Benicia Industrial Broadband Project Assessment

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Stephen A. Blum
Tellus Venture Associates

www.tellusventure.com

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1. Executive summary

1.1. Situation

The Benicia Industrial Park and the adjacent Arsenal area lack access to a full menu of commercial and industrial grade broadband facilities and services. This deficit reduces the value of the City of Benicia's commercial real estate inventory by making it less attractive to new or expanding businesses.

This problem is common amongst California cities, particularly those with older industrial areas. High technology businesses will not locate or expand where broadband service is insufficient to their needs, leaving property owners with fewer options for tenants and cities with reduced revenue from jobs, sales and economic growth.

Demand for broadband connectivity continues to grow, by one estimate at the rate of 29% per year. Increased data traffic is only part of the equation. Expectations of service quality, reliability and availability are rising as well. As with roads, water systems and other utilities, broadband infrastructure planning needs to accommodate anticipated needs in the decades to come as well as current demand.

1.2. Solutions

Some cities – Palo Alto, San Leandro and Santa Monica are examples – are involved to one degree or another in developing broadband facilities and services for commercial and industrial areas. Each city has its own particular set of circumstances, constraints and needs, but all have determined that broadband is an essential twenty-first century utility, as necessary for economic development as water or electricity, and that there is a public interest in encouraging its development.

There are many technological options for providing commercial and industrial grade broadband connectivity. Solutions can be based on wireless, copper and fiber optic infrastructure. The choice of technology should be made with both long term economic development needs and the immediate requirements of potential private sector investors in mind.

The City of Benicia has an opportunity to leverage capital improvement funds to incentivize private sector partners to build state-of-the-art broadband facilities in the Benicia Industrial Park and Arsenal area. This investment by the city would cover a substantial portion of construction costs and could generate returns and public benefits on many levels, as well as ensuring the financial viability of ongoing commercial and industrial grade broadband services.

1.3. Recommendation

Several potential service providers were contacted in the course of preparing this report, and most expressed interest in exploring a partnership with the City. This report recommends that the City pursue such a public/private partnership. The first recommended step is to solicit proposals from interested companies that are capable of fulfilling the needs of local businesses and meeting the City's economic development goals.

However, the preference is for a partnership model that minimizes the City's ongoing role in the project while ensuring that sufficient public benefits are generated by its investment, including, particularly, achievement of its economic development goals.

2. Broadband and Economic Development

2.1. Background

Access to broadband service – fast, reliable, high quality links to the Internet and internal networks – is a basic competitive requirement of twenty-first century economies. Broadband availability is one of the first criteria assessed when businesses consider relocating or expanding. It is considered to be a non-negotiable resource that is necessary for businesses to operate and to keep pace with global competitors. Appendix D contains a list of documents, including municipal case studies, that discuss broadband as an essential utility and consider its vital role in economic development.

Similar to planning roads and water supplies, assessing broadband infrastructure alternatives includes consideration of the immediate needs of existing companies as well as long term growth requirements, particularly of new businesses that might be relocated or started in Benicia.

Demand for broadband services, particularly Internet bandwidth, has grown for more than twenty years, and studies and projects are unanimous in agreeing this growth will continue. Cisco[1], a core Internet technology and manufacturing company, projects that traffic will grow at a compound annual growth rate of 29% at least through 2016. Sandvine[2], a research company, estimates that the total of moved data moved across the U.S. Internet infrastructure will grow five-fold over the next five years. Other studies have reached similar conclusions.

The high level of current demand and its anticipated growth have led to recent investments in fiber optic network infrastructure. Google is building fiber infrastructure that reaches homes and businesses in Kansas City and Austin. Nationally, AT&T is extending the reach of its fiber optic networks directly to commercial properties in the central business districts of major cities, and reports healthy uptake so far. However, AT&T has also been candid in saying it will be very selective about where it builds new network infrastructure and it only intends to do so in locations where it can generate a high rate of return on its investments. It has shown no interest in upgrading low density commercial or industrial areas of outer suburbs such as Benicia.

As detailed in a study prepared for the City of Benicia in September 2010, access to broadband facilities in and around the Benicia Industrial Park is insufficient to attract and support high technology companies or, indeed, any modern enterprise that requires

[1] *Cisco Visual Networking Index: Forecast and Methodology, 2011–2016*, Cisco, 2012.

[2] *Global Internet Phenomena Report*, Sandvine, 2013.

affordable, reliable commercial and industrial grade service. Given the increasing reliance of businesses on Internet resources and the overall traffic growth noted above, this lack will only become more acute. The 2010 study also examines the benefits of publicly supported broadband development and the justification for pursuing it.

Because substandard access limits economic growth, many California cities have taken the initiative and pursued municipal broadband projects and public/private partnerships to bridge this gap.

The City of San Leandro recently entered a public/private partnership with a venture called Lit San Leandro. The city provided non-exclusive access to the conduit network it installed to support its traffic signal system. In return the city received dark fiber for its own use, conduit lease revenue in later years and, most importantly, a boost to the local economy. Similar to the Benicia Industrial Park and surrounding area, San Leandro's commercial and industrial areas lacked adequate broadband access. The Lit San Leandro project solved that problem.

