

City of Palo Alto City Council Staff Report

Report Type: Action Items

Meeting Date: 8/21/2017

Summary Title: Work Plan for Fiber-to-the-Premises and Wireless Network

Title: Staff, Utilities Advisory Commission, and Policy and Services Committee Recommendation that Council Direct Staff to: (1) Pursue a Municipal Fiber-to-the-Node Network (FTTN) for Fiber and Broadband Expansion; and (2) Expand Wi-Fi to Unserved City Facilities and Discontinue Consideration of City-Provided Wi-Fi in Commercial Areas

From: City Manager

Lead Department: IT Department

Recommendation

Staff, Utilities Advisory Commission and City Council Policy and Services Committee Recommend that Council direct staff to:

- Develop a business case for a municipal-provided Fiber-to-the-Node (FTTN) network for fiber and broadband expansion ("Option 2"); engage an engineering firm to design a FTTN network including an expansion option to build a citywide Fiber-to-the-Premises (FTTP) network; and work to identify potential partners and/or service providers, including identification of last mile funding models; and
- 2. Expand Wi-Fi to unserved City facilities and discontinue consideration of City-provided Wi-Fi in commercial areas.

On May 23, 2017, the Policy and Services Committee specifically moved to recommend to the City Council:

- A. Approve the recommendation for the Municipal Fiber-to-the-Node network with neighborhood/private last mile provision; and
- B. Expand Wi-Fi to unserved City facilities while minimizing the investment in facilities that are being redeveloped; and
- C. Discontinue consideration of City-provided Wi-Fi in commercial areas; and
- D. Direct staff on the following:
 - i. Define more clearly the goals of FTTN; and

- ii. Reach out to other communities on the approaches post Google and share strategy and funding models; and
- iii. Include ROI estimates; and
- Present a rollout strategy with an estimate of how many homes will be passed; and
- v. Draft a communication strategy

The Policy and Services Committee Motion passed 3-0 (Kniss absent) – Exhibit A (Policy and Services Final Action Minutes May 23, 2017).

Background

Staff reviewed fiber expansion options and wireless recommendations with the Utilities Advisory Commission ("UAC") on April 5, 2017 and with the City Council Policy and Services Committee on May 23, 2017.

Fiber expansion options:

- **OPTION 1. Municipally-Owned Fiber-to-the-Premises (FTTP)**. Explore potential funding models, such as general obligation bonds requiring a ballot measure with two-thirds voter approval, or revenue bonds secured by ongoing dark fiber license revenues and fiber reserves, to build and maintain a ubiquitous, municipally-owned Fiber-to-the-Premises network; the estimated build costs for a FTTP network is between \$50 million to \$78 million; or
- OPTION 2. Municipally-Owned Fiber-to-the-Node (FTTN) Network with Neighborhood/Private Last Mile Provision. Develop a business case for a Fiber-to-the-Node network,¹ which may be a platform for Public Safety and Utilities wireless communication in the field, Smart Grid and Smart City applications, and new dark fiber licensing opportunities; engage an engineering consultant to design a citywide FTTP network; identify potential partners and/or service providers, and identify last mile funding models; the estimated build cost to build a FTTN network is between \$12 million to \$15 million; or
- OPTION 3. Pause Municipal FTTP Development Efforts; Increase Transparency and Predictability for Third Party Providers. Direct staff to identify additional resources and opportunities to assist Internet service providers committed to deploying gigabit-speed broadband service; in addition, pause internal efforts to pursue municipal FTTP as the telecommunications industry and associated technologies rapidly evolve.

¹ FTTN is one of several options for providing fiber cable telecommunications services to multiple neighborhood access points. FTTN helps to provide broadband connections and other data services through a common network box, which is often called a node. The node provides a neighborhood access point to build the so-called "last mile" to deliver services to the customer premise. The last mile is typically the most expensive portion to build in a FTTP network. Fiber-to-the-Node is also called "Fiber-to-the-Neighborhood."

Wireless Recommendations:

- Expand the City's *OverAir* Wi-Fi Hotspots to unserved City facilities and request that Council approve an estimated \$165,100 for one-time equipment and installation costs funded by the Fiber-Optic Fund and allocation of monthly recurring charges of approximately \$6,239 to the respective departments; and
- Discontinue consideration of building a City-provided public Wi-Fi network in high traffic commercial areas.

Fiber Utility

Given the increasingly competitive telecommunications landscape, including new hybrid fiber/wireless technologies and emerging services and applications requiring access to networks capable of gigabit-speeds and beyond, staff recommended to the UAC and the Policy and Services Committee to pursue one of three identified approaches to fiber-optic expansion. Staff is requesting feedback, direction and approval by Council to direct staff work concerning the fiber utility for the next twenty-four (24) months to best facilitate citywide access to gigabit-speed broadband services. On May 23, 2017, staff recommended the Policy and Services Committee select one of the three options proposed above for approval by Council.

UAC Recommendations

Fiber Options: At its April 5, 2017 meeting, the UAC unanimously recommended Option #2 (Municipally-Owned FTTN, with Neighborhood/Private Last Mile Provision) with the conditions that a business case be developed establishing the benefits to the City and quantify the return on investment ("ROI"). Staff should also identify potential last mile service provider models. Staff agreed with the UAC's conditions and included them in the Option 2 proposal presented to the Policy and Services Committee on May 23, 2017.

Wireless Deployment: With respect to Wi-Fi, staff recommended expanding the City's existing Wi-Fi service to unserved City facilities such as common areas at the Cubberley Community Center, Palo Alto Municipal Golf Course, Lucie Stern Community Center and Lytton Plaza. However, staff does not recommend pursuing deployment of City-provided public Wi-Fi connectivity in high traffic commercial areas such as University Avenue and California Avenue. The UAC unanimously approved Wi-Fi expansion to unserved City facilities with the exception of the Golf Course Pro Shop and Café, and discontinuing consideration of building a City-provided public Wi-Fi network in high traffic commercial areas. Staff agrees with UAC's wireless recommendations, but suggests including the Golf Course Pro Shop and Café consistent with services provided in other City facilities. This expansion of Wi-Fi at unserved City locations will minimize investment in facilities that are being redeveloped.

In general, the UAC indicated that Option 1 is too challenging since voter approval will most likely be required; Option 2 may be feasible, but a viable business case must be developed first in terms of confirming what the FTTN network would be used for and to establish the public benefits, ROI and potential last mile service provider models. Regarding Option 3, the UAC stated that the support of third party network upgrades should be considered a standard activity by the City.

There was significant discussion by the UAC Commissioners regarding Option 2 (FTTN Network with Neighborhood/Private Last Mile Provision). There is a concern that FTTN has potential, but is

speculative; therefore, the UAC requested staff to analyze the benefits and quantify the potential ROI on investment if the City spent \$12 million to \$15 million to build the network. Additionally, the City should consider deploying Fiber-to-the-Premises in one neighborhood as a pilot project, thereby limiting the City's financial exposure and gauging the level of community interest. Staff should also research potential last mile service provider models. These models need to be identified and should be technology independent, otherwise, the City will not know how to design and build the network. The City needs to consider emerging technologies and next-generation Internet speeds provided by the existing Internet Service Providers ("ISPs"). Service upgrades by the ISPs may affect overall community demand for a municipally-owned network. Moreover, staff should identify applications and services that require gigabit-speed broadband such as virtual reality, telemedicine, telepresence or telecommunication, and develop a strategic plan outlining phased deployments of these applications. FTTN has the potential to be a foundational technology that may allow the City to support smart grid applications such as communicating with smart meters, utility supply and demand applications, and gas and water leakage detection. These applications are available and currently being deployed by other municipal and investor-owned utilities.

Policy and Services Committee Recommendations

On May 23, 2017, the Policy and Services Committee reviewed the three above-noted options and the two wireless recommendations. In general, the Committee members agreed with the UAC's recommendation to pursue Option 2 and the wireless recommendations, with the following general comments:

- FTTN benefits and the costs should be made clear to residents with measurable goals and an understanding of what kind of private partners would be interested in the FTTN network;
- Provide an ROI calculation to understand the revenue potential;
- A FTTP pilot has already been done; the City should not consider conducting another pilot;
- This evaluation period is a good opportunity to share ideas and funding models with other cities; staff should reach out to other communities on approaches "post Google Fiber" (e.g. San Francisco);
- Evaluate implementing "dig once" and "one touch make ready" policies, in addition to determining the feasibility of using the microtrenching construction method to reduce fiber build costs;
- A fiber rollout strategy should be developed with an estimate of how many homes will be passed by the network;
- Develop a communications strategy to inform residents; and
- Establish if there are Utilities funds available for the project for smart grid applications.

Staff will address these items as part of the business case. Staff would need to issue an RFP for professional services to develop the business case, engineering design, implementation plan and communication strategy. Staff has researched and contacted other California municipalities in regards to their fiber, wireless and broadband initiatives (Exhibit B - Overview of Municipal Broadband in California).

Discussion

The dark fiber optic backbone network ("fiber network") was originally conceived by the City in the mid-1990s and is maintained and operated by City of Palo Alto Utilities ("CPAU"). Exhibit C – *Fiber History and Initiatives* provides a comprehensive history of various efforts to expand the network from 1996 to the present. The most recent activities under the Council's "*Technology and the Connected City*" initiative involved the preparation of a Fiber-to-the-Premises Master Plan ("FTTP Master Plan") and a Wireless Network Plan, in addition to working with Google Fiber for more than two years on a potential citywide FTTP network build. The FTTP Master Plan and Wireless Network Plan were prepared by the City's consultant, CTC Technology & Energy ("CTC"). Since 2014, staff has also worked closely with a Citizen Advisory Committee ("CAC") on various fiber and wireless issues. In 2016, the CAC was expanded from six to eleven members. The committee meets approximately every two months and has provided valuable feedback and guidance to staff.

Since the FTTP Master Plan and Wireless Network Plan were completed and reviewed by the Council in September 2015, staff has worked to complete the various tasks in the Council's September 28, 2015 (staff report #6104) and November 30, 2015 (staff report #6301) motions. The status of the Council motion items can be found in Exhibit D – Council Motion Status.

In the past year, the competitive landscape in the telecommunications industry has changed dramatically throughout the country, including Palo Alto. The most significant change affecting Palo Alto occurred in July 2016, when Google Fiber advised staff that it was "pausing" its plans to build a fiber-optic network in Silicon Valley and other cities where construction had not yet started. Other significant changes include upgrades to existing wired and wireless networks by AT&T Fiber, Comcast, AT&T Mobility and Verizon Wireless.

At the November 2, 2016 UAC meeting, staff reviewed several elements of the above-noted recommendations and provided other information related to network and service improvements by AT&T Fiber, Comcast and the wireless carriers, in addition to the status of Google Fiber. Information was also provided about the responses to the Request for Information ("RFI") for a partnership for deployment of a citywide FTTP network issued in May 2016. Staff reported that none of the responses to the RFI completely aligned with the City's objective for a public-private partnership. Commissioners provided feedback and suggestions which includes incentivizing the incumbents to accelerate their network upgrades while providing ubiquitous coverage and identifying the public benefits of a municipally-owned fiber network. (Exhibit E – Excerpted Final UAC Minutes of November 2, 2016).

At the November 2016 UAC meeting, City Manager James Keene observed that an incremental Fiber-tothe-Node ("FTTN") approach has potential because of the need to reinvest in the fiber network and the cost is manageable. The fiber ring could be expanded in a way to stay competitive. For example, the fiber network was extended to the school district and there may be other opportunistic expansions. Also, since staff does not exactly know now where the technology is headed for fiber and wireless deployments, FTTN may be back-filler for fiber backhaul opportunities to support citywide coverage and possibly facilitate future 5G services.²

On December 12, 2016, staff provided Council with an informational update regarding fiber and wireless activities (Staff report #6221): <u>http://www.cityofpaloalto.org/civicax/filebank/documents/55016</u>

In light of the rapidly evolving telecommunications marketplace, staff has attempted to pursue and keep all options open. Nonetheless, this staff report is designed to allow the Council to select one of the three options to direct staff to focus on a single effort over the next 24 months. The following provides

 $^{^2}$ 5th generation mobile networks or 5th generation wireless systems, abbreviated 5G, are the proposed next telecommunications standards beyond the current 4G/IMT-Advanced standards.

additional information about the three options, in addition to recommendations for wireless deployment.

Option 1: Municipally-Owned Fiber-to-the-Premises (FTTP).

The 2015 FTTP Master Plan indicated that the City will require an estimated overall capital investment of approximately \$78 million one-time cost to build and approximately \$8 million annually to operate and maintain the network. The estimated network construction and operating costs are subject to change based on real-world variables.

Certain challenges inherent to FTTP deployment are especially pronounced in the Palo Alto. The City's primary challenge in its pursuit of an FTTP buildout is that its costs will be high compared to other metropolitan areas for labor and materials. The cost of outside plant ("OSP")³ and drop cables⁴ will be greater than in other metropolitan areas because Bay Area costs tend to be higher. For example, many of the easements where the City must build are privately owned, which may require every drop cable to be placed in conduit. Additionally, many back yard utility poles in private easements will need to be replaced, because they're too short for new fiber-optic attachments.

The high construction and labor costs result in a higher necessary take rate for the City's FTTP enterprise to obtain and maintain positive cash flow. Based on the financial projections (and the underlying assumptions), a 72 percent take rate is required to financially sustain the network. The FTTP Master Plan also stated that if approximately \$20 million from the Fiber Optic Fund was used to finance the network, then the take rate required would be about 57 percent. These take rates are not only much higher than overbuilders⁵ have been able to achieve in other communities, but also higher than the required take rates for other potential municipal fiber enterprises. As a comparison, other recent analyses performed by CTC for municipalities have shown a required take rate in the mid-40 percent range in order to maintain positive cash flow.

In the FTTP Master Plan, CTC provided an analysis of potential funding models. A key consideration for network implementation is how to fund both capital construction costs and ongoing operational expenses. The importance of factoring in the ongoing cost of operations cannot be overstated; these expenses fluctuate based on the success of the enterprise, and can vary considerably each year, and even month to month. The capital and operating costs associated with a full-scale communitywide build-out will be significant, and the City will have to seek a combination of outside funding, internal subsidies, and/or other financing alternatives such as user-financing, creating Assessment Districts or finding a private sector partner to provide additional funding to support construction and the FTTP network's startup costs. Each of these potential funding mechanisms would require a more detailed legal and practical feasibility analysis, should the Council elect to pursue this option. It's important to note, however, that some private entities involved in financing and building municipal broadband networks may require an ownership stake to secure loans from the private lending markets.

Examples of potential financing models are bond issuances, City subsidies and loans, user-financing and Assessment Districts. Municipalities typically rely on General Obligation Bond and Revenue Bond

³ OSP is physical assets like overhead and underground fiber, accompanying ducts and splice cases, and other network components

⁴ Drop cables connect the fiber optic backbone to the customer premises.

⁵ An "overbuilder" is a private entity or a government entity that builds a new network in the public rights-of-way that will operate and compete with existing networks already built by the cable TV and telecom incumbents.

issuances for capital projects; therefore, the City may be able to issue a bond (i.e., borrow funds) to enable construction of an FTTP network.

General Obligation ("GO") bonds are directly tied to the City's credit rating and ability to tax its citizens. This type of bond is not related to any direct revenues from specific projects, but is connected instead to citywide taxes and revenues that can be used to repay this debt. GO bonds can be politically challenging, because it requires approval by two-thirds of the voters. Because GO bonds can only be used for physical improvements and not for services, they are generally issued for projects such as libraries, museums, community centers, schools, public parks, roadways and other infrastructure improvements.

Revenue bonds are directly tied to a specific revenue source to secure the bond and guarantee repayment of the debt. As of June 30, 2017, the Fiber Optic Fund has accumulated approximately \$27 million dollars in reserves. The Fiber Optic Fund currently generates a positive net income between \$2.5 million to \$3.0 million annually depending on the level of capital improvement activity.

In addition to funding the construction cost, it is also possible that ongoing internal subsidies from other City funds will be necessary to support regular operations if customer take rates are not sufficient. Examples of these operational costs include network equipment license fees, ongoing hardware and software replenishments, labor-intensive customer support, customer acquisition costs, and network maintenance.

