) allocated $7.2 billion to advance "complete broadband and wireless Internet access nationwide." This broadband stimulus program is a significant first step towards advancing the FCC's plan. The "key purposes" criteria for a project to qualify for a federal broadband stimulus grant required the applicant to prove that the project would help to connect populations underserved by broadband providers, especially community anchor institutions such as community colleges, public schools, hospitals, and other organizations that serve the greater community. Under the key purposes criteria, Palo Alto did not meet the definition of an "underserved community" due to the various locally available broadband service options; therefore, the City did not submit an application for a stimulus grant for a "last mile" fiber-to-the-premise network that would primarily serve a residential population with sufficient access to broadband services.

Generally, the grants awarded under the federal broadband stimulus program were for large regional fiber networks under the "Comprehensive Community Infrastructure" project category. These projects involve partnerships between public and private entities building multi-jurisdictional "middle mile" networks serving community anchor institutions in areas underserved or unserved by the incumbent carriers. Middle mile is a term used to describe network connections between the last mile and the greater Internet. Some of these networks were already in place and stimulus money was awarded to further extend the footprint of the network. For instance, in rural areas of the country, the middle mile network would connect a town's network to a larger metropolitan area where it interconnects with major carriers. In more rural areas of the country, the federal broadband stimulus program awarded grants and loans to several municipal and private "last mile" FTTP projects in underserved or unserved communities.

In addition to the municipal FTTP systems cited in the Broadband Properties article, more than 100 municipalities continue to offer competitive retail residential and commercial broadband services using last generation fiber-to-the-node (FTTN) network architecture, in addition to deploying wireless networks using Wi-Fi, Wi-MAX and other wireless technologies.

FTTN networks use hybrid fiber-coax/copper (HFC) architecture. Most municipal networks with FTTN architecture continue to effectively serve and compete against the incumbent carriers in their communities, but like the incumbents they are under increasing competitive pressures to upgrade their networks to address rising consumer bandwidth consumption for advanced broadband services and next generation applications. These constant increases in bandwidth consumption will in time necessitate costly upgrades from FTTN network architecture to FTTP network architecture to facilitate the efficient delivery of these services.

Nationwide, FTTN is still the most widely deployed architecture by all public and private network owners for delivery of broadband services and will be for the foreseeable future due to

the considerable investments made in building these networks. The large incumbent carriers (with the exception of Verizon FIOS fiber-to-the-home service) will continue to fully leverage their FTTN networks to deliver broadband services. In the short-term, as consumer bandwidth consumption grows, FTTN networks will be upgraded with supplemental technologies to ensure greater bandwidth capacities. The race to provide symmetrical 100 megabits per second (Mbps) high-speed Internet service at an affordable cost to both the provider and customer has become a major initiative in the broadband service market; nonetheless, migration to ubiquitous FTTP networks is still several years away except in "greenfield" master plan community projects where FTTP is now an economical solution.

The costs to build a new FTTP network have steadily decreased. Costs are based on several factors whose investment requirements vary based on multiple factors such as local topography, household density, linear distance between households, homes per optical node, and the mix of aerial and underground plant construction. Projected customer "take-rates" are also a significant factor in determining the average construction cost to pass each home. Take-rate is defined as the percentage of potential subscribers who are offered service that actually do subscribe. Municipalities that own and operate utilities and plan to build FTTP networks have an inherent cost advantage, since they already own the rights-of-way, poles, towers and conduits. Fiber optic cables can be deployed alongside power lines much more economically than private companies trying to build FTTP networks from scratch.

Unlike Asia and Europe, in the U.S. there are few homes and businesses with access to all-fiber networks. A combination of population density, higher economic density (dollars per square mile) and better competition allows countries like Japan, South Korea and Sweden to routinely provision broadband services over their fiber networks at a minimum of 100 megabits per second (Mbps) Internet access at affordable rates for the average consumer.

The number of households with access to FTTP networks is slowly growing in the U.S. According to a market research study issued by the Fiber-to-the-Home Council in April 2010, public and private fiber-to-the-home (FTTH) systems now reach nearly 16 percent penetration of U.S. households in terms of homes passed, and 5% in terms of homes connected. It should be noted that Verizon FIOS service (projected to pass 18 million homes by the end of 2011) is part of this penetration percentage cited by the Fiber-to-the-Home Council. Earlier this year Verizon decided to pull back on its plans to expand FIOS in operating areas where construction had not begun - about 30 percent of their operating territory. Instead, Verizon plans to concentrate on expanding its customer base in areas currently under construction or totally built-out. In several markets, FIOS service has not met Verizon's customer acquisition goals to provide a satisfactory return on investment.