Another example is the City of Santa Cruz, which has seen a significant increase in the number of people and businesses added to its downtown economy since an independently owned dark fiber link was built to Silicon Valley. This link provided competition to (and a wider range of choices than) the services offered by AT&T and Comcast. Several co-working centers have sprung up to support entrepreneurs, freelancers, telecommuters and others. City government has proactively supported construction of fiber connections, worked to put more municipal operations online and included broadband connectivity as a master plan element.

Other cities that are directly involved in promoting broadband development and pursuing projects include Palo Alto, Brisbane, Alameda, Oakland, Los Angeles, Santa Monica, Folsom, Lompoc, Watsonville and Shafter. More information can be found in Appendix C. Each city has different resources, needs and priorities, but all have a common interest in ensuring local businesses have access to state-of-the-art broadband service.

2.2. Commercial and industrial broadband needs

“Broadband” refers generally to any telecommunications service capable of supporting digital data transmission at high speeds. These services can include and/or support Internet, television, telephone, private data networks and various specialized uses. Broadband service can be delivered in a variety of ways, including telephone lines (e.g. DSL), coaxial cable (e.g. cable modem), fiber optic cable, wireless cellular/mobile

service (e.g. cell phones, tablets, wireless modems), WiFi, point-to-point and point-to-multipoint fixed wireless service and hybrid networks.

Although different organizations use different criteria, the California Public Utilities Commission considers 6 Mbps download and 1.5 Mbps upload speeds to be the standard for adequate residential broadband service. Consumer-grade Internet access is typically a shared resource, with many subscribers contending for the same bandwidth, and is subject to speed and volume limits as determined by the provider. This type of service often meets the needs of small and medium businesses, but not always. And it is generally inadequate for larger companies, which need commercial and industrial grade broadband facilities.

"Commercial grade" service is defined as being similar to residential service in that the provider takes effectively all responsibility for installing, maintaining and supporting the service. Speeds are similar (6 to 100 Mbps), but service levels, reliability, consistency and pricing are higher. Comcast's Business Class service or AT&T's business DSL service are examples of commercial grade service.

"Industrial grade" service refers to service where the customer plays a much greater role in building and supporting the service, including buying different elements from different vendors and managing installation and support. Speeds would be higher – perhaps as high as a Gigabit per second or more – and quality of service levels could be as high as found in top tier Internet exchanges. DS-3 circuits or dark fiber strands are examples of industrial grade service.

Many different kinds of technology can be used to deliver broadband service, and most are currently in use in and around Benicia. Dedicated wireless links, copper wires and even mobile services can support high speed service. However, these technologies quickly hit limits that are usually inadequate for large commercial and industrial users.

Although improvements continue to be made in the technology used to move data over legacy networks, the primary means of increasing speed is to build fiber infrastructure closer and closer to end users, in order to make copper wire connections shorter.

Dedicated, point to point wireless connections, which are already being used by Benicia businesses, can be very useful in providing connectivity to buildings that lack modern wired infrastructure. This type of service can solve immediate problems for some Benicia Industrial Park tenants, however it is limited in its ability to meet all current needs and it is generally unattractive to prospective tenants because its reliability, quality of service and capacity is significantly lower than fiber.

The capacity of mobile data networks – AT&T, Verizon, Sprint and T-Mobile – continues to increase, however the demand for mobile bandwidth is also increasing. There is no prospect for it to substitute for high capacity wired commercial and industrial services. In fact, like legacy copper networks, one of the primary means of increasing mobile capacity is to extend the reach of fiber backbones in order to make the area covered by cell sites smaller and smaller.

Fiber optic cables themselves, though, can support the highest levels of service and provide the maximum degree of flexibility for sophisticated users, particularly businesses. The cost of installing fiber is higher than building wireless facilities, but the amount of bandwidth it supports is several orders of magnitude higher. Fiber costs are comparable to traditional copper wire facilities: the labor involved in installing cables in conduit or on poles constitutes most of the cost in either case.

These costs can vary greatly. For example, installing fiber optic cable in existing conduit or on poles can cost as little as $5 per foot, although costs in the $10 to $20 per foot range are more common. When conduit has to be installed or poles upgraded, costs can range upwards from $20 per foot to $100 or more. Generally speaking, it is less expensive to install conduit in bare dirt than to cut into and repair streets, and to follow existing utility and transportation right of ways than to blaze new paths.

It is much easier for broadband service providers to make a business case for recovering this cost in residential areas, particularly densely populated urban and suburban neighborhoods. Standardized equipment can be used to provide a managed level of service, and each home can be offered a wide range of products including Internet access, television programming and telephone service. It is a predictable business, and capital investments can be made with a reasonable degree of certainty.

Industrial and commercial customers are much more diverse and less predictable. One business might need Gigabit speeds at top quality of service levels, while the one next door is content with a standard, relatively slow DSL connection. As a result, incumbent carriers tend to approach commercial and industrial customers on a case by case basis or, as AT&T is doing, be extremely selective in choosing locations to upgrade. They do not prospectively build high speed infrastructure. Businesses seeking higher grade service are frequently presented with installation estimates in the thousands and tens of thousands of dollars range.