Option 2: Municipally-Owned Fiber-to-the-Node (FTTN) Network with Neighborhood/Private Last Mile Provision.

To evaluate a potential incremental step for citywide FTTP, staff worked with CTC to develop a preliminary, high-level analysis of the cost to build a FTTN network.⁶ A FTTN network would require construction of approximately 62 miles of fiber plant, compared to 230 miles for a citywide FTTP network deployment. The FTTN network would provide an access point to connect neighborhood-area backhaul communications links.⁷ Building a FTTN network would be an incremental approach for fiber expansion and may lower the barriers for potential FTTP providers to build the "last mile" from neighborhood access nodes to individual premises. FTTN would provide the City with a phased and economically viable deployment approach to push fiber closer to residential neighborhoods and create a potential "jumping off point" to bring fiber to individual premises (i.e. building the "last mile"). Ancillary benefits would also occur by expanding the functionality and the choices of technology that can be implemented for Utilities and Public Safety and to support Smart City, Smart Grid and wireless applications dependent on fiber-optic communication links. Additional opportunities to license dark fiber to third parties for commercial purposes may also develop.

If fiber was expanded to residential neighborhoods, it would be available to the wireless carriers who need to build small cell sites in not just commercial areas, but also in residential areas to improve coverage and capacity for their networks. This is known as "network densification." These small cell sites, located primarily on utility and streetlight poles in the public rights-of-way, will need to be connected to fiber to "backhaul" traffic to a central point in a wireless carrier's network. The carriers can build this fiber themselves, but if City fiber is available it could be licensed to the carriers at a more expedient and cost-effective manner. According to RCR Wireless News, fiber is expected to be a significant focus on planned 5G network deployments. Similar to 3G and 4G before it, 5G is the "next generation" of wireless connectivity built specifically to keep up with the proliferation of devices that need either a fixed or mobile Internet connection, connecting not just a smartphone and computer, but home appliances, door locks, security cameras, cars, wearables, and many other inert devices beginning to connect to the web. This is commonly known as the "Internet of Things" ("IoT"). In effect, these dark fiber licensing opportunities for the wireless carriers and builders of shared wireless infrastructure may facilitate a new opportunity to increase revenues under the existing business model. Additionally, this expansion could also create a communications platform for Smart City and Smart Grid applications, especially for communication with utility meters, streetlights, parking, traffic and City news.

⁶ CTC advises that there are variations of the concept of building some subset of the physical plant to entice private investment. For example, Lincoln, NE used 300 miles of conduit to attract an FTTP provider. Holly Springs, NC built a middle-mile fiber network to serve their own town sites, but designed it specifically with capacity and other attributes intended to make it attractive as a backbone for FTTP. This attracted Ting Internet, who is leasing large quantities of fiber strands (144-count) throughout Holly Spring's approximately 20-mile backbone.

⁷ Backhaul communications fiber links are required to transmit data back to a network backbone or central office.

The following is a high-level breakdown of the FTTN cost components and total estimated network costs provided by CTC:

Cost Components	Total Estimated Costs
Outside Plant (OSP Engineering)	\$1,110,000
Quality Control/Quality Assurance	290,000
General OSP Construction Cost	7,110,000
Special Crossings	150,000
Backbone & Distribution Plant Splicing	310,000
Backbone Hub, Termination & Testing	2,410,000
Drop Connections (Tap to WAP)	45,000
Total Estimated Cost	
*This estimate does not include any of the network electronics, wireless or otherwise	\$11,425,000

The \$11.4 million estimate is within the capacity of the existing Fiber Fund reserves. At this time, staff does not know the ongoing costs to operate and maintain a FTTN network since its contingent on the use(s) of the network.

With regard to business case development, a number of approaches could be considered and staff requests Council feedback on next steps. Preliminarily, staff would recommend proceeding with the following steps if Council directs proceeding with Option 2:

- 1. Staff will engage an engineering consultant to initiate a preliminary design for FTTP and FTTN. Any such design will need to make certain assumptions driven by business case model(s), publicprivate partnership opportunities, and technologies for last mile service delivery. The components of developing a FTTP network design includes identifying the type of services which will be carried over the network and cost estimates for the geographic layout of fiber routes and outside plant, nodes and transmission equipment required. Upon completion of the design and confirmation of the business model, the consultant scope of services will be structured to enable full citywide FTTP design, but with the expectation that authorization to proceed will occur in phases, based on cost estimation, community interest, and/or partnership agreements.
- 2. Utilities staff will develop a public outreach program to solicit neighborhood interest in participating in verifying the business case for FTTP. Residents will be advised that as

envisioned, the City would fund extension of the fiber network to the neighborhood with the understanding that residents may be responsible for some or all of the costs to reach individual homes. An up-front cost estimate per home would be communicated (e.g. estimated range of \$800-\$5,000 per home for wired service or undetermined costs at this time for wireless service), with cost estimates to be refined as the evaluation proceeds. Residents will also be advised that decisions have not been made regarding service provider(s). Depending on the level of interest expressed, a handful of neighborhoods may be selected to proceed with preliminary network design.

- 3. IT staff will explore marketplace interest in (a) participating in the last mile buildout and (b) providing gigabit service to neighborhood residents. Participation in (a) and (b) could be described as integrated or separable levels of involvement.
- 4. Subject to positive responses to the steps above, staff would engage stakeholders in identifying priority characteristics of prospective service provider(s). Topics would likely include characteristics such as services to be provided, customer service expectations, and policies on issues such as data privacy.

Staff would report to the UAC, Policy and Services Committee and Council on the results and conclusions from these steps, ultimately leading to Council action prior to proceeding with construction of the FTTN network.

Under Option 2, staff would likely issue competitive solicitation(s) for a FTTN design and concurrently evaluate other last mile funding models to pay for the connections between neighborhood nodes and homes and businesses. If a certain level of interest is met and property owners are willing to pay for the connections, fiber and/or wireless technologies could be deployed to deliver faster broadband services. Potential funding models for the "Last Mile" include:

- <u>User-Financing</u>. User-financing which relies on homeowners to pay on a voluntary basis for some or all of the cost to build-out the City's existing dark fiber backbone network into residential neighborhoods. Homeowners would voluntarily finance system build-out costs by paying a one-time upfront connection fee that could range from \$800 to \$5,000, or more. The City would provide a wholesale transport-only service to one or more ISPs on an "open access" basis and the homeowner would directly pay the ISP for Internet connectivity. The City would be responsible for building and maintaining the core network while leaving customer service, provisioning, technical support and billing to the ISP. Property owners could self-organize, or a third party could potentially facilitate neighborhood participation, or the City could facilitate the formation of Community Facilities Districts or Assessment Districts.
- <u>Assessment Districts; Mello-Roos/Community Facilities Districts (CFDs)</u>. City staff could also explore using Assessment Districts or CFDs to fund Last Mile development. More study would be required to determine whether using such districts for fiber buildout would be practically and administratively feasible and also adhere to all applicable legal requirements, including statutory requirements for establishing assessment districts in a charter city and constitutional requirements such as Proposition 218.

Assessment Districts may be used to finance new public improvements or other additions to the community. Generally speaking, an Assessment District is formed with property owner mail ballot proceedings involving each property that will be assessed in the district. Owners vote yes or no, and votes are weighted by the assessed amount. A simple majority of "yes" votes is required in order for an assessment to be levied. Assessment districts are still subject to Proposition 218, which requires identification of special rather than general benefits.

Under the Mello-Roos Community Facilities Act of 1982 (Gov. Code §§ 53311, *et seq.*), cities and other local government agencies can form a community facilities district to finance certain facilities and services. These districts can levy a special tax, and issue bonds secured by that tax, upon approval by two-thirds of the registered voters or property owners within the district.

• <u>Public-Private Partnership for Last Mile Expansion</u>. Explore the potential for a public-private partnership, where the City and a private entity work together to achieve mutual goals for an FTTP network. In light of the high cost to build and the extremely high required take rate, it may seem that there is little incentive for any provider (public or private) to pursue an FTTP deployment in Palo Alto. A private entity and a public entity could complement one another by developing a partnership that can take advantage of each entity's strengths, which may significantly reduce cost and risk. While this model is newly emerging, engaging a private partner may enable the City to take advantage of opportunities to mitigate risk and maximize opportunity. The public and private sectors each have unique advantages and disadvantages that may impact their ability to undertake a standalone overbuild.

Option 3. Pause Municipal FTTP Development Efforts; Increase Transparency and Predictability for Third Party Providers.

In light of the aggressive upgrade plans by the incumbents and the development of emerging technologies such as gigabit-speed fixed wireless and 5G that will significantly enhance the delivery of consumer and business broadband services, another potential option is pausing any further municipal FTTP development efforts at this time. Obtaining viable market share and acquiring new customers is necessary to financially sustain a City FTTP offering.

A new City FTTP network would compete directly with existing local incumbent cable, telco, and other ISPs to offer services to customers. Generally, fiber overbuilds do not offer a high rate of return, which is why there are not many private sector providers seeking to build fiber networks in markets where customers are already served. The likelihood that a municipally-owned FTTP network could be financially viable is doubtful, unless the City was willing to subsidize the network indefinitely, or if one of the aforementioned funding approaches was feasible, or if a partner from the private sector was willing to assume a portion of the financial risk. The ability of the City to acquire more than 70 percent market share on its own is highly unlikely, thus the financial risk would be very high. In the FTTP Master Plan a market assessment report was provided in an appendix. This market assessment provides an overview of providers that currently offer services with which the City's potential new fiber-to-the-premises (FTTP) enterprise might compete (Exhibit F – *Palo Alto Existing Market Assessment*). The City's existing dark fiber enterprise is viable, because it is a niche service with little or no competition. Nonetheless, success in providing commercial dark fiber does not translate into a feasible business case for the City to enter a very competitive industry.

In the interest of improving broadband in Palo Alto and based on the concerns noted above, another approach is to identify resources and improve coordination of City policies and processes to facilitate

network upgrades by third-parties such as AT&T, Comcast and other wired and wireless ISPs. This will enhance transparency and predictability for third party providers. Municipal strategies that advance broadband deployment can be grouped into three general categories: (1) ways to facilitate access to key assets such as fiber, conduit, utility poles, and real estate; (2) ways to make useful information available to potential broadband service providers; and (3) ways to streamline and publicize local processes. Access by third-parties to infrastructure data and assets such as poles, conduits and rights-of-ways is essential to encouraging broadband improvements. Ensuring efficient and predictable processes that enhance deployments is equally important, as with any public project. According to a study published by CTC in 2014,⁸ local governments balance the needs of broadband providers with the public cost of the processes necessary to support them and with other priorities that clamor for the same resources. To balance these competing interests, local processes such as permitting and inspection can be formalized and publicized. Timelines can be determined based on local needs, publicized, and then met. Transparency about processes and timelines enables broadband companies to expeditiously plan and deploy networks, enabling localities to manage the costs and burdens of the processes necessary to meet broadband providers' needs.

The City and broadband providers can cooperatively plan before construction so as to understand respective schedules and needs, and so that the provider can plan to stage its work around known and predictable local processes. In order to implement these strategies, staff will need to identify additional internal and/or external resources to better facilitate planning approvals, environmental reviews, permitting, inspections and legal reviews. The work to identify resources was well underway when staff was working with Google Fiber to manage the anticipated large volume of activities to build a fiber-optic network in Palo Alto.

The City Attorney's office, Development Center, Public Works, Planning & Community Environment and Utilities reviewed multiple City policies, practices and procedures to accommodate these activities. The Google Fiber City Checklist process, which required all of the above-mentioned departments to work in concert to identify information about existing infrastructure (e.g. utility poles and available conduit), review various policies and procedures to facilitate access to the public rights-of-way and utility poles, in addition to reviewing infrastructure data such as utility routes to make construction speedy and predictable. An example of this staff review is the "pole intent process" required to manage hundreds of applications to attach fiber-optic cables and other equipment to utility poles jointly-owned by the City and AT&T. Another example was the review of construction methods and various construction constraints to ensure the integrity of the public rights-of-ways and street conditions that would be significantly impacted by large scale excavations and directional boring required to install new conduit and fiber-optic cables in the public rights-of-way, in addition to placing thousands of below-grade vaults citywide.

The following includes information about current and upcoming third-party provider upgrades:

• AT&T Fiber plans to upgrade their network beginning in January 2018 in Palo Alto in order to provide gigabit-speed broadband services to the community. AT&T plans to select

⁸ GIGABIT COMMUNITIES - Technical Strategies for Facilitating Public or Private Broadband Construction in Your Community

http://www.ctcnet.us/wp-content/uploads/2014/01/GigabitCommunities.pdf

neighborhoods with high potential for adoption and will use consumer demand levels to determine further deployments in the city.

- Comcast now provides a 1GB and 2GB service in Palo Alto. Comcast has launched DOCSIS 3.1 technology citywide to offer multi-gigabit service to its residential customers. Data over Cable Service Interface Specification ("DOCSIS") is an international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable TV system. DOCSIS technology is employed by many cable television operators to provide Internet access over their existing hybrid fiber-coaxial (HFC) infrastructure. DOCSIS 1.0 was released in 1997. The most recent version of DOCSIS (3.1) was released in 2014. The DOCSIS 3.1 specification supports Internet speeds of 10 Gigabits per second (Gbps) for downloads downstream and 1Gbps upstream - the level of speeds typically only available with a fiber optic connection. For business services, bandwidth will be scalable from 1 Mbps to 10 Gbps, and as high as 100 Gbps if specific criteria are met. The brand name for this service is Gig-speed Internet from XFINITY. Upgrading to Gig-speed Internet requires the customer to swap out their existing modem for a new DOCSIS 3.1 compatible modem. The modem swap requires a professional installation. The pricing for Gig-speed Internet is \$110 per month with a one year contract and \$120 per month with no contract. Comcast also currently offers a 2 Gigabit Per Second ("Gbps") broadband service called *Gigabit Pro* when certain conditions are met.
- Other Telecommunication Service Providers: Several wireless carriers and builders of shared infrastructure for the cellular industry are seeking to deploy new communication facilities such as distributed antenna systems ("DAS") and small cell technologies in Palo Alto. In the past few years, AT&T Mobility and Crown Castle have deployed approximately ninety-five (95) DAS and small cell sites in several areas of the city to improve the coverage and capacity of the carriers' mobile networks. These facilities are typically located on City-owned utility poles and streetlight poles in the public rights-of-way. More deployments are planned by AT&T Mobility (16 small cell installations), Verizon Wireless (93 small cell installations) and other carriers, in addition to the builders of shared wireless infrastructure such as Crown Castle (16 small cell installations to add to the 19 small cell sites built in the downtown area in 2016).

WIRELESS DEPLOYMENT

The expansion of Wi-Fi technology at unserved City facilities and public areas was evaluated with the Community Services Department ("CSD"). Most City facilities already have Wi-Fi access ("*OverAir Wi-Fi Hotspot*"). The outcome of the evaluation reflected concern from CSD regarding the deployment of Wi-Fi at Rinconada Pool and City parks due to safety concerns. The potential for distracted parents in the areas of the City where parents are expected to supervise their children is the primary concern. In addition to potential safety concerns, parks and other open spaces provide an important respite from technology, a place to "unplug" and focus on spending time with family and friends and to connect with the outdoors and nature.

The areas of the City where CSD recommends Wi-Fi deployment at common areas in the Cubberley Community Center, Lucie Stern, the Golf Course Pro Shop and Cafe, and Lytton Plaza. A high-level cost estimate for the recommended sites is \$165,100 for installation and \$6,239 for monthly recurring charges. Exhibit G – Wi-Fi CSD Site Summary provides estimated costs of the individual sites.

Multiple interviews conducted during the assessment for the Wireless Network Plan indicated there have been no specific requests from the business community or the general public for City-provided Wi-Fi services in high traffic commercial areas. A significant number of Palo Alto businesses already offer free Wi-Fi service to patrons as an amenity. Additionally, companies such as AT&T and Comcast have installed and operate Wi-Fi access points for their customers in many areas of the City and are planning upgrades to these services in 2017.