In Palo Alto, AT&T U-Verse provides broadband Internet access, TV, and phone. U-Verse is part of AT&T's *Project Lightspeed* broadband initiative and is in direct competition with Comcast and other broadband and multichannel providers. AT&T uses FTTN network architecture. In new residential subdivisions AT&T is deploying FTTP. U-Verse is available to more than 20 million homes in 22 states.

From the early planning stages, municipal broadband projects typically encounter strong opposition from the incumbent carriers, in addition to opposition from citizens and taxpayer groups that believe a municipality should not enter the ultra-competitive broadband business.

Some municipal projects that began construction of their networks in the last few years were caught up in protracted litigation before the network build-out moved forward. Litigation or the threat of litigation was used as a scare tactic by the incumbent carriers to stall municipal competition, or as a ploy to create enough uncertainty to cause the municipality to shelve the project altogether.

In some communities where municipalities are evaluating broadband business models, the incumbent carriers reacted to the threat of municipal or private overbuilder competition and initiated system upgrades or system rebuilds to preempt community concerns that poor service with second-rate technology would continue. The incumbent carriers also initiated more aggressive marketing campaigns, stronger product offerings and improved customer service after these system upgrades were implemented.

Despite several new municipal FTTP projects in the last two years, communities considering building FTTP networks have begun to question whether the delivery of conventional triple-play services offer sufficient economic justification for a FTTP overbuild, especially in markets where there are dominant incumbent carriers with well-established customer penetrations. A key concern is that the incumbent carriers have an inherent scale advantage against small public and private FTTP overbuilders, which allows them to price below cost in overbuild markets because the profits from nearby non-competitive markets they operate in can temporarily subsidize losses.

To deter customer acquisition efforts by FTTP overbuilders, incumbent carriers typically engage in sustained discount and/or promotional pricing that is difficult for a new market entrant to match on an ongoing basis. The incumbent carrier simply spreads the operating loss in that competitive market to surrounding communities where they operate. The incumbents selective under-pricing of service offerings in an overbuild market may be viewed as anti-competitive, or even a form predatory pricing, but it is an established practice and proves to be an effective retention tool to keep customers from switching to fiber network providers.

Consumer demand for the voice, video and data components of the traditional facilities-based triple-play offerings is rapidly changing. For example, many consumers are permanently disconnecting analog and digital landline telephones as they begin to rely exclusively on their cellular or smart phones for voice communication and mobile broadband connectivity; or they use attractively priced Voice-over-Internet Protocol (VoIP) services such as Vonage, or peer-to-peer software applications like Skype that allows end users to make voice calls over the Internet.

Facilities-based triple-play service bundles are increasingly perceived by consumers to have less value, despite the attractive pricing they receive for buying bundles of voice, video and data services. As wireless networks migrate from 3G to 4G platforms, consumer demand for reasonably priced mobile broadband connectivity and associated applications will increase.

Another factor affecting broadband service providers is the emerging “cord-cutting” trend where consumers are cancelling their multichannel subscriptions from cable, satellite and telco TV services. In turn, consumers are beginning to access video content from “over-the-top” (OTT) or Internet Protocol TV (IPTV) services which stream movies and shows from the web directly to their TV. This emerging trend toward web-delivered streaming video services will gradually change the way consumers access and view video content, shifting traditional television viewing

to à la carte delivery platforms accessed via the web from Internet-TV appliances available from Apple TV and Google TV, and other IP-delivered services (e.g. NetFlix).

The incumbent carriers acknowledge this progression in IP-based video technology and changes in consumer TV viewing habits and the threat posed to their business models that are based on providing packages of multichannel services, in addition to voice and high-speed Internet access. They are already working to form partnerships with these OTT companies to integrate their networks with these services. OTT services will need to deliver content over the networks of the incumbent carriers and the competitive overbuilders, in addition to acquiring access to the video content the incumbent carriers often own – particularly the cable TV companies that have made large investments in cable networks.