One solution is for public agencies to create incentives and pursue other means of reducing the risk for private telecommunications companies that are considering building broadband infrastructure in advance of documented needs. These steps have included leveraging existing information technology budgets to provide a base level of

revenue for new systems, streamlining permitting procedures, directing redevelopment funds towards broadband projects and other measures.

3. Benicia Industrial Park

A study[3] completed in September 2010 for the City of Benicia had three key findings regarding the Benicia Industrial Park (BIP):

- *Many BIP tenants (over 30%) believe available Internet services are inadequate for current high-bandwidth applications such as video and telephone calling over the Internet, and almost 20% feel their connections are insufficient for even basic applications such as e-mail and Web browsing (tenants' replies to open-ended questions indicate this is due to insufficient speed, poor coverage or both);*
- *Benicia Industrial Park tenants intend/hope to use Internet access within three-to-five years to run several bandwidth-intensive applications that tenants feel are important to them doing business nationally and internationally; and*
- *Current Internet access services in the BIP will not enable tenants to use the online business applications they foresee being important in five years, particularly given that service in several areas of the BIP are too slow or nonexistent.*

Businesses and commercial property owners in the adjacent Arsenal area face similar constraints.

Data provided by telecommunications companies to the California Public Utilities Commission (CPUC) supports these conclusions. The current CPUC broadband availability map shows substandard service, and even complete service gaps, in BIP and the Arsenal area, while residential areas have a uniformly high degree of service availability. (Full size wireline broadband availability maps for BIP and the Arsenal area are in Appendix B).

BIP broadband availability (see Appendix B)

A site survey conducted on 2 August 2012 with the assistance of Ed Greco from the City of Benicia's Engineering Division provided insight into the service limitations in BIP and the surrounding area. In general, AT&T has built a fiber network in residential areas to support its Uverse television service and also apparently has placed fiber along

[3] *Broadband Needs Assessment for the Benicia Industrial Park*, Successful.com, 15 September 2010.

Industrial Way in BIP. It is possible this fiber was installed to provide connectivity for cellular telephone sites in the area, but it potentially could be used to provide a higher level of service to those business customers that happen to be along its path.

AT&T also owns a major long haul fiber route that runs along East Second Street, on the northern boundary of BIP. Long haul fiber routes are designed to provide connectivity between major metropolitan areas. There is no evidence of an access point to this fiber in the area, however, and as a general rule this kind of fiber route is not available for local services.

It is also possible that other long haul fiber carriers have nearby routes, because these routes frequently follow railroad right of ways and the Benicia-Martinez Bridge serves as a crossing point for fiber cables and other utilities.

With the possible exception of Caltrans facilities, there was no indication that any publicly owned or accessible conduit routes exist in or near BIP, although its possible that some privately owned conduit could be accessible by certified service providers under CPUC rules.

There are several utility pole routes through the area which are similarly accessible. In addition, there are railroad rights of way and buffer zones between parcels which might provide options for installing conduit if property owners consent.

Cellular sites that provide data service are located within the Benicia Industrial Park. These facilities appear to provide consumer-level mobile service, which places a priority on reaching handheld devices and does not focus on fixed locations such as businesses. It is likely that some or all of these sites are connected to fiber optic networks. Several businesses have antennas that are typically associated with fixed wireless Internet providers, however there is no evidence of any wireless data hubs or other facilities that might be used to provided advanced services.

Several current and potential broadband service providers, including AT&T, Comcast, IP Networks, Sunesys and Zayo, were contacted to determine interest in expanding or building fiber infrastructure.

The major consumer-focused carriers did not express any interest in pursuing further investment in BIP and the surrounding area. Smaller telecommunications companies that specialize in serving commercial and industrial customers are generally interested in expanding their presence if any investments are supported by a viable business case.

4. Potential BIP Broadband Initiative

4.1. Technology

There are two principal types of broadband facilities: wireline and wireless. Both types have advantages and disadvantages. There are applications where either might work, and applications where only one type of technology is suitable.

Wireline technologies include copper telephone and cable television systems as well as fiber optic lines.

Wireless technology includes cellular telephone and data services, such as those offered by AT&T, Verizon and other mobile phone companies, WiFi access points, satellite services and fixed wireless systems. Generally speaking, fixed wireless provides Internet service using outdoor antennas installed on homes and businesses. It is most commonly found in rural areas, but it is also sometimes used by businesses, including some in the Benicia Industrial Park, to compensate for poor wireline service.

It is possible that some or all current needs in the Benicia Industrial can be met by either technology. However, as mentioned above, wireless systems have lower capacity limits and quality of service standards than some types of wireline networks, in particular those based on fiber optic technology. There are differences in cost as well. Wireless systems tend to be less expensive to build, but are frequently difficult to upgrade and need to be replaced more often. Fiber optic systems can be relatively expensive initially, but have useful lives measured in decades and can be upgraded by replacing electronics as necessary.

If the City pursues a broadband upgrade initiative in the Benicia Industrial Park, it should do so initially on a technology-neutral basis. Potential partners should be free to propose a wide range of possible solutions, which can then be evaluated on financial and technical merits. **In order to attract the widest variety of alternatives and because service providers will offer proposals based on optimization of their existing infrastructure, the City should not pre-design a network or specify particular technology.** Proposals should be solicited and evaluated on the basis of the likely future needs of current and prospective businesses in the area, given that demand for capacity and requirements regarding quality of service and reliability will continue to rise.