It should be noted, too, that other cities' implementations of municipal Wi-Fi services generally did not develop the anticipated level of acceptance. Part of the problem with those deployments was related to the speed and reliability of earlier Wi-Fi technology compared to commercial wireless options. In the same timeframe that those cities implemented municipal Wi-Fi, the commercial wireless carriers successfully deployed 3G and 4G data access technologies that have developed a high degree of consumer acceptance based on cost, performance, and the convenience of essentially universal service. In contrast, many municipal Wi-Fi deployments served only a limited area and performance in many cases fell short of user expectations.

Ongoing Initiatives

Fiber Network Rebuild Project

In fiscal year 2016, the City established a new capital improvement project, Fiber Optic System Rebuild (CIP FO-16000), to rebuild portions of the dark fiber network for improved reliability and increased capacity. The rebuild project will install new aerial duct or substructures (conduit and boxes) and additional fiber backbone cable to increase capacity for sections of the dark fiber ring that are at or near capacity and allows CPAU to meet commercial customer requests for service. See Exhibit H - Fiber Optic Network Rebuild Project for project description and current status.

In the FTTP Master Plan, CTC noted that it's important to recognize that the rebuild reinvestment does not increase the attractiveness of the fiber to encourage a partner to build FTTP. The current commercial dark fiber reach would be a relatively small portion of the total FTTP investment, and a citywide FTTP endeavor will likely benefit little from commercial dark fiber expansion.

Dig Once Policy

The Council's September 28, 2015 Motion directed staff to develop a "dig once" ordinance. The basic objective of dig once is to promote broadband by lowering the cost of building infrastructure by making it unnecessary to tear up the streets every time a company wants to reach new homes with its underground network. In the above-noted informational update provided to the Council on December 12, 2016, staff provided a summary of the issues related to developing an ordinance or policy in view of the changes nationwide and in Palo Alto with the third party telecommunications providers. The assumption in 2015 was that the City should actively encourage or require simultaneous underground construction and co-location of broadband infrastructure in the public rights-of-way with the intention of creating benefits for both the City and private sector communications providers. Establishing a dig once policy may reduce the long-term cost of building communications facilities by capitalizing on significant economies of scale as outlined in the informational update.

At this time, telecommunications providers are not proposing the same citywide, large scale excavations or builds that the City was anticipating back in 2015 with a Google Fiber build. Instead, with Google Fiber's reorganization and apparent retreat from a comprehensive infrastructure build, the City is finding that incumbent telecommunications providers are more inclined to explore incremental expansions or, where the scope of a project is larger, above ground builds on utility poles. As a result, staff is reevaluating the approach to dig once and has met with AT&T, Comcast and other companies that may propose large scale excavation projects in the future. These discussions are ongoing. Staff is also reviewing existing Municipal Code provisions governing Third Party Coordination in the public rights-of-ways and Joint Trench Coordination in Underground Districts, including specifically an assessment of how cross-departmental teams (Utilities, Public Works, Development Center and Planning) currently work together on both City-initiated and third party infrastructure projects to determine if there are other joint opportunities for streamlining and improvement.

Public Safety Point-to-Multipoint Wireless Network

A Request for Quotation ("RFQ") was issued in June 2017, for equipment to expand and upgrade the existing Point-to-Multipoint public safety wireless network. The overall goals are to:

- Improve coverage throughout the City and areas outside the City limits in the area of operations for public safety mutual aid, with focus on mobile command vehicles, including the Mobile Emergency Operations Center (MEOC)
- Enhance data throughput and quality of service (QoS)
- Expand client applications supported on the network

Staff will return to Council with a recommendation to approve a vendor contract and the funding source for the equipment purchase and installation costs.

Public Safety Wireless Mobile Network

Staff is developing a competitive solicitation for a pilot project to support public safety officers in the field with a broadband mobile network that will provide:

- Enhanced vehicular day-to-day network coverage and capacity by deploying approximately fifteen wireless access points on traffic signals poles throughout the City;
- Coverage redundancy in key areas of the city;
- In vehicle mobile broadband and phone access is provided by Verizon Wireless. This access will continue, but this alternative, private network with controlled user access, will supplement that access when the Verizon Wireless network performance is impacted due to high consumer demand.

This pilot project will first support a limited number of vehicles (approximately 5), and if deemed feasible, eventually support all public safety vehicles. Staff will return to Council for approval to fund the equipment purchase and installation costs.

RESOURCE IMPACT

Depending on the option selected for fiber and broadband expansion, staff will develop cost estimates and a work plan and return to Council for approval.

An estimated \$165,100 for one-time equipment and installation costs and monthly recurring charges of \$6,239 are required to expand Wi-Fi in unserved City facilities. Funding is available in the FY 2018 operating and capital budgets for the Fiber Fund for the contract amendment and one-time installation fees. The monthly recurring charges will be allocated to the respective departments consistent with the City's existing chargeback model.

POLICY IMPLICATIONS

The fiber and wireless activities are consistent with the Telecommunications Policy adopted by the Council in 1997, to facilitate advanced telecommunications services in Palo Alto in an environmentally sound manner (Reference CMR: 369:97 - Proposed Telecommunications Policy Statements).

ENVIRONMENTAL REVIEW

The recommended actions in this staff report are exempt from the California Environmental Quality Act ("CEQA") under section 15262 (Feasibility and Planning Studies for possible future action) and section 15301 (Negligible Expansion of Existing Facilities). Environmental review will be conducted, where required, prior to approval of subsequent projects.

Attachments:

- Attachment A: Policy and Services Final Action Minutes May 23 2017
- Attachment B: Overview of Municipal Broadband in California
- Attachment C: Fiber History and Initiatives
- Attachment D: Council Motion Status
- Attachment E: Excerpted UAC Minutes April 5 2017
- Attachment F: Palo Alto Existing Market Assessment
- Attachment G: WiFi CSD Site Summary
- Attachment H: Fiber Optic Network Rebuild Project



POLICY AND SERVICES COMMITTEE ACTION MINUTES

Special Meeting Tuesday, May 23, 2017

Chairperson Wolbach called the meeting to order at 6:14 P.M. in the Community Meeting Room, 250 Hamilton Avenue, Palo Alto, California.

- Present: DuBois, Kou, Wolbach (Chair)
- Absent: Kniss

<u>Agenda Items</u>

1. Discuss the Topic of Aircraft Noise, Review Federal Legislative Updates and Recommend That City Council Reaffirm City's Positions to Reduce Aircraft Noise and Make Other Recommendations as Needed to Advance City's Goals to Reduce Aircraft Noise Over the Skies of Palo Alto.

MOTION: Council Member DuBois moved, seconded by Chair Filseth to recommend the City Council direct Staff to:

- A. Take into account the public comments made tonight and received in writing, and reaffirm the City's position to reduce aircraft noise over the skies of Palo Alto; and
- B. Endorse and advocate a seat on the Select Committee's proposed Ad-Hoc Committee and any new permanent entities whose actions will impact Palo Alto and communicate that interest to Representative Eshoo; and
- C. Obtain an expert opinion on aircraft noise monitoring strategy and make a recommendation to Council; and
- D. Reach out to neighboring communities such as Portola Valley, Woodside, Menlo Park, Mountain View, Los Altos, Sunnyvale and East Palo Alto to establish a regional position on this issue; and
- E. Be prepared to respond to the FAA Select Committee Report in the form of legal or professional representation; and

ACTION MINUTES

- F. Emphasize as a priority a focus on minimizing noise, the equitable dispersion of noise and improving technology and flight methods to minimize the noise in general; and
- G. Recognize that on the ground noise matters, even if it is within the vicinity of an airport and establish an objective standard for noise at certain elevations and flight methods; and
- H. Ask FAA to consider emissions from aircraft

MOTION PASSED: 3-0 Kniss absent

The Committee took a break from 8:09 P.M. to 8:18 P.M.

2. Staff and Utilities Advisory Commission Recommendation That the Policy and Services Committee Make a Recommendation That Council Recommend: (1) Option 2 for the Municipal Fiber-to-the-Node Network (FTTN) for Fiber and Broadband Expansion; and (2) Expand Wi-Fi to Unserved City Facilities and Discontinue Consideration of City-Provided Wi-Fi in Commercial Areas.

MOTION: Council Member DuBois moved, seconded by Chair Wolbach to recommend the City Council:

- A. Approve the Option 2 recommendation for the Municipal Fiber-to-the-Node Network (FTTN) with Neighborhood/Private Last Mile Provision; and
- B. Expand Wi-Fi to unserved City facilities while minimizing the investment in facilities that are being redeveloped; and
- C. Discontinue consideration of City-provided Wi-Fi in commercial areas; and
- D. Direct Staff on the following:
 - i. Define more clearly the goals of FTTN; and
 - ii. Reach out to other communities on approaches post Google and share strategy and funding models; and

ACTION MINUTES

- iii. Include ROI estimates; and
- iv. Present a rollout strategy with an estimate of how many homes will be passed; and
- v. Draft a communication strategy; and

MOTION PASSED: 3-0 Kniss absent

3. Recreational and Medical Marijuana: Review and Discussion of State Law Developments and Input to Staff on Next Steps, Including Possible Ordinance Adopting Local Regulations Regarding Commercial Marijuana Activity, Outdoor Cultivation, and Marijuana Dispensaries. This Action is Exempt Under Section 15061(b)(3) of the California Environmental Quality Act.

STAFF REQUESTED THIS ITEM BE MOVED TO JUNE 13, 2017.

Future Meetings and Agendas

ADJOURNMENT: Meeting was adjourned at 9:19 P.M.

Overview of Municipal Broadband in California

FIBER-TO-THE-PREMISES AND WIRELESS COMMUNICATIONS INITIATIVES

#	СІТҮ	MODEL, SERVICES OFFERED, BROADBAND INITIATIVES	CURRENT STATUS & NEW ACTIVITIES	
1	Anaheim/Public Utilities Department	Dark Fiber	No update available.	
2	Atherton	FTTP Atherton Fiber is a locally owned company operated by Mike Farmwald of Atherton and Robert Hayes of Palo Alto. Note: This network is not a public-private partnership.	Atherton Fiber will run at least one fiber to the easement front of every home in Atherton. This fiber may be lease by any ISP to offer internet access, video or phone to th home. The connection from the easement to the house w be for the homeowner's account. Homeowners have the option to purchase an irrevocab right-of-use (IRU) for either two or four dedicated fiber These will be "home-runs", i.e. each fiber will be a direc unshared optical connection from the home to th Atherton Fiber central office. Atherton Fiber is current working with homeowners who want fiber-optic intern service, and doing site assessments of individual propertie The company doing that work is Paxio, a subcontractor	
3	Berkeley	Broadband Development Assessment	In 2015, the city and Tellus Venture Associates prepared a Broadband Development Assessment: http://www.tellusventure.com/downloads/berkeley/tva_c ity_of_berkeley_broadband_development_assessment_2 <u>9may2015.pdf</u> The objective of the assessment was to gain a better understanding of the types of conduit the city currently uses. The assessment also aimed to identify conduit that could accommodate high-speed fiber in the future. Berkeley is a Webpass city. Webpass, is a wireless internet provider that Google Fiber bought in 2016. Webpass uses radio devices to connect with existing Ethernet wiring, making it less infrastructure-heavy than traditional Google Fiber, which brings fiber cables directly to homes.	
4	Beverly Hills	Developing plan for citywide FTTP	City currently owns and maintains a scalable high-speed fiber-optic network designed to support additional capacity to benefit businesses and residences. The city is planning to invest in a citywide Fiber-to-the-Premises (FTTP) network for all homes and businesses, including apartments and condos, inside the city. A pilot installation will begin in July 2017.	
5	Brentwood	FTTP Public-private partnership between city and Sonic.net. Residential and business Internet and phone provided by Sonic.net.	The city began installing conduit as a regular practice in 1999; the community adopted the policy as a local ordinance, requiring new developers to install it in all new construction. Per MuniNetworks.org, the city has experienced significant growth and the conduit has grown to over 150 miles, reaching over 8,000 homes and a large segment of Brentwood's commercial property. As a result, Brentwood incrementally developed an extensive network of fiber-ready conduit. In an agreement with the city, Sonic.net agreed to install fiber-optic cables in businesses and homes in the city's Yamanaka neighborhood, located in the eastern section of town. In return, the city agreed to maintain the conduit, and lease the fiber-optic cables over	



			to Sonic. The company has also agreed to provide free Internet to the city's public schools, provided that at least 30 percent of households within those schools' jurisdictions are Sonic customers.
6	Burbank Water & Power/ONE Burbank	Dark Fiber and Business Internet Services	ONE Burbank offers: Dark Fiber, Dedicated Internet Access (DIA), Virtual Private LAN Services (VPLS), Wave Lambda Services, and Communication Transport Services (CTS).
7	Culver City/Culver Connect	Business Internet Services Culver Connect is the Municipal Fiber Network for facilitating high speed connectivity to the business community, the Culver City Unified School District, and for municipal services to promote economic development in Culver City.	Since 2013, city staff has been consulting with the Culver City business community about their need for enhanced broadband connectivity. A consultant was then engaged to assist with developing a high-level network design & potential business models. In November 2015, the City Council appropriated funding for the design and construction of a Municipal Fiber Network. The City has partnered with Culver City-based Mox Networks to provide professional services to design, implement, and operate Culver Connect. The City will install an open access network, where it is envisioned that any Internet Service Provider (ISP) will have the opportunity to utilize the City's fiber infrastructure to service the business community. The Network is currently under construction and is expected to be completed in August 2017.
8	Fresno	Issued Request for Qualifications for <i>Gigabit</i> <i>Fresno</i> initiative (seeking public-private broadband partnership).	In October 2016, city issued Request for Qualifications (RFQ) for a Gigabit Wireless and/or Wired/Fiber System for affordable, ubiquitous Gigabit-class broadband services and capabilities available throughout the City. Gigabit Fresno <u>https://www.fresno.gov/informationservices/gigabit- fresno/</u> RFQ <u>https://www.fresno.gov/informationservices/wp- content/uploads/sites/15/2016/10/WiFiRFQwithAppendic es_FINAL.pdf</u> Fresno wants to build citywide high-speed internet system <u>http://www.fresnobee.com/news/local/article109779602.</u> <u>html</u>
9	Glendale/ Glendale Fiber Optic Solutions	Commercial Dark Fiber	Program Overview Glendale Fiber Optic Solutions provides both large and small commercial customers optical fiber lease services both within the City limits and to adjacent cities. Glendale Water & Power owns and operates approximately 98 miles of dark fiber network within Glendale. Recent Activity Glendale Fiber Optic Solutions connects libraries and Fire Stations. Recently strung over 17 miles of dark fiber in order to add additional capacity and coverage through the entire Glendale fiber optic system.
10	Hayward	Fiber deployment in industrial zones for economic development.	The federal government awarded a \$2.74 million grant to Hayward to help fund the design and installation of conduit and fiber-optic network in the city's industrial zone. The grant, from the U.S. Department of Commerce's Economic Development Administration, will enable Hayward (pop. 150,000) to install at least 11 miles of new conduit and fiber optic cable. Construction will begin in September 2017, and should be finished by the fall of 2019. The \$2.74 million grant award is 50 percent of the total estimated project cost roughly \$5.4 million. The city's