As a competitive response, ownership and licensing of video content will become more important to the large cable companies. These companies (e.g. Comcast, Cablevision and Time Warner) already have significant ownership positions in cable TV networks, web-based video services and partnerships with wireless companies. To further enhance customer retention, the incumbent carriers are rolling-out new product innovations such as applications for electronic tablets, smart phones and deploying Wi-Fi hotspots in public places. The old axiom in the telecommunications industry continues to be true in terms of customer retention and improving revenues: "it's about the bundle." The incumbent carriers are beginning to redefine the components of the bundle to preempt the erosion of their customer base and they will make the necessary network upgrades to accommodate escalating bandwidth demands for enhanced services that go beyond the traditional triple-play services. Improving the value of the broadband service bundle will be the key to future customer retention and growth for all broadband service providers.

The primary example of the "vertical integration" of content and distribution platforms is Comcast's imminent plans to buy a controlling interest in entertainment giant NBC Universal, Inc. Comcast already owns a significant number of cable networks, and has a minority ownership stake in a number of others. Vertical integration of the ownership of the content and distribution of that content by the large cable TV companies is a long-term survival strategy and strengthens customer retention by linking multiple services into packages that will go beyond the standard triple-play offering.

Telecommunication industry analysts contend that small all-fiber network operators (especially municipal overbuilders) providing residential and commercial triple-play services over open or closed networks need to adjust their business model which is outdated and based on essentially selling bandwidth in increments. To fully leverage the value of their networks to prevent customer losses, private and municipal FTTP overbuilders are working to identify so-called "next generation apps" or "killer apps" which are bandwidth intensive and will require robust FTTP networks that have symmetrical bi-directional throughput for the delivery of rich interactive applications. Growing consumer demand for these apps will eventually provide significant new revenue streams to fiber network owners that have plenty of bandwidth to accommodate these services and provide a competitive advantage over the bandwidth-constrained incumbent networks. These emerging apps are viewed by analysts as the primary justification for building FTTP networks - especially open access networks - that will provide the end user with reasonably priced access to a variety of applications requiring high bandwidth capabilities.

FTTP network owners are pursuing partnerships with the developers of these next generation apps in order to fully leverage the value of their networks and to avoid the continuous triple-play commodity price wars with the incumbent carriers, which are considered to be an antiquated business model and a race to the bottom. These FTTP networks are also well-positioned to provide business class broadband services in the commercial market.

Bandwidth intensive apps delivered over all-fiber networks offering affordable symmetrical ultra high-speed service connections with low latency would not only provide new revenue streams to FTTP network owners, but would differentiate them from other broadband service providers wedded to providing traditional triple-play services over FTTN networks. Examples of applications requiring large amounts of bandwidth capacity for efficient service delivery are virtual private networks (VPNs) for business and home based work, telecommuting, telemedicine and telehealth services, K-12 and higher education distance learning, business and personal real time two-way video conferencing, telepresence video conferencing, interactive gaming, remote data storage and retrieval, and whole-home automation, monitoring and security.

Internet traffic is growing exponentially as businesses and institutions process large amounts of data and consumers stream standard-definition and high-definition video, share high-resolution photos and participate in online gaming. Today's FTTN networks won't be able to provide the speed and bandwidth required for applications like streaming video, cloud computing and distributed data storage at an affordable price. Access to these emerging next generation apps delivered over high-bandwidth broadband networks require subscriptions to expensive ultra high-speed service tiers of 50 megabits per second (Mbps), 100 Mbps, or even 1 gigabits per second (Gbps); however, the prices charged by the incumbent carriers for these speedy high-bandwidth service tiers are generally prohibitive for most end users, especially for the residential customer or small business that needs these Internet speeds, but cannot afford them.

Google's *Fiber for Communities* initiative, which plans to experiment with new fiber optic technologies and new deployment techniques in one or more trial locations in the U.S., is expected to provide symmetrical 1 Gbps fiber-to-the-home connection, at a competitive price. Although Google does not plan to be a national network owner, their primary goal is to prove high-capacity "open access" fiber networks with affordable prices are feasible and will accelerate broadband deployment in the U.S. and spur competition to deliver next generation apps. As noted earlier, the availability of all-fiber networks in the U.S. is significantly behind as compared to Asia and Europe, resulting in the U.S. ranking 16th in the world in average connection speeds (source: Akamai Broadband Survey, October 2010). As a consequence, affordable access to next generation apps will be hindered if the delivery platforms are bandwidth-constrained networks from the incumbent carriers.