4.2. Scoping a fiber solution

A system based on fiber optic technology would provide the greatest amount of broadband capacity. Examining the costs associated with a fiber optic network provides useful benchmarks that can be used to evaluate all technological alternatives. Doing so does not preclude wireless or copper-based proposals which might also meet needs.

The total combined road mileage in BIP and the Arsenal area is about 17 miles, which includes three miles of East Second Street on the periphery (see table in Appendix A). An engineering study would be necessary to develop a reliable cost estimate for building a fiber network that reaches substantially all the parcels in the two areas, however it is possible to gauge the rough order of magnitude of such a project.

First, it is probably not necessary to install fiber along the full length of every street. Many parcels are accessible from more than one street or can be reached via buffer zones or adjacent properties. It is likely that at least 10 route-miles of new infrastructure would be needed, though.

Second, there appears to be something like an even split between streets served by pole routes and those requiring underground installation (not necessarily 50/50, but more even than, say, 75/25 one way or the other). A reasonable mid-range estimate of underground construction cost is $45 per foot. It could be less than that – in the $25 per foot range – if a substantial amount of bare dirt construction is possible – but it could be more – perhaps in the $60 per foot range or higher – if significant challenges exist.

The cost of installing fiber on existing pole routes is likelier to be at the upper end of the normal range, say around $20 per foot. Many of the poles in BIP are already heavily used and some "make-ready" work will likely be required. If extensive make-ready work is necessary, the cost could be higher.

Averaging $20 and $45 per foot and rounding up gives a starting point of $35 per foot, and a range of about $1.8 million for 10 miles of construction to about $3.1 million for 17 miles. A more pessimistic cost estimate – $45 per foot – gives a range of $2.4 to $4 million. A more optimistic figure – $25 per foot – puts the project in the $1.3 to $2.2 million range.

It's likely that the base cost of building a fiber network that reaches substantially all the businesses in BIP and the Arsenal area is somewhere between an optimistic $1.3 million and a pessimistic $4 million, with a reasonable midpoint somewhere in the $2 million range.

This base cost estimate leaves out two important elements: providing the local fiber network with connectivity to middle-mile and long haul fiber routes, and installing the connections – service "drops" – between fiber on a pole or in a street and the customer's building. These two elements require electronic components as well as additional fiber.

A full network plan and design would include interconnection solutions to the base network, but connections to middle-mile and long haul routes would have to be determined by service providers, and it is reasonable to assume for the sake of this rough, order of magnitude estimate that the cost of these interconnections would be supported by monthly charges. The cost of building drops to customer locations would either be likewise amortized over time or paid for upfront by the customer (or property owner).

4.3. Potential City of Benicia Contributions

The City Council has identified approximately $750,000 of funds previously allocated to another capital improvement project that could be redirected toward fiber infrastructure. This amount represents, perhaps, somewhere between one-half and one-quarter of the total cost of building the base network, and provides a substantial base on which to form a public/private partnership.

Other means of increasing the value of the City's investment in a partnership include waiving or modifying fees for permits and other services, leveraging existing budget items to buy services from the partnership as an anchor tenant and investigating other programs such as utility undergrounding projects.

The City also owns a corporation yard adjacent to the project area, and has jurisdiction over most of the roadways. These assets can potentially be leveraged to reduce construction expenses.

Finally, the City has the standing to bring other interested parties to the table, including property owners and other government agencies, which could also mitigate costs.

On the revenue side the City has already conducted quantitative market demand research[4] that can be used to support a private or public/private business model.

[4] *Broadband Needs Assessment for the Benicia Industrial Park*, Successful.com, 15 September 2010.

4.4. Partnership models

The City has several alternatives it may consider in determining the structure of a public/private partnership, including:

- Full city ownership
- Partial city ownership
- For profit organization, such as a corporation
- Non profit organization
- Cooperative

These options are more fully explained in Appendix C. A California municipality has a large degree of discretion when it comes to offering or participating in telecommunications services within its jurisdiction. City telecommunications services are not generally subject to regulation by the CPUC, but are subject to the same requirements as any other municipal utility.

However, the preference is for a model that minimizes the City's ongoing role in the project while ensuring that sufficient public benefits are generated by its investment, including, particularly, achievement of its economic development goals.

5. Recommendation

The City of Benicia does not have the funds available to pay the full cost of building a fiber network in the project area, nor does it have sufficient staff, facilities or systems to support it. On the other hand, it does have sufficient resources to be a substantial partner in such a venture, to the extent that the City's participation in a public/private partnership could turn a difficult business case into an easily fundable proposition.

Several of the specialized telecommunications companies contacted expressed interest in considering such a partnership, and there are undoubtedly others with similar outlooks.

It is not possible to propose a single solution – either technical or financial – that would suit all potential private sector partners. But those prospective partners – wireless, copper and fiber-based alike – can be presented with an opportunity to offer solutions for commercial and industrial grade broadband service in BIP and the Arsenal area and develop partnership models that would make those solutions possible.

The most effective way to encourage the maximum number of potential partners to evaluate investing in a commercial/industrial broadband network in Benicia and to submit proposals for doing so is through an open and competitive process, either by issuing a Request for Proposal or a less formal tender such as a Request for Information. Recommended elements for this document are contained in a separate report.