11	Huntington Beach	City retained consulting firm for broadband strategic plan initiative and connectivity survey. Retained consulting firm to study city's broadband infrastructure and develop a plan that will involve either helping private companies better connect with customers or for the city to develop its own broadband service.	matching share of the project includes a \$2.1 million in- kind contribution of the city's publicly-owned right-of-way property, \$480,000 in general funds, and an additional \$156,000 that has already been committed to the construction and installation of fiber-optic conduit in the Whitesell Street segment of the fiber loop. Broadband Strategic Plan Initiative & Connectivity Survey http://www.huntingtonbeachca.gov/announcements/ann ouncement.cfm?id=959 Magellan Advisors http://www.magellan-advisors.com/resources/city-of- huntington-beach-ca-retains-magellan-advisors-for- broadband-wireless-strategic-plan.stml Huntington Beach could take over broadband service http://www.latimes.com/socal/hb-independent/news/tn- hbi-me-0114-broadband-20160113-story.html
12	Loma Linda	City FTTP provided to homes built since 2004. Funding Method: in part, requirements for private developers to include fiber optics and wiring in new construction projects. Internet access. Top residential speed 15 Mbps symmetrical.	In 2004, fiber connections and structured wiring were required in any home newly built or significantly remodeled in the city. Since 2005, 600 new homes were built and all are connected to the muni fiber network, with half choosing to buy Internet bandwidth from the city. The service is \$30 per month for 5 Mbps service, going up to \$100 for 15 Mbps.
13	Lompoc/Lompocnet	Citywide Wi-Fi	Lompocnet is a municipal Wi-Fi network that provides broadband level, internet service to citizens, businesses and city agencies.
14	Long Beach	Commercial Dark Fiber	 Fiber Expansion Plans The City owns approximately 60 miles of fiber optic cable in the City. Expanding the capacity and adding more City facilities to the Fiber Infrastructure is operationally and strategically critical to the City's business processes due to three major trends: Significant increase in network traffic Significant increase in connected devices moving applications to the cloud In FY 2015, the city had over 8,000 feet of optical fiber installed to connect the Airport, Fire Headquarters and Police Field Support. The city will be developing plans to expand even further to satisfy the demand for a high performance network backbone. The Internet of Everything (IoE) phenomenon, or the next wave of the Internet in which people, processes, data, and things connect to the Internet and each other, is showing tangible growth. The move to cloud applications necessitates good end to end connection from the tenant host site to each City facilities because the cloud applications rely primary on the network connectivity and less on the CPU, memory and hard drive on the user's local workstation. With that, the fiber infrastructure is a critical operational and strategic City asset that hand in hand with City workers, facilitates the delivery services to our constituents, businesses and visitors.
15	Los Angeles Department of Water &	Commercial Dark Fiber and Business Internet Services	Fiber Optic Enterprise manages an extensive fiber-optic
	Power/Fiber Optic Enterprise		intrastructure, offering various fiber optic transport services to the Los Angeles area businesses including



			leasing to both private businesses and the public sector
			throughout the Los Angeles City area LADWP does not
			provide residential fiber service.
			City of Los Angeles Broadband Expansion Plans
			In June 2015, the Los Angeles City Council approved a
			Request for Participants (RFP) to identify one or more
			providers to commit to deploying advanced wireline and
			wireless networks that can provide one gigabit broadband
			speed or more to residences and businesses. The RFP
			including free basic wireless services and to complete
			build-out within the next five years. The RFP was issued as
			part of <i>CityLinkLA</i> , the long-term initiative led by Mayor
			Eric Garcetti and City Councilmember Bob Blumenfield to
			ensure that Los Angeles is among the most connected
			cities worldwide. The RFP received unanimous approval
			from the City Council. The city will not pay for the
			nermitting for high-speed broadband and free Wi-Fi. The
			RFP responses and subsequent negotiations were not
			satisfactory for elected officials and all proposals were
			rejected. The city's Information Technology Agency is
			leading a cross-department task force (Connectivity &
			Digital Inclusion Group), which is coordinating a large
			number of factical efforts (e.g. connectivity around the
			5G permits for digital inclusion).
			P
			CityLinkLA
			http://citylinkla.org/about/index.htm
			Los Angelos is a "potential" Google Eiher city
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16	Modesto/LinkMODESTO	May 2017: City released Fiber Network Infrastructure	Los Angeles is a "potential" Google Fiber city. The City of Modesto currently utilizes a combination of aerial and in-ground fiber optic cables for City
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16 17 18	Modesto/LinkMODESTO Mountain View Oakland	May 2017: City released Fiber Network Infrastructure Master Plan.	Los Angeles is a "potential" Google Fiber city. The City of Modesto currently utilizes a combination of aerial and in-ground fiber optic cables for City communications – primarily used for the advanced traffic management system (ATMS) that controls the City's signal system. There is also a fiber-optic connection between City Hall and the Police Department downtown. The City leases space on the Modesto Irrigation District's aerial poles for fiber where conduit is not available or existing. The in- ground fiber optic cable is mainly located in the downtown district where aerial is not present, but is also located around the City. In addition, the City is working with private-sector communications companies (e.g. CVIN, Wave) to install additional empty conduits for City use as these companies build out their fiber networks. The City's existing fiber optic network was mainly funded by federal funds (Congestion Management and Air Quality Funds - CMAQ) and thus cannot be used for commercial purposes. For this reason, the City is exploring the option of installation of an additional, somewhat parallel separate fiber optic network that may be used for commercial purposes, as well as other City uses. This effort to for a City- wide fiber optic network is collectively referred to as LinkMODESTO. Mountain View is a "potential" Google City, but has no plans to pursue fiber-to-the-premises on its own. In 2015, the city prepared a <i>Fiber-Optic Network Master</i>
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		 Electrical Services Division Transportation Services Division Economic Development (would also serve as conduit for public- private partnerships) Public Safety Fiber connections with Port of Oakland and BART 	 the groundwork for developing a strategic approach to implementing projects and policies that will: Strengthen the City's IT fiber-optic network; Expand the capacity of the fiber-optic network; Integrate and connect City facilities; Establish system redundancy; and, Position the City for strategic and methodical expansion of the system in the future. Oakland is a Webpass city. Webpass, is a wireless internet provider that Google Fiber bought in 2016. Webpass uses radio devices to connect with existing Ethernet wiring, making it less infrastructure-heavy than traditional Google Fiber, which brings fiber cables directly to homes.
19	Ontario/Ontario Net	Dark Fiber and Business Data Services Planned expansion of the network.	City is developing a Fiber Optic Master Plan to guide design, construction and operation of a fiber optic backbone infrastructure as a long term investment. The City has planned the Ontario Net infrastructure that will connect city facilities in the New Model Colony area to ultimately provide a City owned Fiber-to-the-Home (FTTH) to begin once there is sufficient potential subscribers to support operational costs
20	Palo Alto/Utilities Department	Commercial dark fiber. 49 mile dark optical fiber backbone network to support City infrastructure and facilities (e.g. traffic signal system and electric substations). Network routed to pass commercial areas and business parks. Network serves the Palo Alto Unified School District.	CPAU Fiber Program <u>http://www.cityofpaloalto.org/gov/depts/utl/business/pr</u> <u>ograms/fibernet.asp</u> Palo Alto is a "potential" Google Fiber city.
21	Pasadena/Department of Information Technology	Commercial Dark Fiber and Business Internet services	The City owns and operates approximately 50 miles of fiber network. The fiber infrastructure supports City business and transportation operations, and also provides the foundation for a variety of business-oriented services that the City offers currently and plans to expand in the future. Currently the City does not provide service in residential areas. For businesses seeking to connect multiple facilities within Pasadena, the City offers either dark fiber leases or lit services between locations within Pasadena. With a dark fiber lease, the customer lights the fiber itself. For customers that prefer service, the City can offer the security and dependability of a private, secure campus network, with bandwidths of 1 Gbps, or 10 Gbps. <u>Access to Lit Services</u> For businesses interested in Internet access and related services, Pasadena can also provide access to lit services, such as Internet access and connectivity to local collocation and regional collocation and peering sites. The City offers 100 Mbps, 1 Gbps, and 10 Gbps connections.
22	Riverside/Riverside Public Utilities	Commercial Dark Fiber	Riverside Public Utilities installed a fiber optic network in the 1990s to help protect its electric system. The network is also a commercial asset that officials hope to market to make money for the utility. Riverside's utility makes about \$420,000 a year by leasing fiber to five customers, according to a city report. The biggest user is Riverside City Hall, followed by UC Riverside, California Baptist University, Charter Communications and TelePacific Communications.

			The system could be expanded further, making room for
			more business customers who would use the cables for
			Utilities will spend \$2.1 million to add fiber to an already
			planned city traffic signal project.
23	Riverside	County issued RFP for	The California county of Riverside issued an RFP in April
	County/RIVCOconnect	broadband initiative seeking	2017, seeking proposals as part of its RIVCOconnect
		a public-private partifership.	S2 billion to S4 billion and aimed at developing what it
			believes will be the nation's largest broadband network.
			Proposals are due August 15, 2017. RIVCOconnect is a Riverside County initiative, supported by the Riverside County Board of Supervisors and Executive Office, and led by Riverside County Information Technology (RCIT), that seeks to remove the road blocks that obstruct service providers from building out the current infrastructure. RIVCOconnect seeks to invite the private sector, either incumbent vendors or business entities new to the County, to work in cooperative fashion and create partnerships to deliver Broadband services Countywide at speeds of 1 Gbps
24	Can Dura (Can Dura Cabla	Cituwido recidential and	and above.
24	San Bruno/San Bruno Cable	business Cable	Comcast does not operate in San Bruno. The cable system
		TV/Broadband/Telephone	was built in the early 1970s and has been periodically
			upgraded to deliver high-speed Internet, digital phone and advanced cable TV services. Business services currently
			offered include: Business Phone Line, Business Fax, SIP
			Trunks, DIDs, LNP, Hosted IP PBX service (Cisco Unified
			Communications Manager based), Ethernet services including point-to-point and up to 1 Gbps IP circuits.
25	San Jose	Developing digital inclusion	The city has retained the consulting services of Price
		and broadband strategy.	 Waterhouse Coopers to help develop a digital inclusion and broadband strategy. The project will develop a citywide strategy to achieve the goals of: Improving the City's existing digital infrastructure to support San Jose's Smart City Vision and improve digital inclusion; Understanding options to improve residential and business broadband and Internet choices, quality and pricing; and Promoting availability of gigabit level broadband Internet to support economic development and inclusion. <u>https://www.sanjoseca.gov/index.aspx?NID=5557</u> San Jose is a "notential" Google Fiber city.
26	San Leandro/Lit San Leandro	Public-Private Partnership	Lit San Leandro LLC and San Leandro Dark Fiber LLC
			comprise the private partnership that works with the City
		ISP Partners	of San Leandro to create the Fiber Loop. The City brings their underground conduit to this partnership. San Leandro
			Dark Fiber owns the fiber optic cable that runs through the
			City's underground conduit. Lit San Leandro owns and
			access to the community.
			In March 2017, the City posted a Request for Proposal to
			engage with an experienced "Smart City" consultant to assist in development of a Fiber Optic Master Plan.
27	San Luis Obispo	Public-Private Partnership	As part of the City's Economic Development Strategic Plan,
		Business Internet Services	the City partnered with a local provider to bring high speed fiber to government buildings and provide the opportunity
			for fiber connectivity to local business and residences.



			Currently, 23 miles of fiber optic network are already in place, providing 75 "lit" commercial buildings with Internet
			services.
28	Santa Clara/Silicon Valley	Commercial Dark Fiber	In 2000, SVP developed its 145 conduit mile dark fiber backbone to link the electrical substations that serve the
	Power		community. The fiber backbone was overbuilt to allow the
			city to act as a wholesale provider and lease dark fiber
			within the City of Santa Clara.
			The Dark Fiber Enterprise Program serves:
			Business and institution sectors throughout the City
			 Co-locations to the proximity of local exchange data center central offices
			Key data centers within Santa Clara
			 Long distance points of presence (POPs)
			 SVP is responsible for installing network attachments and maintaining the backhone throughout Santa
			Clara
			Canta Clara in a "castantial" Canada Fikar situ
29	Santa Clarita	Dark Fiber lease to one client:	Fiber began in the City Traffic Engineering Division when
23		Wilcon	the City received federal grants for the implementation of
			Intelligent Transportation System (ITS) throughout the city.
			installed by the City for commercial use. The City is still very
			new at providing any services other than dark fiber. The City
			currently leases 86 miles of dark fiber to Wilcon, a provider
			of dark fiber, lit transport and colocation services in southern California. In April 2017, Crown Castle announced
			an agreement to acquire privately-held Wilcon Holdings LLC
			("Wilcon") for approximately \$600 million.
30	Santa Cruz/Santa Cruz Fiber	FTTP Public-Private	The City Council has approved encroachment permits for
		In 2016, the City and local ISP	citywide fiber optic network. The broadband upgrade will
		Curzio Internet agreed to	provide internet speeds of 1 Gigabit per second to both
		build citywide FTTP under a	businesses and residents. With the permit's approval,
		agreement branded. The	the summer of 2017. The network will be built using a
		network is called Santa Cruz	construction technique called "horizontal boring," which
		Fiber.	allows the installation of fiber conduit with minimal street
		Services: Business and	trenching, and almost no traffic interruptions.
		Residential Internet	
31	Santa Monica/Santa Monica	Commercial Dark Fiber and	Unlike the majority of municipal fiber networks, Santa Monica does not have a municipal power provider. City Net
	City Net	business internet services	is run out of the Information Systems Department. City Net
		FTTP digital inclusion Pilot in	offers business broadband, wavelength services and dark
		attordable housing.	tiber. The network also supports city facilities and public
			Digital Inclusion Pilot in 2015. The City has connected the
			first of 10 affordable housing buildings with 10 Gigabit
			Broadband. City Net's model is considered to be one of the
32	San Francisco	Commercial Dark Fiber	The City has constructed approximately 216 miles of fiber
52			optic network. The City's current fiber optic network was
		Fiber network primarily	originally developed beginning in 2002 when the
		supports city functions, services and facilities	Department of Emergency Management (then the Emergency Communications Department) issued a bond to
			construct a fiber-optic network to connect public safety
		In March 2017, San Francisco	buildings. Since then, the Department of Technology has
		Supervisor Mark Farrell	taken over the management of the network, which has
		privacy and academic experts	a small portion of its excess fiber capacity, commonly
		to discuss and study the issues	known as "dark fiber", to private companies and nonprofit
		related to Farrell's plan to	



		wire the city with high-speed Internet service. The San Francisco Municipal Fiber Blue Ribbon Panel will conduct research and provide recommendations on the feasibility of deploying a network that could cost up to \$1 billion.	organizations. These leases generate \$279,000 in annual revenue. Plans for Expansion The City plans to spend \$5.45 million over the three fiscal years between FY 2015-16 and FY 2017-18 to expand the existing fiber network, City Fiber, to connect the remaining 178 City buildings that are still using private Internet Service Providers (primarily AT&T) to access the Internet. Of the \$5.45 million, \$4.3 million was appropriated by the Board of Supervisors for FYs 2015-16 and 2016-17. Blue Ribbon Panel to Wire the City with High-speed Internet Service In March 2017, San Francisco Supervisor Mark Farrell assembled a group of business, privacy and academic experts to discuss crucial, early-stage questions surrounding Farrell's plan to wire the city with high-speed Internet service. Farrell will serve as the panel's co-chair alongside Harvard Law School Professor Susan Crawford. Crawford, who teaches courses on municipal uses of technology, Internet law and communications law, worked as an assistant to the president for science, technology and innovation policy in Barack Obama's administration and coled the FCC's transition team between the Bush and Obama administrations. In addition to providing recommendations for the most cost-effective ways to finance the fiber project and how to create and maintain privacy and security standards for customers, the volunteer panel will also evaluate whether to operate the network as a public or private utility, or a combination of the two. Farrell said the panel's work would build on a report published by the San Francisco budget and legislative analyst's office that laid out a number of possible scenarios. Financial Analysis of Options for a Municipal Fiber Network for City Internet Access: http://sfbos.org/sites/default/files/FileCenter/Documents //55324-BLA.MuniGigabitFiberFinance031516.pdf The Blue Ribbon Panel issued its first report in June 2017: WHY FIBER? SHOULD SAN FRANCISCO DEPLOY A FIBER BKOADBAND NETWORK? San Francisco Blue Ribbon Panel on Municipal Fiber Subcom
33	Shafter/Shafter Connect	Business and residential FTTP	to nomes. Shafter Connect uses qualified vendors to provide faster and more reliable high speed Internet and telephone
		Service providers include Level 3 and Vast Networks (ISP).	service over a fiber optic network. The Shafter Connect network consists of a 30+ mile backbone ring serving key areas of the City. Additional backbone and ring extensions are planned and under construction to expand the service reach of the network. The network is designed and built to industry standard metro-Ethernet or "Finished E" specifications.