Business Models

This report will provide a summary of the three basic business models used by municipal broadband providers and outline the issues faced by communities developing business cases to build all-fiber networks to provision services to homes and businesses. There is no standard model for municipal broadband networks. Municipalities build fiber networks for a number of different reasons which include the support of internal communication infrastructure, economic development opportunities, changing local economies, and as a response to the legacy of poor performance records by the incumbent carriers who are slow to initiate network upgrades.

Municipal broadband projects face a number of legal and competitive barriers, use several different financing approaches, engage private-sector companies, operate networks offering an assortment of services and bring varying skill sets to the projects. Local differences appear to far outweigh the simple fact of public ownership.

There are basically three business models for municipalities to provision open access wholesale and closed access retail broadband services to residential and business users over community fiber networks. Each model has advantages and disadvantages. A municipality pursuing deployment of FTTP infrastructure must fully evaluate which model would work best in their community before pursuing a business plan.

The three models for municipal broadband projects are:

1. The ***"open access"*** network model, where the network owner treats the network as a common carrier, like public roads. The advocates of open access networks believe that services should be the focus of competition, not infrastructure – especially as technology has separated the services from the infrastructure.

   Open access networks invite multiple independent broadband service providers on the network to compete for residential and commercial customers on the basis of service quality and price. With the open access model, the network owner does not collect revenues that would come from operating the network on a closed basis directly provisioning retail broadband services. The network owner generates revenues by collecting network transport fees paid by the independent service providers. Depending on regulatory constraints, the open access network owner may or may not offer retail services directly, but would attempt to attract a variety of independent service providers to market their services to potential residential and business customers. The common term for this organizational arrangement under the open access model is "structural separation" of the network.

   As a practical matter, few communities in the U.S. have used the open access model for delivery of broadband services over all-fiber networks, and several that used the model face significant challenges to make the network financially viable. The municipal open access network model is typically used if there are regulatory constraints that prevent the network owner from directly provisioning retail broadband services.

   The primary reason open access networks have difficulty succeeding in the U.S. is due to the inconsistency in how much revenue is generated compared to when the network owner controls all aspects of the network. Unlike Asia and Europe, where the open access model is supported by national governments with favorable regulatory frameworks and subsidies, municipal open access networks in the U.S. have struggled to generate sufficient revenues. In simple terms, open access networks and their service providers have often been unable to acquire sufficient numbers of customers to generate enough revenues to payoff the debt required to build the network.

   A fundamental problem in deploying the open access network model is the lack of independent broadband providers capable of competing against the incumbent providers. As a result, without an adequate number of service providers on the network, it is unlikely customers will be acquired quickly enough to satisfy the network owner's debt

obligation. Moreover, under the open access network model, participating service providers may have a tendency to "cherry-pick" potential customers and serve only those seeking subscriptions to high-end triple-play service tiers. Cherry-picking customers will ensure low market penetration since service providers will concentrate on the relatively small number of customers willing to subscribe to expensive premium service packages that provide high average-revenue per-unit (ARPU) and a sufficient return on investment.

Another pitfall in the open access model is that service providers may be tempted to take risks to increase operating margins by providing substandard customer support after service installation. The service provider has less to lose than the network owner if the customer is dissatisfied and disconnects the service and returns to an incumbent provider.

It should be noted that open access network owners usually invite incumbent carriers to use their networks, but the incumbents have routinely declined the invitation, preferring to deliver services over their own networks.

Under the open access model the structural separation between the network owner and the service providers make the relationship very complicated. The risk for the project is mostly assumed by the network owner. The network owner has made a significant investment in building the network, but it must have good service providers to succeed. Service providers immediately profit from a new customer, but the network owner requires several years just to recover the initial outlay to build the network and install the customer. If the network owner and the service provider are not on the same page about customer acquisition methods and customer fulfillment standards, the customer gets caught in the middle and take-rates will suffer if the service is unreliable and customer expectations are not met. Customers switching from incumbent carriers to services available from an overbuilder will have very high expectations. If the process of switching services is too complicated, or the service experience is unsatisfactory in any way, customers will be hesitant to switch or they will quickly return to an incumbent carrier if the service experience is poor.

2. The ***"closed"* or *"retail"*** network model, where a municipality builds and operates the network and directly provisions broadband services to residential and commercial users. This is the most common model used by municipalities engaged in provisioning broadband. Under this model the municipality can fully develop the revenue potential of the network, but also assumes the entire risk of competing against incumbent carriers that have the advantage of brand identity, well-established market share, large marketing budgets, operational economies of scale and the financial resources to combat new entrants into the market.