6. Appendix A – Project Area Road Mileage

Arsenal Area		
Street Name	**Length (feet)**	**Length (miles)**
Bayshore Road	5,250	1
Adams Street	2,690	0.5
Tyler Street	1,120	0.2
Jackson Street	1,360	0.3
Polk Street	1,250	0.2
Lincoln Street	990	0.2
Grant Street	1,830	0.3
Jefferson Street	1,840	0.3
Park Road	1,820	0.3
Washington Street	540	0.1
Subtotal	18,690	3.5

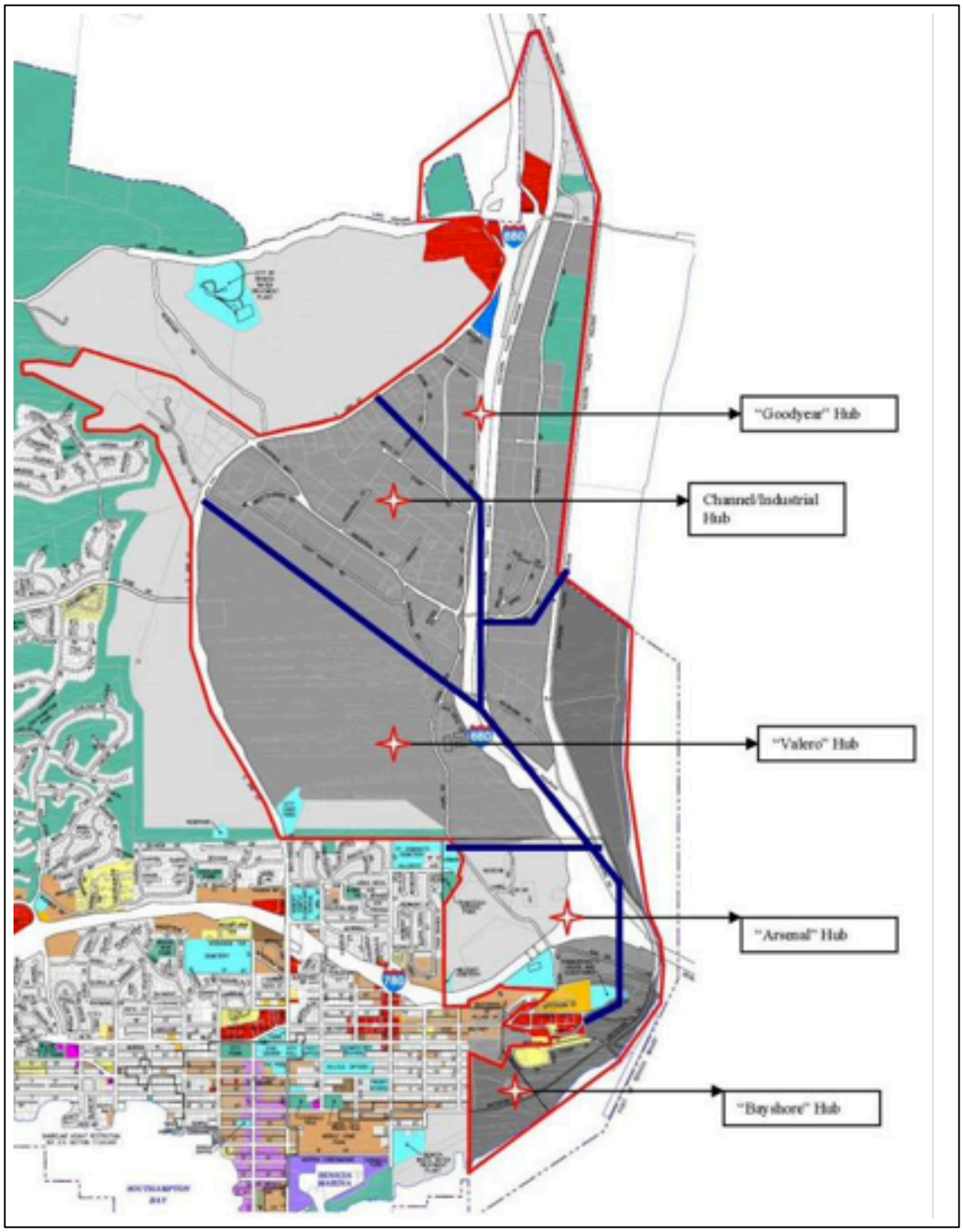
Benicia Industrial Park		
Street Name	**Length (feet)**	**Length (miles)**
Industrial Park		
Industrial Way	16,380	3.1
Industrial Court	930	0.2
East Second Street East	16,050	3
Channel Road	3,740	0.7
West Channel Road	2,070	0.4
Oregon Street	760	0.1
Bayshore Road	3,300	0.6
Park Road	10,080	1.9
Noyes Court	300	0.1
Nevada Street	560	0.1
Indiana Street	1,300	0.2
Iowa Street	740	0.1
Stone Road	3,820	0.7
Getty Court	410	0.1
Wanger Street	960	0.2
Mallard Drive	1,240	0.2
Spring Drive	1,060	0.2
Teal Drive	880	0.2
Teal Court	770	0.1
Gateway Plaza Drive	1,570	0.3
Goodyear Road	2,800	0.5
Bay Vista Court	870	0.2
Subtotal	70,590	13.4
Total	89,280	16.9

Source: City of Benicia

7. Appendix B – Maps

Wireline broadband availability, Benicia Industrial Park (source: CPUC)

Wireline broadband availability, Arsenal area (source: CPUC)



Project area (source: City of Benicia)

8. Appendix C – Public/Private Partnership Options

California cities have a wide range of choices when considering how to pursue broadband projects. They can work with, or even own, for profit corporations, participate in cooperatives and non profit corporations or they can own and operate a broadband network, either fully or in partnership with a private sector company.