			The city currently operates a 10 Gbps Ethernet network over the Shafter Connect all-fiber optic network. The
			installed infrastructure supports 100 Gbps and faster
			speeds as technology standardizes.
			Business and residential services are provisioned and
			supported directly by established, qualified service
			providers (Level 3 and Vast Networks). Bandwidth to the
			selected service provider. Additional capabilities such as
			high-speed intra-network connections and video are
			planned as the Shafter Connect network grows.
34	Sunnyvale	SmartCities Assessment	City in the process of conducting a SmartCities Assessment
			of that effort, the city will be defining what infrastructure
			will be needed to support the city as a whole.
			Sunnyvale is a "potential" Google Fiber city, but has no plans to pursue fiber-to-the-premises at this time.
35	Truckee/Truckee Donner	Dark Fiber	No update available.
	Public Utilities District		
36	Union City	Provide fiber in a former	Union City spent \$318,000 of bond money to run new high-
	-	industrial area to encourage	speed Internet fiber lines underground near the Union City
		pusiness development and	BART station as part of its larger effort to try to attract and retain businesses
		recention.	Tetain businesses.
			In February 2017, the City Council authorized
			Communication Network Resources to pull the lines
			Road and Cheeves Way. in the city's southern end.
			The underground conduit where the fiber will be installed
			Is already in place, a result of the city's more than 15-year effort to revitalize a former industrial area into transit-
			oriented housing and office space known as the Station
			District.
			The fiber will be "dark" at first, as the city will need to work
			out a deal with an Internet provider to eventually add
			service to the lines. The goal is to create incentives for
27	Vallaia	Public-Private Partnershin	businesses to move to Union City.
3/	vallejo	r ublic r muter arthership	City owns and operates approximately 36 miles of three-
		Business Internet services	inch conduit. The majority of the conduit was built for
			traffic communications. Fiber is routed from City locations
			hub at City Hall. The Ethernet switches are interconnected
			with the main City network hub at City Hall. The remainder
			of the conduit not containing fiber generally contains
			twisted-pair copper cables used for traffic signal
			its existing fiber network to Inyo Networks, Inc., which will
			then provide internet service to city facilities, along with
			businesses, medical facilities, other governmental
38	Vernon: Vernon Gas &	Citywide FTTP	Vernon is the smallest incorporated city in the state of
50	Flectric Department Fiber		California. Describing itself as "exclusively industrial," the
	Optic Division	Business and Residential	city is home to over 1,800 businesses that employ 50,000
		internet services	people from surrounding communities. The residential
			network offers these few residents an opportunity to
			connect.



Note: This information was obtained from various city and county web sites, news outlets, and other entities that track municipal broadband projects. The City of Palo Alto cannot guarantee the accuracy of this information.



HISTORY OF THE CITY OF PALO ALTO DARK FIBER OPTIC BACKBONE NETWORK FIBER-TO-THE-PREMISES AND WIRELESS COMMUNICATIONS INITIATIVES

This document is intended to provide a summary of the highlights of the City's dark fiber optic backbone network, in addition to various initiatives to expand the network for citywide fiber-to-the-premises and wireless services.

City of Palo Alto Dark Fiber Optic Backbone Network

The dark fiber optic backbone network ("fiber network") was originally conceived by the City in the mid-1990s and is maintained and operated by City of Palo Alto Utilities ("CPAU"). The City's initial telecommunications strategy was to build a dark fiber ring around Palo Alto that would be "capable of supporting multiple network developers and/or service providers with significant growth potential." In the mid-1990s, most investor-owned and public utilities invested in fiber optics to improve command and control of their utility infrastructure. Many of these networks typically had excess capacity that could be licensed or leased to third parties.

The first phase of the fiber backbone construction occurred in 1996-1997. The initial portions of the network were constructed in a backbone ring architecture in existing utility rights-of-way. The fiber backbone was routed to pass and provide access to key City facilities and offices. The majority of the City's business parks (e.g. Stanford Research Park) and commercial properties are also passed by the fiber backbone. The original fiber backbone consisted of 33 route miles with 144 or more strands of single-mode fiber along most routes. Since the late 1990s, the fiber backbone has been expanded to approximately 49 route miles of mostly 144- or 288-count single-mode fiber.

Fiber network construction was financed internally by the Electric Enterprise Fund through a 20-year, \$2 million loan at a 0% interest rate. These funds were used to construct the network and to cover operating expenses. At the end of Fiscal Year 2008, the fiber optics business completed the loan repayment to the Electric Enterprise Fund for all capital and operating expenses from the beginning of the project. A separate Fiber Optics Enterprise Fund, capable of maintaining its own capital and operating budgets and financial operating reserve, was also created. In Fiscal Year 2009, a Fiber Optics Enterprise Fund Rate Stabilization Reserve (RSR) was established.

The fiber network was built in part in response to telecommunications service providers such as emerging Competitive Local Exchange Carriers (CLECs) that would use available dark fiber to provide various telecom services. In the mid-1990s, there was a high demand for fiber transport facilities to support the expansion of bandwidth-intensive broadband services.

By the late 1990s, many CLECs left the market either through mergers with other CLECs or bankruptcy; the so-called "dot com bust" also occurred at roughly the same time. As a result, the anticipated demand for dark fiber in the original target market proved to be somewhat limited. By the late 1990s there was a glut of available dark fiber in many areas of the country. Nonetheless, it was evident that a fiber network would be a valuable asset for command and control of City of Palo Alto Utilities (CPAU) facilities (e.g. electric substations) and other critical City infrastructure such as traffic signals. The network would also support a wide range of broadband voice, data and video applications for City departments, in addition to various commercial users, telecommunications service providers, and the community as a whole.



In 2000, the City began to license "dark fiber" for commercial purposes. Dark fiber is unused fiber through which no light is transmitted, or installed fiber optic cable not carrying a signal. The basic business model is to provide dark fiber connectivity to users requiring access to large amounts of bandwidth. Customers are responsible for providing and maintaining the equipment to "light-up" or provision licensed fiber strands. Dark fiber is licensed or leased by a provider such as the City without the accompanying transmission service. In contrast, traditional telecommunication service providers only make available certain products (commonly known as "managed services") within their service options that may not adequately meet the requirements of the specific applications.

The fiber network has high market share and brand awareness among commercial enterprises and other organizations that need the quantity and quality of bandwidth provided by direct fiber optic connections.

By connecting to the City's fiber backbone, the customer gains fiber access to their Internet Service Provider (ISP) of choice. A dark fiber customer can interconnect communications systems or computer networks across multiple Palo Alto locations and can also connect directly to their local and/or long distance carrier(s) of choice with a full range of communications services. Dark fiber customers can also have redundant telecommunication connections for enhanced reliability.

Many of the City's commercial dark fiber customers gain access to the Internet through the Palo Alto Internet Exchange (PAIX, now owned by Equinix). PAIX is a carrier-neutral collocation facility and hosts over 70 ISPs at their facility located in downtown Palo Alto. Equinix has 21 similar facilities in the United States and other collocation facilities in Asia and Europe.

The City currently licenses dark fiber connections to 107 commercial customers. The fiber network also serves the following City accounts: IT Infrastructure Services, Utilities Substations, Utilities Engineering, Public Works, Water Quality Control Plant and Community Services (Art Center). The total number of dark fiber service connections serving commercial customers and the City is 219 (some customers have more than one connection). At the end of fiscal year 2016, the licensing of dark fiber service connections resulted in a fiber reserve of approximately \$24 million. There is a separate \$1.0 million Emergency Plant Replacement fund. According to the proposed Fiscal Year 2017 Budget, the fiber reserve is projected to increase by \$2.3 million.

Annual dark fiber license revenues come from the following customer categories:

• City service connections: 27% of gross revenues.

Private sector entities licensing dark fiber from the City:

- Resellers: 42% of gross revenues. "Resellers" are telecommunication companies that purchase large amounts of transmission capacity from other carriers and resell it to smaller end-users. Examples of resellers are telecom companies that sell broadband, telephony and video services to the commercial and residential markets.
- Various commercial enterprises: 31% of gross revenues. Examples of private end-users are companies involved in various technologies, web hosting, social media, finance, medical, pharmaceuticals, research and development, software, law firms, consulting firms, e-commerce, etc.



Service offerings: Dark fiber backbone license fees are based on the number of fiber miles per month. The base license price is \$272.25 per fiber mile, per month. Quantity, route, length, topology, and other discounts are available. The minimum backbone license 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. Available configurations include point-to-point and diverse rings.

The majority of business parks and commercial properties are passed by the fiber backbone. In 2014, CPAU completed a project to serve all Palo Alto Unified School District facilities with dark fiber service connections.

2016 - 2017: In 2016, CPAU retained Celerity Integrated Services, Inc. to provide a one-time comprehensive review and audit of the City dark fiber optic network. Celerity completed the review and audit and provided a physical description of the network; documented the number of fiber strands, in addition to conducting an inspection of 90 fiber nodes/cabinets (i.e. network splice points) to identify what is labeled within the individual nodes/cabinets.

CPAU Engineering is currently working with CAD Masters to reconcile the audit data provided by Celerity with various fiber databases, in addition to rebuilding front-end databases to facilitate fiber assignments at the engineering level and to improve network mapping.

In 2017, CPAU initiated a \$1.3 million backbone rebuild project that will install new aerial duct or substructure (conduit and boxes), in addition to fiber backbone cable to increase capacity for sections of the dark fiber ring that are at or near capacity. This project will allow CPAU to meet customer requests for services. The project areas primarily cover the Stanford Research Park, Palo Alto Internet Exchange/Equinix at 529 Bryant, and Downtown areas. This project basically "overlays" new fiber over existing fiber routes in the network. Existing fiber will continue to serve City facilities and commercial dark fiber customers.

Fiber-to-the-Premises

For more than fifteen years, the City has worked to develop a business case to build a citywide fiber-to-the-premises ("FTTP") network to serve homes and business. A number of business models have been evaluated. The following is a summary of the highlights to develop a network:

1999: A Request for Proposal (RFP) was issued to build citywide FTTP. There were no viable bids.

2000-2005: The City Council approved a Fiber-to-the-Home ("FTTH") trial to determine the feasibility of providing citywide FTTH access in Palo Alto. The FTTH trial passed 230 homes and included 66 participants in the Community Center neighborhood. The purpose of the trial was to test the concept of fiber-to-the-home. The FTTH trial proved successful (i.e., proved technical feasibility), but when initial investment and overhead expenditures were included in the calculation to create a business case, it was not profitable for the City and the trial was ended.

2006-2009: In 2006, the City issued another RFP and negotiated with a consortium of private firms to build FTTP under a public-private partnership model. In 2009, Staff recommended to Council termination of the RFP process and negotiations due to the lack of financial resources of the private firms.

2010: The City responded to Google Fiber's Request for Information.



2011: Staff worked with two telecommunications consulting firm to evaluate the expansion of the existing dark fiber network for its commercial dark fiber licensing enterprise and also to expand the network on an incremental basis to attract a "last mile" FTTP builder and operator. This is a link to the staff report provided to the Utilities Advisory Commission in June of 2011, and the Council Finance Committee in November of 2011:

Subject: Provide Feedback on the Development of a Business Plan for the Citywide Ultra-High-Speed Broadband System Project

http://www.cityofpaloalto.org/civicax/filebank/documents/27421

2012: Staff worked with a telecommunications consulting firm to study the feasibility of an alternative model for citywide FTTP which would rely on homeowners paying on a voluntary basis for some or all of the cost to build-out the existing dark fiber network into residential neighborhoods. The name of this model is "user-financed" FTTP. The analysis concluded that an opt-in FTTP network can be built using a combination of upfront user fees and City financing; however, there is very little probability of the debt incurred being repaid through operations. Ongoing subsidies would be required, very likely in excess of surpluses in the Fiber Optics Fund reserve generated by licensing dark fiber. The study was supported by a market survey which concluded there was limited interest among residents in this model. This is a link to the staff report provided to the Utilities Advisory Commission in June 2012:

Subject: Request for Feedback Concerning the Dark Fiber Optic Backbone Network

http://www.cityofpaloalto.org/civicax/filebank/documents/30112

2013 - **2015**: The City Council started it's *"Technology and the Connected City"* initiative and directed staff to prepare a *Fiber-to-the-Premises Master Plan* and a *Wireless Network Plan*. In 2015, staff worked with a telecommunications consulting firm to prepare these plans and they are provided for your review in this September 28, 2015 Council staff report:

Summary Title: Discussion of Fiber-to-the-Premises and Direction on Next Steps for Fiber and City Wireless Services http://www.cityofpaloalto.org/civicax/filebank/documents/49073

At the September 28, 2015 Council meeting, staff and the consultant reviewed these plans with the Council Members. As a result, a Council Motion directed staff to pursue several initiatives, which are described in this August 16, 2016 staff report which updated the Council about the various activities from the Motion:

Summary Title: Fiber-to-the-Premises update on City Council Motions and Google Fiber http://www.cityofpaloalto.org/civicax/filebank/documents/53363

2014 - 2016: Google Fiber announced Palo Alto as a potential "Google Fiber City" for a build-out of their fiber optic network. Since early 2014, staff has been engaged with Google personnel to complete an extensive checklist process regarding City infrastructure and processes, in addition to negotiating agreements for a project description, utility pole attachments, encroachment permits, environmental reviews and other agreements for cost recovery for use of staff time. Based on Council direction, staff has also worked with Google to develop a "co-build" concept which would explore the feasibility of building a City network in parallel with Google's network. In July 2016, Google announced a delay in their plans for up to six (6) months to build a fiber optic network in Silicon Valley, which also included Mountain View, San Jose,



Santa Clara and Sunnyvale. Google advised staff that they are exploring more innovative ways to deploy their network, which may include implementing wireless technologies. Co-build discussions have also been delayed.

In the summer of 2016, the City approved permits for two cabinets so AT&T can begin to deploy their "AT&T Fiber" service. AT&T is exploring deployment of additional cabinets in 2017. Based on Council direction, staff is also pursuing co-build discussions with AT&T.

On December 12, 2016, staff provided Council with an informational update regarding Fiber-to-the-Premises and wireless initiatives:

Summary Title: Update for Fiber-to-the-Premises and Wireless Initiatives: http://www.cityofpaloalto.org/civicax/filebank/documents/55016

Wireless Network Plan

Based on the above-mentioned Wireless Network Plan, Council directed staff to issue an RFP for a Point-to-Multipoint Secure Access Network for Public Safety and Utilities communications, in addition to an RFP for a Mobile Broadband Network to improve "in-vehicle" broadband access in Public Safety vehicles. Staff is also working to extend the City's existing Wi-Fi service to other City facilities that are currently unserved. Most key City facilities already have Wi-Fi available for staff and public use.