   Municipalities using the closed network model typically built a fiber backbone network for command and control of critical municipal infrastructure such as utility services. Since these fiber networks use only a small portion of the fiber capacity, it made sense to fully leverage revenue generation possibilities of the network by building hybrid fiber-coaxial cable (HFC) systems or in some communities building FTTP networks in direct competition with incumbent carriers. However, with the exception of the 88 communities cited earlier in this report that built FTTP networks, most municipalities that invested in fiber backbones for their own internal communication needs have not pursued

fiber build-outs to homes and businesses due to the high financial risks involved and a sense that their community was already sufficiently served by the incumbent carriers. Most municipalities with under-utilized fiber networks decided to follow the low-risk path of renting or "licensing" its unused fiber to commercial users and community anchor institutions, in addition to building Institutional Networks (I-Nets), rather than enter a competitive business which requires a skill set that most municipalities do not possess.

3. An emerging municipal broadband model is the ***"hybrid"*** model, where the municipality is the sole initial retail provider, but over a period of several years migrates to an open access platform. This model takes the best from both the retail and open access concept. This model uses the profitability component of the retail model to ensure that debt incurred to build the network can be met in a reasonable amount of time.

   In reality, there are few examples of the hybrid model, but in recent years it has been recommended by municipal broadband advocates as a way to avoid the numerous pitfalls of the open and closed access business models.

Customer acquisition costs under the abovementioned models are very high in a competitive overbuild market. Additionally, ongoing operational costs to serve and retain broadband customers continue to escalate for broadband service providers - including the incumbent carriers - resulting in frequent rate increases to cover operational costs and service the debt required to build the network. A satisfactory return on investment must come from a large number of customers subscribing to high revenue triple-play service packages supported by a high retention rate after the initial service installation. Despite the low customer satisfaction ratings of the incumbent carriers, the "build-it-and-they-will-come" business plan is a risky strategy for a public or private overbuilder that plans to compete in a community that is already well-served with multiple service providers. Overly optimistic projected customer take-rates embedded in the business plans for these overbuild projects need to be carefully examined since many municipal projects (especially the projects using an open access model) have fallen far short of customer acquisition goals.

Consumers want multiple choices for broadband services, but they are primarily motivated to switch to a new provider by lower prices and introductory sign-up deals that include discounted prices for a trial period; more service options and better customer service are important considerations when consumers go shopping for alternative broadband services, but they are usually secondary in the decision to switch providers.

The municipal fiber network models described in this report have many unique features with varying degrees of success, and in some cases outright failure. The primary reason for the failure of some municipal broadband projects using either the open or closed models are insufficient customer "take-rates" caused by slow system build-outs, construction cost overruns, ineffective customer acquisition plans, operational, financial and institutional constraints that inhibit good customer service, and a strong competitive response from the incumbent carriers.

Theoretically, municipal FTTP open access networks should generate enough revenue to pay for themselves when they attract high take-rates since these networks are technologically superior to incumbent networks; however, the network owner receives a smaller percentage of revenue than

under a closed network model and runs the risk of attracting independent providers that may provide deficient service as compared to the incumbents.

To succeed under any operating model in the broadband industry, there must be an aggressive, well-funded marketing and customer acquisition plan in addition to providing exceptional customer service as compared to the incumbent carriers. Implementing effective customer acquisition plans is the linchpin of a successful municipal network. Customer fulfillment processes and retention efforts are equally important. Successfully provisioning customer service in a highly competitive broadband market requires 24/7/365 availability to customers; however, ensuring "round-the-clock" availability requires very high operational costs that are difficult to sustain unless customer take-rates are large enough to justify the cost.

Municipal networks operating under either an open access network model or under a closed network model are essentially selling megabits for dollars. Telecommunication industry analysts believe this is no longer a sustainable business model if it's based on providing traditional residential triple-play services in markets already saturated with broadband service options. To remain financially viable, municipal networks will need to aggressively pursue opportunities to provide business services, in addition to more affordable high-speed Internet services with increased bandwidth capacity for next generation apps, which provide better operating margins. Nevertheless, providing broadband services to businesses is becoming very competitive because large cable TV system operators now view business customers as the best alternative revenue stream to replace lost revenues from their eroding residential customer base.