Generally, California cities (and special districts) can provide telecommunications services within their boundaries with few restrictions. Even if a city provides a service that falls under the CPUC's jurisdiction, it is exempt from CPUC oversight. On the other hand, it is subject to all the controls, restrictions and obligations that pertain to any other municipal function, such as public oversight, open access and Brown Act requirements.

8.1. Full City Ownership

A common way of organizing a municipal telecommunications utility is to run it via a separate enterprise fund. Several cities received stimulus grants for the purpose of building publicly available telecommunications networks.

Examples:

Cities of Palo Alto and Santa Clara. Both cities operate their own electric utility and have installed fiber optic cables along key utility routes. They lease dark fiber to businesses on a first come, first served basis. Palo Alto shows an annual operating surplus in the million dollar a year range. The fiber networks are run by the electric utility departments, with a mix of dedicated staff and staff that spend part of their time on fiber duties.

City of Santa Monica. The city does not operate an electric utility, but does provide water, waste water and refuse services. It used the fiber optic network installed to support its traffic signal system as the basis for a fiber optic service. It provide dark fiber and “lit” Ethernet connectivity to businesses. It does not directly provide Internet service, but its network can be used to connect directly to Tier 1 Internet providers. The service is run by the city’s IT department.

City of Lompoc. Evaluated both a fiber-to-the-home and a wireless Internet system. Lompoc moved ahead with a WiFi-based Internet utility, and continues to provide basic Internet service to residents on a subscription basis.

City of Alameda. Also an electric utility provider. Alameda built and operated a cable television system that provided TV and Internet service in competition with Comcast. It was financed through bonds, but the system could not support the debt service requirements. Eventually, it was sold to Comcast for about half the value of the bonds. The bondholders are currently suing for the balance.

Advantages: City controls operating policy and benefits from any profits generated, most regulatory requirements do not apply.

Disadvantages: City would have to support any financial deficits, could require additional costs such as staff time.

8.2. Partial City Ownership

When a city contributes resources to a broadband network project, it can take ownership of specific parts of that network, rather than owning and operating the entire system.

Examples include:

City of San Leandro. The city signed an agreement that allows a local company to install fiber optic cables in city-owned conduit on a non-exclusive basis. The agreement eventually provides for lease payments, but the primary initial benefit (in addition to the economic development advantages) is that the city receives ownership of a certain number of fiber optic strands, systemwide. The city has complete discretion over the use of these strands, and may use them for internal networking purposes, or even sell access to private companies. The city has no interest in going into competition against its private sector partner, however it retains that option as a guarantee that the system will always be available to meet economic development goals.

City of Monterey. When Comcast installed an institutional network as part of its former franchise agreement, the city paid for extra fiber strands to be installed. Those strands are the property of the city, and are now being used to provide effectively free connectivity between city locations even though local franchise agreements have been preempted at the state level.

Advantages: City gains access to telecommunications resources for its own use and can exercises a degree of control over the operation of a system that it helped to fund.

Disadvantages: Control is only partial. Continued access to the resource may depend on the viability or cooperation of a private sector partner. Care must be taken to avoid exposure to liability or unreasonable ongoing costs.

8.3. Corporation/LLC

Limited liability companies and for-profit corporations of various types can do business with few restrictions. Telecommunications companies are potentially an exception. For example, if it is deemed to be a telephone company (CLEC/competitive local exchange carrier) a private company would fall under the California Public Utilities Commission's jurisdiction.

Corporations are owned by shareholders, and different classes of stock can have different voting rights. The assets of a corporation can be sold or assigned to shareholders or others with few restrictions. To a great degree, ongoing governance and control of a corporation can be predetermined by the founders, who can also put requirements and restrictions on how it can do business and structure it to achieve goals they set (and benefit from), within limits.

For profit organizations make money, pay taxes and distribute dividends to shareholders. Individual shareholders can usually sell their stock, although there are ways to limit the ability of new stock owners to control the company. The City can be shareholder of such a corporation.

Examples run from the national organizations (AT&T and Comcast) to intrastate networks (Sunesys, Abovenet, IP Networks) to local companies (Cruzio Internet). Cruzio has agreements with the Cities of Watsonville and Santa Cruz for conduit access and colocation of wireless facilities, and participates with other local government agencies in the three-county Central Coast Broadband Consortium.

Several public-private partnerships were formed to apply for broadband stimulus grants in 2009 and 2010. Examples include the City of Oakland and the City of Watsonville.

Advantages: freedom of action, ability to maintain control, able to operate company for the direct benefit of shareholders, able to borrow money and take private investment.