Staff Work Plan Update: City Council Motion from September 28, 2015 (CMR ID #6104) and status of November 30, 2015 (CMR ID #6301) staff recommendations:

	Task		Target Date	Status
Council requests an update to the consultant's report including:				
	a	In the FTTP Master Plan: Detailed assumptions, and their impacts, used to forecast the FTTP capital additions are to be reviewed by Citizen Advisors if there is a disagreement between the consultant's report and the CAC's recommendation, the Staff Report to Council will highlight the discrepancy. Once this is accomplished, a revised forecast is to be provided to the Council as an Action Item;	12/31/2015	Completed. Reviewed assumptions for outside plant costs and capital additions in FTTP Master Plan with CAC and CTC on 1/21/16 and 2/18/16. CAC now in agreement with CTC's FTTP network cost estimates and there are no discrepancies to report.
	b	In the Wireless Network Report:		
		 i. A 20-year forecast should be provided consistent with the FTTP report; 	12/31/2015	Completed
		ii. The description of Scenario 1 lacked both a price forecast and fiber backhaul details for the proposed municipal properties to be served. These details should be included in an update prior to an RFP. Evaluate expanding wireless access in retail areas, with an option for expanding Wi-Fi coverage at City facilities and public areas as part of the RFP (Scenario 1);	9/30/2016	Completed. The cost estimates for the extension of existing City Wi-Fi to unserved City facilities & public areas/parks are shown in Exhibit A. The evaluation of expanding Wi-Fi access in retail areas showed that Wi-Fi coverage in retail areas is adequately provided by the retail

				institutions. Expanding Wi-Fi coverage in these areas is not recommended by City Staff.
2	Iss co foi (So	ue RFP to add dedicated wireless mmunications to increase communication Public Safety and Utilities departments cenarios 3 and 4);	9/30/2017	In progress. The RFQ for the equipment to support the Point-to-Multipoint Network for Secure City Enterprise Access (Public Safety & Utilities) was issued in June 2017. Currently, Public Safety is obtaining a quotation for installation of the equipment. The draft RFP for the Citywide Mobile Data Network for Public Safety is completed and currently being reviewed by the CAO.
3	Dii	rect Staff to bring a dig-once Ordinance;	Fall/Winter 2017	In Progress. The CTC draft report was provided on 5/16/16. The report evaluates existing dig once models from other municipalities and provides recommendations for the City to consider. The CAO, in consultation with cross-departmental staff, is currently reviewing the recommendations contained in the report.
4	Dii Gc the	rect Staff to discuss co-build with AT&T and pogle how the City can lay its own conduit to e premise during the buildouts;		
	а	AT&T	12/30/2016	Completed. The City met with AT&T representatives to discuss a co-

				build opportunity as AT&T deploys their AT&T Fiber Internet service in Palo Alto. AT&T representatives subsequently indicated the company is not interested in a co-build at this time.
	b	Google	TBD	On-Hold. At Google Fiber's request, the discussion regarding deployment of FTTP for the 5 proposed Bay Area cities is on hold while they examine new, innovative methods for fiber deployment.
5	Mo on mo pa ele ma	ove forward with RFI exploring both Muni- vned model with contractors for build and going operations, and Public—private odel with City owned fiber and private rtner (such as Sonic) operating and owning ectronics, considering both Google in the arket and not;	9/30/2016	Completed. The 8 RFIs received have been reviewed and CTC provided an evaluation report of the RFIs in Exhibit B. 3 of the respondent firms were interviewed, none of the respondent's proposals completely align with city goals.
6	Ap Fik Pro an pe	pprove a temporary contract position for a ber and Wireless Telecommunications oject Manager, dedicated to Fiber-to-the- emises and wireless initiatives, in the nount of \$228,000 annually, \$684,000 for a riod up to three (3) years;	TBD	On-Hold. The decision was made to put this position on hold due to the Google Fiber "pause". Staff will evaluate whether a contract position or professional services agreement is needed dependent on City Council's decision regarding next steps for the project.

	Ар	prove and authorize the City Manager or his		
	de	signee to execute amendments to two		
7	со	ntracts with Columbia Telecommunications		
	Со	rporation dba CTC Technology & Energy		
	("(CTC") as follows:		
	а	Increasing the not-to-exceed amount for Contract No. C15152568 (Wireless Network Plan) by \$94,490 from \$131,650 to \$226,140 (includes a 10% contingency for the provision of related additional, but unforeseen consulting services) and extend the contract to June 30, 2016 to develop a Request for Proposal for dedicated wireless communications for Public Safety and Utilities, in addition to evaluating the expansion of wireless access in retail areas	12/31/2015	Completed. Amendment finalized on 1/6/16.
	b	Increasing the not-to-exceed amount for Contract No. C15152569 (FTTP Master Plan) by \$58,850 from \$144,944 to \$203,794 (includes a 10% contingency for the provision of related additional, but unforeseen consulting services) and extend the contract to June 30, 2016 to provide technical analysis of the Request for Information (RFI) responses and any consulting services needed to help develop a "Dig Once" Ordinance for consideration by the Council	12/31/2015	Completed. Amendment finalized on 1/6/16.



DRAFT

UTILITIES ADVISORY COMMISSION MEETING MINUTES OF April 5, 2017 MEETING

ITEM 2: ACTION: <u>Utilities Advisory Commission Recommendation that Council Approve a</u> <u>Recommendations Concerning: (1) Future Plans for Fiber and Broadband Expansion; and (2)</u> <u>Expansion; and (2) Expand Wi-Fi to Unserved City Facilities; and Discontinue Consideration of</u> <u>City-Provided Wi-Fi in Commercial Areas</u>

Strategic Business Manager Dave Yuan gave an overview of past Fiber-to-the-Premises (FTTP) efforts to build a municipally owned network including multiple studies and issuance of various request for proposals (RFPs) and request for information (RFI). In the last couple years, under advisement from Council, UAC, City Manager's Office, and Citizen Advisory Committee (CAC), we've pursed numerous FTTP initiatives such as the master plan, Google Fiber effort, co-build discussions with Google and AT&T, and RFI issuance for a public-private partnership. We have gathered a lot of valuable information through these endeavors. We've come to a point where we're asking UAC and Council to provide us direction on where we should focus our efforts towards in the next year or so. We present you with three options and we would like the UAC to recommend one of these options to Policy & Services Committee (P&S) and Council.

Option 1 – Explore funding models to finance a municipal FTTP network with an estimated cost of \$77.6M.

Option 2 – Pursue a design a fiber-to-the-node network with an estimated cost of \$12M; in addition, explore different funds models to finance the "last mile" build.

Option 3 – Discontinue pursuing FTTP thus pausing municipal FTTP efforts, redirect resources to streamline 3rd party upgrades and allow the market to play out.

Chief Information Officer Jonathan Reichental spoke about the future of wireless services, stating that most industries will be using wireless for most applications in the future. One of five U.S. households are now mobile only access to internet. The number of households with mobile only access is increasing rapidly. It doubled in the last two years from one in ten households in 2013. He discussed the coming Fifth generation (5G) standard, which is intended to be a connection fast enough to replace fixed connections such as cable. 5G specifications is not complete but anticipate it will move to mainstream around 2020. There's a lot of experimentation happening today with 5G. It will be far faster than 4G LTE, a minimum of 20 Gigabits for download and 10 Gigabits for upload, and is far faster than physical connections. 5G will be about 2000x faster than 4G and average U.S. broadband will be 400x faster. Google

had stopped its fiber rollout to focus on wireless broadband. Verizon currently has 5G fixed wireless technology testing underway in "eleven geographies" and "different environments" including urban and suburban settings. AT&T is piloting in Austin, TX with Intel and Ericsson using millimeter wave reaching 1GB speeds up and down. Mobile World Congress 2017, the mobile industry's biggest trade show, 5G was everywhere. Big players Qualcomm, Ericsson, Intel, Nokia, and all chip and mobile leaders betting the future on it. Telecom Italia says Turin, Italy will become 100% 5G by 2020.

Senior Management Analyst Jim Fleming discussed three options being offered tonight for action on Fiber to the Premises (FTTP). The first option was to implement municipal FTTP. The cost was estimated at \$78M for construction, \$8M annual O&M, and would require a 72% take rate. If the City used \$20M from its fiber reserves, required take rate could decrease to 57%. A key consideration for network implementation is how to fund both capital construction costs and ongoing operational expenses. Acknowledging that capital and operating costs associated with a full-scale citywide build-out will be significant, the City will likely have to seek outside funding and/or internal subsidies to support construction and the FTTP network's startup costs. Certain challenges inherent to FTTP deployment are especially pronounced in the Palo Alto. In particular, high construction and labor costs in the Bay Area result in a higher necessary take rate to obtain and maintain positive cash flow. As a comparison, other recent analyses performed by our consultant for municipalities have shown a required take rate in the mid-40 percent range in order to maintain positive cash flow.

The second option was to explore the design of a Fiber-to-the-Node Network, which may provide a platform for Public Safety and Utilities wireless communication in the field, communications support for Smart Grid and Smart City applications, and new dark fiber licensing opportunities. This approach may also create a basis to explore alternative "last mile" models for Fiber-to-the-Premises, including user-financing, creating Assessment Districts, Mello-Roos Community Facilities Districts and/or public-private partnerships. Construction costs were estimated at \$12M to \$15M, with unknown ongoing O&M cost and would be dependent on usage of the network. A FTTN network would require construction of approximately 62 miles of fiber plant, compared to 230 miles for a citywide FTTP network deployment. This network would provide access points to connect neighborhood-area backhaul communications links. The network could be a phased approach for fiber expansion and it may lower the barriers for potential providers to build the so-called "last mile" from neighborhood access nodes to the premises, and provide the City with an economically viable deployment approach. Additionally, this approach may expand the functionality and the choices of technology that can be implemented for Utilities and Public Safety communications, and possibly support communication requirements to implement future Smart City and Smart Grid New opportunities to license dark fiber may also occur, particularly for the applications. wireless carriers who will be densifying their networks to improve coverage and capacity with more wireless communication facilities such as small cell antennas deployed within residential neighborhoods and high traffic commercial areas such as University Ave. These small cell antennas and other distributed antenna systems will need fiber for backhaul purposes to connect to the wireless carriers' macro cellular towers and other network hub sites. This

potential opportunity aligns with the existing commercial dark fiber enterprise. A FTTN network may include an option for the City to build the "last mile" at a later date, or as a means of creating an incentive for a private sector partner to build and operate the last mile. Another potential approach is to direct new investment to neighborhoods that meet established subscription requirements – in other words "take rates." If a certain level of interest was met and property owners were willing to pay for the connections between the neighborhood node and homes and businesses, assessment districts could be created as an incentive to build FTTP

The third option was to stop evaluation of either FTTP or FTTN and focus on streamlining the ability for third parties to perform network upgrades in the City, where feasible. In light of the anticipated upgrade plans by the cable and telco incumbents and challenge in obtaining sufficient market share, another potential option is pausing any further municipal FTTP development efforts at this time. In the interest of improving broadband in Palo Alto, another option is to identify resources and improve coordination of City policies and processes to facilitate network upgrades by the incumbents and other independent ISPs. To that end, the objective of this recommendation is to enhance transparency and predictability for third party providers. Access by third-parties to infrastructure data and assets such as poles, conduits and public rights-of-ways is essential to encouraging broadband improvements. Ensuring efficient and predictable processes that enhance deployments is equally important, as with any public project.

Staff also has two wireless recommendations. The first recommendation is to expand Wi-Fi to unserved City facilities at common areas in Cubberley, Lucie Stern, the Golf Course Pro Shop and Cafe, and Lytton Plaza. A high-level cost estimate for the recommended sites is \$165,000 for installation and \$6,200 for monthly recurring charges. The second wireless recommendation is to discontinue consideration of City Wi-Fi in commercial areas since there have been no specific requests from the business community or the general public for Wi-Fi services in high traffic commercial areas. A significant number of Palo Alto businesses already offer free Wi-Fi service to patrons as an amenity.

Citizen Jeff Hoel serves on the CAC, but expressed his personal views. Hoel referenced a lengthy email that was sent to the UAC. There is \$25M in fiber fund and the dark fiber has revenue stream of \$2.5M per year. User financed approach could be used for part of funding. If planning smart meters in Palo Alto, City could use Electric Special Project fund for fiber. There seems to be enough funding to do FTTP. A previous staff report couldn't find the necessary funds. We can still afford to pay for a very large phase 1 of the project. Sandy, OR had a contest that showed many neighborhoods were interested.

Citizen Herb Borock stated the FTTP project has been managed under multiple departments and no decision has been made on whether it's a project or not. The City just conducted another lengthy study but now no one wants to give it the time of day. The CAC is not present tonight, the sense I have is the CAC is simply responding to what staff says should be done. There have not been substantive discussions, although staff promises stronger action in the future. The CAC can help, but not in role they have today. Create a demand-driven dark fiber partnership, then lease fiber to partner. PA is unique, we have bridge funding for the additional fiber. The main thing is Council needs to make a choice. If we study for 2 more years, it will take too long.

Commissioner Ballantine said he did not think much about the options had changed since the previous year's discussion. He thought the best idea was some kind of citizen referendum about whether it would be possible to raise funds for the rollout. He said tonight's recommendation did not align with the Council's guidance. He did not see any way to reasonably approve any of the three options. It was not reasonable to abandon the effort given Council direction. He thought FTTN might end up coming for free as a result of the smart grid buildout. He understood the issue with financing.

Commissioner Johnston said a member of the public had e-mailed with questions about conflicts of interest. He said he did not have a conflict, and that he did not own the stocks cited in the e-mail. He asked what the revenue might be from an FTTN rollout.

Fleming said it was difficult to predict the revenue, but the business model was in line with the City's current business model. The City currently partnered with resellers of the City's dark fiber service. By contrast, competition in the area of FTTP was very difficult, a new service for the City, with two existing incumbents to compete with.

Commissioner Schwartz asked staff to confirm that FTTN would support a 5G rollout.

Reichental confirmed fiber was essential to support better wireless.

Commissioner Schwartz said it would be helpful to talk about applications that would be enabled by 5G, rather than listing speeds. It helped people relate to the discussion effectively. She also suggested something such as a "scholarship fund." If there was a startup or nonprofit that required fiber, she would like to see the City provide that service at a lower rate. She said she had seen progress since the previous year's discussion, particularly the inclusion of the FTTN option. Lastly, she clarified that in her Commissioner comments, when she had mentioned Chattanooga Electric Power Board, that organization was evaluated as a utility rather than a telecom.

Yuan spoke to the "scholarship fund" idea, saying staff could consider adding fiber under the Emerging Technology program. He said regarding the comments on lack of progress, most of the work over the last couple years have been focused on a potential partnership with Google Fiber, which had not panned out.

Commissioner Danaher said option three was not that feasible. Staff had seen how difficult it was to work with a third party when collaborating with Google Fiber, and he had seen AT&T make excuses and delay, such as the color requirements for equipment cabinets, to delay rollouts. He asked about FTTP, and whether the City would be the service provider or license to third parties. He also said that option #1 will pass all homes, but there's no data collection.

Fleming said in an FTTP rollout it was best for the City to be the provider, but pulling together those services, such as providing cable services, was difficult. It was typically a money-losing business for a small operator. The classic "triple-play" model is outdated. It was possible to partner with an ISP, but that would be a revenue sharing situation, meaning it would be difficult to make any return on investment. The breakeven take rate required to make FTTP work was very high, making it difficult even without a revenue sharing arrangement.

Commissioner Danaher said it would be a matter of what the City was willing to subsidize.

Fleming said that was the case. He noted that Chattanooga, a commonly cited public provider, had built their system using Federal grants, had built it out to roll out a smart grid service, and had been underserved by other telecom providers. One-third of the build costs came from federal grants and they were able to allocate costs against their electric utility. Comcast answered by performing upgrades in Chattanooga to maintain their market share.

Commissioner Danaher asked whether there would be just one provider on the City network. He noted the challenges with that approach. He asked how the buildout of the last mile of an FTTN network would work. How does FTTN get us to FTTP?

Fleming said there were few ISPs who would be interested in partnering and capable of providing services to all homes in the community. Fleming said it's speculative, we might attract a partner. The last mile is the most expensive part of the build and the provider would probably want a guaranteed take rate.

Commissioner Danaher asked about the alternative in which citizens signed up as a neighborhood to fund the last mile.

Fleming said user-financing has been considered but there wasn't enough community interest given the costs. Nowadays, connections to homes could be wireless, which costs much less. The home owner could pay for the wireless connection.

Reichental noted that it was more likely that the last mile would be served wirelessly by 5G providers.

Fleming said that was the likely future business model for Google Fiber.

Commissioner Danaher said it was important to distinguish between the business model and the technology. The business model must be thought through. He said the City could subsidize connections and amortize them over twenty years. He agreed with the assessment on the technology, but still had questions about the technology.

Councilmember Filseth asked whether future wireless technologies could replace the need for fiber backhaul.

Reichental said it was hard to predict, but he did not see anything on the horizon. There was a need for fiber backhaul for good wireless services.