Disadvantages: could bear a regulatory burden, would likely require arms-length dealings with the City, no guarantee that it will always put the public interest foremost.

8.4. Non-Profit

A non-profit corporation can do nearly everything a for-profit corporation can do. The major differences are that a non-profit must offer some kind of public benefit, has limits

on the amount of cash surplus it can generate from its operations and its governance structure is less controllable by the founders.

Non-profits aren't owned by anyone. The corporation is governed by a board that can be chosen by voting members, named by organizations designated in the bylaws or by the board itself. There are restrictions on the degree to which board members can act on items in which they have a financial interest.

With self-perpetuating boards and boards chosen by voting members, there is a chance that the organization will take a direction that was not intended by the founders. A board with directors appointed by other people or organizations, for example the founders, is less likely to take an unintended direction but there are limits on the extent to which appointed directors can act in the interest of their parent organization.

A mutual benefit corporation is another type of non-profit, and is similar in concept to a cooperative.

In California, CENIC (Corporation for Education Network Initiatives in California) is a non-profit that runs a statewide broadband network supporting K-12 and higher education institutions. It is a membership based non-profit, controlled primarily by major public and private universities, which in turn are its major customers. Because it is a non-profit serving primarily government entities (as well as a few private non-profit schools) it can more directly serve the needs of its members than it could if its members were for-profit companies.

The Nevada Hospital Association (technically a not-for-profit professional association) received a $20 million stimulus grant to build a public access fiber network throughout Nevada. OneCommunity received a stimulus grant to build a fiber network in Ohio, as did the University Corporation for Advanced Internet Development, which is working on a national network primarily for higher education use.

Advantage: some freedom of action, less potential for conflict of interest with the City.

Disadvantage: can be difficult to maintain control over the long term, financial and managerial options are restricted.

8.5. Cooperative

Cooperatives are not-for-profit corporations that are usually set up to provide some kind of benefit to members. Commonly, cooperatives are set up to pool buying power. Although there can be different classes of membership with different rights, generally

governance is on the basis of one vote per member, regardless of the amount of business a member does with the cooperative. Operating surpluses, on the other hand, are usually distributed to members according to how much business they do with the co-op.

The board of directors is chosen by a vote of eligible members. Although there are ways that founders can maintain a large degree of influence, it is possible that other members, representing a majority of votes, can gain control.

Examples:

California Broadband Cooperative. A stimulus grant recipient currently building a 500+ mile fiber optic network from Reno, down the eastern side of the Sierra generally along U.S. 395 in California to Barstow.

Plumas-Sierra Rural Electrical Co-op. A rare California example of a traditional rural utilities cooperative. These sorts of organization are common in the midwest and south, and provide telecommunications services as well as electricity.

Mid-Atlantic Broadband Cooperative. Located in rural Virginia, operates a fiber optic network of several hundred miles. Built with tobacco settlement money and stimulus funds.

Advantages: can be run strictly for the benefit of members, has freedom of action and can do business as a private company would.

Disadvantage: can be run strictly for the benefit of members (rather than focusing on public policy objectives), difficult for the founders to maintain control.

9. Appendix D – Reference Material

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10. Appendix E – Glossary

ADSL	Asymmetric Digital Subscriber Line: DSL service with a larger portion of the capacity devoted to downstream communications, less to upstream. Typically thought of as a residential service.
ATM	Asynchronous Transfer Mode: A data service offering by ASI, that can be used for interconnection of customer's LAN. ATM provides service from 1 Mbps to 145 Mbps utilizing Cell Relay Packets.
Backhaul	Connecting Internet access to a location over long or short distances. Traditionally, wired networks have been necessary for backhaul, but with 802.16, also known as WiMAX, backhaul via wireless will become even more common than it is with WiFi.
Bandwidth	The amount of data transmitted in a given amount of time; usually measured in bits per second, kilobits per second, and megabits per second.
Bit	A single unit of data, either a one or a zero. In the world of broadband, bits are used to refer to the amount of transmitted data. A kilobit (Kb) is approximately 1,000 bits. A megabit (Mb) is approximately 1,000,000 bits.
Broadband	"Broadband" refers generally to any telecommunications service capable of supporting digital data transmission at high speeds. These services can include and/or support Internet, television, telephone, private data networks and various specialized uses. Broadband service can be delivered in a variety of ways, including telephone lines (e.g. DSL), coaxial cable (e.g. cable modem), fiber optic cable (e.g. Lit San Leandro), wireless cellular/mobile service (e.g. cell phones, tablets, wireless modems), WiFi, point-to-point and point-to-multipoint wireless service (e.g. TelePacific, Etheric) and hybrid networks (XO Communications). Although different organizations use different criteria, the California Public Utilities Commission considers 6 Mbps download and 1.5 Mbps upload speed to be a standard for adequate broadband service availability. Unless otherwise stated, this report uses the CPUC definition.
Byte	The amount of memory space needed to store one character, which is normally 8 bits.