Councilmember Filseth said two things have changed in the past one and a half years. First is whether we get on the Google train? Second, there's more clarity on 5G and it's looking more realistic where fiber to node and wireless to the home is more likely. The fundamental question regularly raised was why the City would want to be in this business in the first place given there are commercial providers and there are a lot of technology services the City does not provide such as ISP, commercial cellular or citywide commercial Wi-Fi. He said he could not speak for the whole Council, but for some the motivation related to a "bad scenario" was one in which laying fiber was so expensive that the first provider in became the sole provider, and he was concerned that with a natural monopoly the operator could end up being rapacious. The concern is we don't want to operate the network but if the monopoly provider is not servicing our community, we wanted an insurance policy against the "bad scenario" such as "dig once" with Google. It seems that 5G and wireless are looking concrete enough at this point, that if we pursue the same path as the incumbents, we would avoid the "bad scenario" because there will be multiple providers. Under option 1, there's a risk that we could have a \$50M - \$100M boat anchor years down the road; if the service provider could provide enough bandwidth through wireless and avoid the massive investment in trenching and adding fiber. He would be cautious in making the investment now under option 1 and would want to see what happens with wireless. The City would likely not lose by delaying a short time. FTTN is a much cheaper option; it could work if wireless is used for the last mile. He also wondered whether FTTN might be obsolete eventually. Is this a logical thought process?

Reichental agreed. This is similar to Clay Christensen's "disruptive innovation" model where a company goes along a path of innovation but an upstart enters the market and makes the technology obsolete. This happens often.

Commissioner Ballantine suggests to prevent a "bad scenario" under option 2, can we implement a neighborhood lottery? Build to the node and extend to premise in one neighborhood, gather data, and experiment partnership models. If a "bad scenario" materializes, we can stop and the cost is marginal.

Chair Cook thanked staff for the presentation. He said option one was infeasible without a vote, given the high costs and take rate required. His "bad scenario" was spending a lot of City money and having it become worthless. Option 2 seemed promising on its face since the Fiber Fund has \$20M - \$25M in reserves, but wondered whether there was really enough value in that option to move forward. Per Jeff Hoel, is this "fiber to the nothing" or "fiber to the node"? He said the benefits for option 2 had to be quantified before the City moved forward. Is there really a tie-in with smart grid and what's the advantage of advanced meters and smart devices? He said some of the possible benefits sounded interesting, but a clearer benefit had to be shown. He was skeptical about 5G, and wanted a clearer explanation of the value. Will FTTN

encourage something, not just something speculative? He did not like option 3. He also did not think municipal Wi-Fi was a good idea. He thought the golf course can pay for its own Wi-Fi. Vice Chair Danaher said he agreed that more work needed to be done on the service provider model associated with FTTN. Under option 2, need to explore design of FTTN, identify service provider model and financing mechanisms. It should be technology independent.

Councilmember Filseth said in looking at option 2, it seems pretty likely that next generation wireless will be much faster than now. If the incumbents are offering 20Mb-40Mb and citizens can get these speeds directly from them without going through the city; we need to think about this when researching. We need to assess the value of option 2. Some customers will pay more for faster speed but most are probably content with their existing service.

Reichental said he was 100% confident various wireless providers would provide speeds above what Filseth stated.

Councilmember Filseth said 3G had not rolled out anywhere near as quickly as had been expected. 2.5G carried people a long way.

Vice Chair Danaher said there were many virtual reality startups, and there were a variety of applications even beyond entertainment such as work, medical, telepresence and other applications that have not been invented. It would require very fast gigabit connection speeds.

Commissioner Schwartz said option 2 is a foundational technology. FTTN which would enable a variety of new technological applications, such as smart grid, interval meters, supply and demand applications and gas and water leak detection which already exists. She said it was hard to find any businesses really using telepresence. But she said that if virtual reality became more prevalent, the FTTN investment would not be a waste of money since it would enable technology for these types of applications. She expected that the consultants hired for the strategic plan would address these issues. We need to build a strategic plan outlining phased application deployment.

Commissioner Ballantine said Palo Alto doesn't have underground wiring citywide. Earlier underground wiring costs more to maintain but future undergrounding was made better because of lessons learned. Utilities has a plan to underground in a piecemeal fashion. For option 2, add an element of option 1 as an experiment so we're able to learn from it.

ACTION: Commissioner Schwartz made a motion to recommend Council approval of Option Two, taking into account UAC feedback on that option including the idea of a neighborhood beta. Commissioner Danaher seconded the motion. The motion passed unanimously (5-0), with Chair Cook, Vice Chair Danaher and Commissioners Ballantine, Johnston, and Schwartz voting yes and Commissioners Forssell and Trumbull absent)

Second motion – Commissioner Schwartz, second Ballantine, approve the recommendations on wireless expansion, excluding extension of Wi-Fi to the golf course and discontinue consideration of City Wi-Fi in commercial areas. (5-0)

EXHIBIT D

ctc technology & energy

engineering & business consulting

Appendix A: Existing Market Assessment Final

Prepared for City of Palo Alto July 2015

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	2.2	2	DSL		9
		2.2	.1	AT&T	9
		2.2	.2	EarthLink	0
		2.2	.3	MegaPath10	0
		2.2	.4	Sonic	0
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1 Existing Market Assessment

This existing market assessment provides an overview of providers that currently offer services with which the City's potential new fiber-to-the-premises (FTTP) enterprise might compete. The information provided here is based on what was publicly available—providers often do not publish extensive information about their networks (e.g., capacity and other specific details).

2 Enterprise Market

This section summarizes competitors for dark fiber and Ethernet services with respect to the enterprise customers within the City of Palo Alto.

During the course of our research, we identified 11 service providers in the Palo Alto area that offer a range of services from dark fiber connectivity to data transport services, with speeds that range from 1 Megabit per second (Mbps) to 100 Gigabits per second (Gbps). Individual providers tailor these services to a customer's requirements, such as speed and class of service. Greater proximity to the provider's existing network infrastructure results in lower service pricing. Providers prefer to offer transport services between locations on their network (On-Net) and provision Multiprotocol Label Switching (MPLS) based services for connecting locations that are Off-Net.

A trend that we expect to continue is the consolidation of competitors through mergers and acquisitions. Competitors are discussed in detail in the following sections.

1.1 Dark Fiber Services

In addition to the City of Palo Alto Utilities (CPAU) dark fiber offering,¹ our analysis found that three service providers in the City offer dark fiber services²: Integra Telecom, Level (3) and Zayo.³ There may be other providers that offer dark fiber (e.g., on a case-by-case basis), but this analysis yielded information only about the three discussed here.

1.1.1 Integra Telecom

Integra Telecom offers dark fiber services within the city. They provide flexible options in securing dark fiber through bundles, lease, and indefeasible rights of use (IRU). The dark fiber routes are depicted in Figure 1.^{4,5} Dark fiber pricing varies individually, based on distance from the

¹ CPAU is engaged in capital improvements for added capacity and to provide additional dark fiber routes.

² An assessment of the potential impact of alternative dark fiber provider offerings to City of Palo Alto's existing dark fiber enterprise is beyond the scope of this analysis.

³ While this analysis yielded only these three, there may be other providers offering dark fiber—for example, on a case-by-case basis.

⁴ <u>http://www.integratelecom.com/pages/network-map.aspx</u>, accessed March 2015.

⁵ As we noted, carriers typically do not publish details such as whether they directly own the routes depicted on their publicly-available maps.

provider's fiber ring. A difference in a few tenths of a mile can lead to significant differences in the price of dark fiber connectivity due to additional construction costs.



Figure 1: Integra Telecom Network Map

1.1.2 Level(3)

Level(3) has multiple dark fiber routes in Palo Alto as depicted in Figure 2.⁶ Services are offered only to select customers based on their application requirements.

⁶ As we noted, carriers typically do not publish details such as whether they directly own the routes depicted on their publicly-available maps.



Figure 2: Level(3) Dark Fiber Routes⁷

1.1.3 Zayo

Zayo provides dark fiber connectivity over its national network of metro and intercity fiber.⁸ The company claims to have proven expertise in deploying major new dark fiber networks and offers multiple financing options including lease or Indefeasible Rights of Use (IRU). Pricing varies significantly depending on whether the building is On-Net or not; if the location is Off-Net, construction and splicing costs would apply.⁹

⁷ <u>http://maps.level3.com/default/</u>, accessed May 2015.

⁸ Zayo is also a CPAU Value Added Reseller (VAR), based on conversations with CPAU staff.

⁹ <u>http://zayofibersolutions.com/why-dark-fiber</u>, accessed May 2015.



Figure 3: Zayo Fiber Map¹⁰

1.2 Ethernet Services

Most existing service providers offer enterprise-grade Ethernet based services. These are typically classified under two categories: point-to-point connectivity and access services, such as Dedicated Internet Access (DIA) and IP Virtual Private Networks (IP-VPN). Bandwidths range from 1 Mbps to 100 Gbps. Providers prefer to offer MPLS based IP-VPN services when the service locations are Off-Net to avoid construction and installation costs. MPLS based networks provide high performance for real-time applications like voice and video, and are typically priced higher.

The carriers who provide these services in the Palo Alto region are AT&T, CenturyLink, Cogent Communications, Comcast, ¹¹ Integra Telecom, Level (3), Megapath, Verizon, Windstream Communications, XO Communications and Zayo. Prices depend on the bandwidth, location, and network configuration, whether the service is protected or unprotected, and whether the service has a switched or mesh structure.

1.2.1 AT&T

AT&T has four different types of Ethernet products—GigaMAN, DecaMAN, Opt-E-MAN, and Metro Ethernet. GigaMAN provides a native-rate interconnection of 1 Gbps between customer end points. It is a dedicated point-to-point fiber optic based service between customer locations which includes the supply of the GigE Network Terminating Equipment (NTE) at the customer

¹⁰ <u>http://www.zayo.com/network/interactive-map</u>, accessed March 2015.

¹¹ It appears Comcast may be pursuing the enterprise market more aggressively through means like going into wireless backhaul. <u>http://www.fiercetelecom.com/offer/gc_backhaul?sourceform=Organic-GC-Backhaul-FierceTelecom</u>, accessed July 2015.

premises. DecaMAN connects the end points at 10 Gbps and is transmitted in native Ethernet format similar to GigaMAN, only 10 times faster. Opt-E-MAN service provides a switched Ethernet service within a metropolitan area. It supports bandwidths ranging from 1 Mbps to 1,000 Mbps, and configurations such as point-to-point, point-to-multipoint, and multipoint-to-multipoint. Metro Ethernet service provides various transport capabilities ranging from 2 Mbps through 1 Gbps while meeting IEEE 802.3 standards.¹²

1.2.2 CenturyLink

CenturyLink provides point-to-point inter-city and intra-city configurations for full-duplex data transmission.¹³ The company offers speeds of 100 Mbps to 10 Gbps.¹⁴

1.2.3 Cogent Communications

Cogent Communications' Ethernet services are available at speeds of 1.5 Mbps to 10 Gbps.¹⁵ The company provides middle mile services with the last mile service provisioned through local exchange carriers (LEC).¹⁶ Often, more competitive pricing and better customer support is available through Cogent even though the company utilizes the LECs' last-mile services. Cogent has two on-net locations (data centers) in the City.

1.2.4 Comcast

Comcast provides Ethernet Private Line (EPL) services. EPL service enables customers to connect their Customer premises equipment (CPE) using a lower cost Ethernet interface, as well as using any Virtual Local Area Networks (VLAN) or Ethernet control protocol across the service without coordination with Comcast. EPL service is offered with 10Mbps, 100Mbps, 1 Gbps or 10 Gbps Ethernet User-to-Network Interfaces (UNI) and is available in speed increments from 1 Mbps to 10 Gbps.¹⁷

It is important to note that Comcast began offering "Gigabit Pro" service in 2015, a 2 Gbps service priced at \$300 per month with installation fees of up to \$1,000.¹⁸ Given the installation and monthly fees, this service is priced out of most residential users' reach. Further, the service does not have the bells and whistles that traditional Metro Ethernet has—such as committed interface

¹²

http://www.business.att.com/service_overview.jsp?repoid=Product&repoitem=w_ethernet&serv=w_eth

¹³ CenturyLink is also a CPAU VAR and typically uses ring configuration for redundancy, based on conversations with CPAU staff.

¹⁴ <u>http://www.centurylink.com/business/products/products-and-services/data-networking/private.html</u>, accessed May 2015.

¹⁵ <u>http://www.cogentco.com/en/products-and-services</u>, accessed May 2015.

¹⁶ Cogent is also a CPAU VAR, based on conversations with CPAU staff.

 ¹⁷ <u>http://business.comcast.com/ethernet/products/ethernet-private-line-technical-specifications</u>, accessed April
 2015.

¹⁸ <u>http://www.theverge.com/2015/7/13/8949207/comcast-gigabit-pro-price-300</u>, accessed July 2015.

rates. However, if Gigabit Pro is successful, it could disrupt the Metro Ethernet market by filling a mid-range gap with service and pricing that has not previously existed.

1.2.5 Level(3)

Level (3)'s Metro Ethernet dedicated service is available in bandwidth options of 3 Mbps to 1 Gbps and its Ethernet Virtual Private Line (VPL) offers in speeds ranging from 3 Mbps to 10 Gbps.¹⁹ It is an end-to-end Layer 2 switched Ethernet service delivered via a Multi-protocol Label Switched (MPLS) backbone. Internet services are available in a range of 14 speeds up to 10 Gbps.²⁰

1.2.6 Megapath

Megapath offers business Ethernet services in the Palo Alto area with advertised speeds up to 45 Mbps. Higher speeds are available on a case- by-case basis.²¹

1.2.7 Integra Telecom

Integra Telecom offers Ethernet services from 1.5 Mbps to 10 Gbps. The point-to-point E-Line and multipoint -to -multipoint E-LAN configurations are available.²²

1.2.8 Verizon

Verizon offers Ethernet services under three different product categories—Ethernet Local Area Network (LAN), EPL, and EVPL. The Ethernet LAN is a multipoint-to-multipoint bridging service at native LAN speeds. It is configured by connecting customer User-to- Network Interfaces (UNIs) to one multipoint-to-multipoint Ethernet Virtual Connection or Virtual LAN (VLAN), and provides two Class of Service options—standard and real time. The Ethernet Private Line is a managed, point-to-point transport service for Ethernet frames. It is provisioned as Ethernet over SONET (EoS) and speeds of 10 Mbps to 10 Gbps are available. The EVPL is an all-fiber optic network service that connects subscriber locations at native LAN speeds; EVPL uses point-to-point Ethernet virtual connections (EVCs) to define site-to-site connections. It can be configured to support multiple EVCs to enable a hub and spoke configuration and supports bandwidths from 1 Mbps to 10 Gbps.²³

¹⁹ <u>http://www.level3.com/en/products-and-services/data-and-internet/vpn-virtual-private-network/evpl/</u>, accessed March 2015.

²⁰ <u>http://www.level3.com/~/media/files/factsheets/en_ethernet_fs_ethernetmatrix.pdf</u>, accessed April 2015.

²¹ <u>http://www.megapath.com/data/ethernet/</u>, accessed May 2015.

²² <u>http://www.integratelecom.com/enterprise/products/pages/carrier-ethernet-services.aspx</u>, accessed May 2015.

²³ <u>http://www.verizonenterprise.com/products/networking/ethernet/</u>, accessed April 2015.

1.2.9 Windstream Communications

Windstream Communications has a nationwide presence serving major metropolitan areas, including the City, with private line and MPLS VPN services with speeds up to 10 Gbps.^{24, 25}

1.2.10 XO Communications

XO Communications offers carrier Ethernet services at multiple bandwidth options from 3 Mbps to 100 Gbps over their Tier 1 IP network.^{26, 27}

1.2.11 Zayo

Zayo delivers Ethernet in three service types with bandwidth ranging from 100 Mbps to 10 Gbps and options like quality of service (QoS) guarantees and route protection based on customer needs. The different types of services offered are: Ethernet-Line, which provides point-to-point and point-to-multipoint configurations with reserved bandwidth availability; Ethernet-LAN, with multipoint configurations having a guaranteed service level; and Ethernet Private Dedicated Network (E-PDN) with a completely private, managed network operated by Zayo with dedicated fiber and equipment.²⁸ As an example of pricing, Zayo charges a monthly recurring cost of \$1,613 to \$2,090 (depending on contract term) for 1 Gbps point-to-point Ethernet service between On-Net sites in the Los Angeles region that are three miles apart.

²⁴ <u>http://carrier.windstreambusiness.com/wordpress/wp-content/uploads/2014/10/Carrier-Ethernet-Ordering-Guide-10.8.14.pdf</u>, accessed April 2015.

²⁵ <u>http://www.windstreambusiness.com/shop/products/ca/palo-alto,</u> accessed May 2015.

²⁶ <u>http://www.xo.com/carrier/transport/ethernet/</u>, accessed May 2015.

²⁷ <u>http://www.xo.com/network-services/internet-access/ip-transit/100G/</u>, accessed May 2015.

²⁸ <u>http://www.zayo.com/ethernet,</u> accessed April 2015.

2 Residential and Small Business Services

Residential and small business customers in the Palo Alto region have access to a range of services, though individual service options are dependent on location. Table 1 lists the service providers and minimum price for each type of service that is available in at least some part of the City.

Service Type	Provider	Minimum Price (per month)
Cable	Comcast	\$29.99
DSL	AT&T	\$29.95
	Earthlink	\$80
	MegaPath	\$45
	Sonic	\$40
Satellite	DishNET	\$49.99
	Exede	\$49.99
	HughesNet	\$49.99
3G/4G/	AT&T	\$50
WISP	Cricket	\$35
	Sprint	\$35
	Verizon	\$60
	T-Mobile	\$20
	Etheric Networks	\$85

Table 1: Overview of Residential and Small Business Data Services in Palo Alto

2.1 Cable

Comcast offers internet service from 3 Mbps to 150 Mbps download speeds starting at \$29.99 per month in the City as illustrated in Table 2. Promotional rates are available for the first year after which the rates increase. Discounted prices are available if bundled with another service like voice or TV.²⁹ On the small business side, multiple options are available starting at 16 Mbps download speeds up to 150 Mbps download speeds as illustrated in Table 3.³⁰ Bundling with voice introduces a savings of \$30-\$40.

²⁹ <u>http://www.comcast.com/internet-service.html</u>, accessed March 2015.

³⁰ <u>http://business.comcast.com/internet/business-internet/plans-pricing</u>, accessed May 2015.

PACKAGE	INTERNET SPEED	REGULAR PRICE	PROMO RATE
Economy	Up to 3 Mbps download	\$39.95/mo	-
Performance Starter	Up to 6 Mbps download	\$49.95/mo	\$29.99/mo
Performance	Up to 25 Mbps download	\$61.95/mo	\$39.99/mo
Blast!	Blast! Internet - up to 105 Mbps download	\$78.95/mo	-
Extreme	up to 150 Mbps download	\$114.95/mo	-

Table 2: Comcast Residential Internet – Internet Only

Table 3: Comcast Small Business Internet – Internet Only

PACKAGE	INTERNET SPEED	PRICE
Starter	16 Mbps download/3 Mbps upload	\$69.95/mo
Deluxe 50	50 Mbps download/ 10 Mbps upload	\$109.95/mo
Deluxe 75	75 Mbps download/15 Mbps upload	\$149.95/mo
Deluxe 100	100 Mbps download/20 Mbps upload	\$199.95/mo
Deluxe 150	150 Mbps download/20 Mbps upload	\$249.95/mo

2.2 DSL

Four providers offer DSL services in Palo Alto: AT&T, EarthLink, MegaPath, and Sonic.

2.2.1 AT&T

AT&T offers DSL service for residential customers in Palo Alto starting at as \$29.95 per month for unbundled or standalone DSL service at 3 Mbps with a 12-month commitment. Additional options up to 45 Mbps are available as indicated in Table 4.

INTERNET SPEED	REGULAR PRICE	PROMO RATE	
Up to 3 Mbps download	\$42/mo	\$29.95/mo	
Up to 6 Mbps download	\$52/mo	\$34.95/mo	
Up to 18 Mbps download	\$62/mo	\$44.95/mo	
up to 45 Mbps download	\$82/mo	\$44.95/mo	

Table 4: AT&T Residential Internet – Internet Only

2.2.2 EarthLink

EarthLink provides DSL based business services in the region starting at \$80 per month and offering speeds up to 6 Mbps with 99.9% network availability.³¹

2.2.3 MegaPath

MegaPath is an Internet service provider that offers speeds of up to 20 Mbps download and 1 Mbps upload for business customers in certain parts of Palo Alto.³² The lowest plan offered by them is for 1.5 Mbps download speeds at \$45 per month.

2.2.4 Sonic

Sonic offers residential internet services at 20 Mbps and 40 Mbps at a rate of \$40 per month and \$60 per month respectively in Palo Alto. The service also includes a phone connection. The provider is promoting the development of gigabit fiber connectivity on a neighborhood by neighborhood basis depending on the interest shown by consumers.³³ Sonic also offers business internet and phone service in some locations in Palo Alto for \$89.95 per month for speeds of 40 Mbps.

2.3 Satellite

Satellite Internet access is available in the area as well and three providers offer the service: HughesNet, Exede, and DishNET.

2.3.1 HughesNet

HughesNet has four packages available for residential users: 1) Connect Satellite with speeds up to 5 Mbps download/1 Mbps upload, a monthly data cap of 5 GB, and 5 GB of "bonus" data (10 GB total) for \$49.99 per month2) HughesNet Power with speeds up to 10 Mbps download/1

³¹ <u>http://www.earthlinkbusiness.com/DSL/</u>, accessed March 2015.

³² <u>http://www.megapath.com/services/</u>, accessed May 2015.

³³ <u>https://www.sonic.com/availability</u> ,accessed May 2015.

Mbps upload, a 10 GB monthly data cap, and 10 GB of bonus data (20 GB total) for \$59.99 per month; and 3) HughesNet Power Pro with speeds up to 10 Mbps/2 Mbps, a monthly data cap of 15 GB, and 15 GB bonus bytes (30 GB total) for \$79.99 per month; and 4) HughesNet Power Max with speeds up to 15 Mbps/2 Mbps, a monthly data cap of 20 GB, and 20 GB of bonus data (40 GB total) for \$129.99 per month.

HughesNet offers two packages for Internet services to small businesses. The Business 50 package provides speeds of up to 5 Mbps download and 1 Mbps upload for \$69.99 per month with a 5 GB per month anytime allowance and 10 GB bonus bytes from 2am to 10 am for a total monthly data allowance of 15 GB. This package requires a two year agreement and only supports up to five users. The Business 100 package provides the same download and upload speeds of the Business 50 package, but offers a higher data allowance threshold of 10 GB per month anytime and 15 GB bonus bytes from 2 am to 10 am for a monthly data allowance of 25 GB. This package also requires a two year agreement and is best for 5 to just over 10 users.

2.3.2 Exede

Exede offers three Internet packages in the region each with up to 12 Mbps download and 3 Mbps upload speeds. These packages are: 1) Evolution 5 with a monthly 5 GB data cap (excluding emails and web pages) for \$49.99 per month 2) Evolution 20 with a 20 GB monthly data cap for \$69.99 per month and 3) Freedom with unlimited access for \$99.99 per month.

2.3.3 DishNET

DishNET offers three residential Internet packages in the region. These packages are: 1) Up to 5 Mbps download speed with a monthly 5 GB data cap and 5 GB of bonus data for \$49.99 per month with a 24-month commitment; 2) download speeds up to 10 Mbps with a 10 GB monthly data cap and 10 GB of bonus data for \$59.99 per month with a 24-month commitment; and 3) up to 10 Mbps download speed with a 15 GB monthly data cap and 15 GB of bonus data for \$79.99 per month with a 24-month commitment.

2.4 Wireless

There are six providers that offer wireless Internet services in Palo Alto: Verizon, Sprint, AT&T, Cricket Wireless, T-Mobile, and Etheric Networks.

2.4.1 Verizon

Verizon offers two 4G LTE data packages with multiple choices for data allowances and pricing depending on the desired mobility and equipment chosen. The HomeFusion Broadband Package is a data-only 4G LTE service with WiFi connectivity and wired Ethernet for up to four devices. There are download speeds of 5 Mbps to 12 Mbps and upload speeds of 2 Mbps to 5 Mbps. Monthly prices range from \$60 for a 10 GB data allowance to \$120 for a 30 GB data cap. Overages are charged at \$10 per additional GB. A two-year contract is required with a \$350 early

termination fee. Verizon offers a \$10 monthly deduction for every month completed in the contract. The Ellipsis JetPack provides a mobile solution with download speeds of 5 Mbps to 12 Mbps and upload speeds of 2 Mbps to 5 Mbps. Prices for the 12 options of data allowances range from \$30 per month for a 4 GB data allowance to \$335 per month for 50 GB of data, in addition to a monthly line access charge of \$20.The device is \$0.99 with a two-year contract. There is a \$35 activation fee.

2.4.2 Sprint

Sprint offers 4G LTE wireless data in Palo Alto. The three data packages offered range from 100 MB per month data allowance for \$15 per month to 6 GB per month data allowance for \$50 per month to 12 GB per month data allowance for \$80 per month. Each MB over the limits is billed at a cost of \$.05. A two-year contract is required as well as an activation fee of \$36, and equipment charges for three different types of devices. There is also an early termination fee of \$200.

2.4.3 AT&T

AT&T also provides 4G LTE wireless data service in the area, but only offers one package type with a 5 GB per month download allowance for \$50 per month. There is an overage fee of \$10 per 1 GB over the limit. There are also equipment charges with or without a contract and an activation fee.

2.4.4 Cricket Wireless

Cricket Wireless, which recently became a subsidiary of AT&T, offers 4G LTE wireless service in Palo Alto with a download speed of up to 8 Mbps with three options for data allowance packages. Starting at \$35 per month for 1 GB of data allowed there are also options for data allowances of 3 GB (\$45) and 10 GB (\$55).Data used beyond allowances are at reduced speeds. There is a \$79.99 modem fee for an additional device. There is a \$15 activation fee, but no contract or early termination fees.

2.4.5 T-Mobile

Of the cellular wireless providers in the area, the least expensive wireless data option offered is from T-Mobile for \$20 per month with a limit of 1 GB per month. T-Mobile offers additional capabilities and increasing data limits at incremental costs in a total of six packages up to \$70 per month for up to 11 GB of data. Depending upon current promotions, the \$35 activation fee may be waived.

2.4.6 Etheric Networks

Etheric Networks is a wireless internet service provider (WISP) that provides services in Palo Alto for speeds up to 30 Mbps.³⁴ The range of speeds and pricing available are indicated in Table 5. A radio and antenna fee of \$299 is also charged during setup and installation.

PACKAGE	INTERNET SPEED	PRICE	
Bronze	Up to 5 Mbps download	\$85/mo	
Silver	Up to 10 Mbps download	\$99/mo	
Gold	Up to 20 Mbps download	\$139/mo	
Platinum	up to 25Mbps download	\$179/mo	
Diamond	up to 30 Mbps download	\$229/mo	

Table 5: Etheric Networks Internet Services

³⁴ <u>http://ethericnetworks.com/residential/</u>. accessed May 2015.

EXHIBIT E

Palo Alto Wi-Fi sites Installation & Monthly Costs (City Staff Estimates)

					Fiber	Exterior	WAP	Equipment	Aerohive	WAP	NW	Equip
Site #	Site name:	# sites	Address:	Monthly	Install	Mount	NIU	Monthly	WAP	Cabling	Equipment	Fotals
Proceed with												
Deployment												
2	Cubberley	1	4000 Middlefield Rd.	\$ 2,361	\$ 4,200		\$ 3,500	\$ 142			\$ 8,500	\$ 16,200
	Theater waiting area	2						\$ 47	\$ 2,800	\$ 800		\$ 3,600
	Classrooms A - H	8						\$ 560	\$ 33,600	\$ 24,000		\$ 57,600
	Artist Studio	1						\$ 70	\$ 4,200	\$ 3,000		\$ 7,200
	Dance Studio U	1						\$ 23	\$ 1,400	\$ 400		\$ 1,800
3	Lucie Stern	1	1305 Middlefield Rd.	\$ 647	\$ 2,400						\$ 6,000	\$ 8,400
	Children's Theatre Lobby	2						\$ 47	\$ 2,800	\$ 800		\$ 3,600
	Courtyard in front of outdoor theatre	2						\$ 47	\$ 2,800	\$ 800		\$ 3,600
4 & 5	Golf course: Pro Shop & Bay Café	2	1875 Embarcadero Rd.	\$ 1,351	\$ 3,900		\$ 7,000				\$ 1,000	\$ 11,900
	Pro Shop	4						\$ 93	\$ 5,600	\$ 1,600		\$ 7,200
	Bay Café	4						\$ 93	\$ 5,600	\$ 1,600		\$ 7,200
9	Lytton Plaza: entire plaza	1	202 University Ave.	\$ 635	\$ 21,000	\$ 4,500	\$ 3,500	\$ 123	\$ 1,400	\$ 400	\$ 6,000	\$ 36,800
			Monthly Total	\$ 4,994				\$ 1,245				\$ 6,239
			Installation Total		\$ 31,500	\$ 4,500	\$ 14,000		\$ 60,200	\$ 33,400	\$ 21,500	\$ 165,100

Assumptions and notes:

1 Each connection contains two new fibers from specified location to CC Level A.

2 Established government rate applied

3 Prevaling Utility construction costs

4 CPAU Fiber does not perform substructure work

5 Support during business hours only (8-5)

6 Estimates use existing poles at all locations

7 These estimates are high level "desktop" estimates. Actual fees to be determined by field investigation and contractor bids.

Construction Fees

Overhead per span is \$1,500 Underground is \$75/ft. Small splice box in the sidewalk \$5,000+

Notes

WAP - Wireless Access Point - \$1400 NIU- Network interface Unit - \$3500 Splice - tap point into existing fiber



Utilities Department Version:1.0

Fiber Optic Network Rebuild Project Summary

FIBER-TO-THE-PREMISES AND WIRELESS COMMUNICATIONS INITIATIVES

February 1, 2017

Project Description: The rebuild project will install new aerial duct or substructure (conduit and boxes), in addition to fiber backbone cable to increase capacity for sections of the dark fiber ring that are at or near capacity. This project will allow City of Palo Alto Utilities ("CPAU") to meet customer requests for services. The project areas primarily cover the Stanford Research Park, Palo Alto Internet Exchange/Equinix at 529 Bryant, and Downtown areas. This project basically "overlays" new fiber over existing fiber routes in the network. Existing fiber will continue to serve City facilities and commercial dark fiber customers.

2016: As a first step, CPAU retained Celerity Integrated Services, Inc. to provide a one-time comprehensive review and audit of the City dark fiber optic network. Celerity completed the review and audit and provided a physical description of the network; documented the number of fiber strands, in addition to conducting an inspection of 90 fiber nodes/cabinets (i.e. network splice points) to identify what is labeled within the individual nodes/cabinets.

• CPAU Engineering is currently working with CAD Masters to reconcile the audit data provided by Celerity with various fiber databases, in addition to rebuilding front-end databases to facilitate fiber assignments at the engineering level and to improve network mapping.

2017-2021 Capital Improvement Projects: The budget for the rebuild was reduced by the City Council during the Fiscal Year 2016 budget process. The Fiscal Year 2017 budget reflects this adjustment from \$2.4 million to \$1.3 million. The rebuild is a CIP charged to "system improvements."

- Rebuild Work in Progress
 - Route from PAIX at 529 Bryant to the Park Boulevard Substation. Substructure work, fiber pulling and cabinet installation are nearing completion. The new fiber installed for the backbone rebuild is 312-count single-mode fiber (2 x 144-count single-mode fiber, plus 24-count single-mode fiber).
- Upcoming work scheduled over the next 12 months:
 - Route from Park Substation to Hansen Substation
 - Route from Hansen Substation to Stanford Research Park
 - Additional phases/routes to be determined.

Estimated cost is between \$500,000 and up to \$1,000,000 for substructure work. Approximately another \$250,000 for the overhead portion of the work. CPAU crews are performing the equipment installation, cable pulling and terminations. CPAU's substructure contractor is installing the conduit and boxes.