Cable modem	A device that hooks to your cable TV line to allow your computer to receive data at about 1.5 Mbps. The theoretical maximum for downstream transactions is 27 Mbps and 2.5 Mbps upstream, but the connection is usually much slower because the provider may be hooked to the Internet via a T-1 line.
CDMA	The type of digital cellular phone network used throughout most of the United States, but rare elsewhere in the world. CDMA stands for Code Division Multiple Access, and CDMA2000 1x is the third-generation, or 3G, extension to which CDMA cellular operators are upgrading their networks. It is a digital cellular technology that uses spread-spectrum techniques. Unlike competing systems, such as GSM, that use TDMA, CDMA does not assign a specific frequency to each user. Instead, every channel uses the full available spectrum. Individual conversations are encoded with a pseudo-random digital sequence. CDMA consistently provides better capacity for voice and data communications than other commercial mobile technologies, allowing more subscribers to connect at any given time, and it is the common platform on which 3G technologies are built.
Cell	The geographic area covered by a cellular telephone transmitter. A connected group of cells form a cell system, which is what you gain access to when you sign up for cellular telephone service.
Cellular	A mobile communications system that uses a combination of radio transmission and conventional telephone switching to permit telephone communications to and from mobile users within a specified area.
CLEC	Competitive Local Exchange Carrier: Wireline service provider that is authorized under state and Federal rules to compete with ILECs to provide local telephone service. CLECs provide telephone services in one of three ways or a combination thereof: a) by building or rebuilding telecommunications facilities of their own, b) by leasing capacity from another local telephone company (typically an ILEC) and reselling it, and c) by leasing discreet parts of the ILEC network referred to as UNEs.

Coaxial cable	A type of cable that can carry large amounts of bandwidth over long distances. Cable TV and cable modem service both utilize this technology.
Commercial grade	Broadband service similar to residential service in that the provider takes effectively all responsibility for installing, maintaining and supporting the service. Speeds are similar (6 to 100 Mbps), but service levels, reliability, consistency and pricing are higher.
CPCN	Certificate of Public Convenience and Necessity: Authorization given by the CPUC to telecommunications carriers in order to provide service in the state of California.
Dial-Up	A technology that provides customers with access to the Internet over an existing telephone line.
DS3	A dedicated phone connection supporting data rates of about 43Mbps (megabits per second). Also called a T-3, the line actually consists of 672 individual channels, each of which supports 64Kbps. DS3 lines are used mainly by Internet Service Providers (ISPs) connecting to the Internet backbone. Large businesses also use DS3 lines when they have large sites to interconnect.
DSL	A common form of broadband Internet connection. DSL stands for Digital Subscriber Line.
E-Rate	A Federal program that provides subsidy for voice and data lines to qualified schools, hospitals, CBOs, and other qualified institutions. The subsidy is based on a percentage designated by the FCC. CTF benefits are calculated net of the E-rate subsidy.
E911	Enhanced 911, an emergency service that automatically sends phone number and location information to the operator. E911 comes in handy, say, when you need to get emergency help and are unable to speak or don't know your location.
Ethernet	The most common networking standard in the world, formally known as IEEE 802.3.
Fixed wireless	The operation of wireless devices in a specific location, such as an office. This term is usually reserved for devices that need to be plugged in to operate, such as a desktop computer. If it runs off a battery, it's not fixed wireless. The point-to-point signal transmissions occur through the air over a terrestrial microwave

	platform rather than through copper or fiber cables; therefore, fixed wireless does not require satellite feeds or local phone service. The advantages of fixed wireless include the ability to connect with users in remote areas without the need for laying new cables and the capacity for broad bandwidth that is not impeded by fiber or cable capacities.
FTTN	Fiber To The Neighborhood: A hybrid network architecture involving optical fiber from the carrier network, terminating in a neighborhood cabinet with converts the signal from optical to electrical.
FTTP	Fiber To The Premise (Or FTTB
Gigahertz	A measure of electromagnetic wave frequency equal to one thousand million (1,000,000,000) hertz, often abbreviated as GHz and used to specify the radio frequency used by wireless devices. 802.11a networks operate at 5 GHz. 802.11b and g networks use 2.4 GHz, which is susceptible to interference from nearby cordless phones and microwave ovens that use the same frequency.
GPON	Gigabyte-Capable Passive Optical Network: GPON uses a different, faster approach (up to 2.5 Gbit/s in current products) than BPON.
GSM	Global System for Mobile Communications: This is the current radio/telephone standard in Europe and many other countries except Japan and the United States.
Hub	A common connection point for devices, such as computers and printers, in a network.
ILEC	Incumbent Local Exchange Carrier. An ILEC is a telephone company that was providing local service when the Telecommunications Act of 1996 was enacted. Compare with CLEC, a company that competes with the already established local telephone business.
Industrial grade	Broadband service where the customer plays a much greater role in provisioning and supporting the service, including buying different elements from different vendors and managing installation and support. Speeds would be higher – perhaps as high as a Gigabit per second or more – and quality of service levels could be as high as Tier 1. Comcast's Business Class service or AT&T's business DSL service are examples of

	commercial grade service. A DS-3 or dark fiber strands are examples of industrial grade service.
Inet	Institutional Network. Provides a high-speed connection between government, educational and community entities. It is often negotiated with a cable franchise, in exchange for using right- of-way in a jurisdiction.
ISP	Internet Service Provider: A company providing Internet access to consumers and businesses, acting as a bridge between customer (end-user) and infrastructure owners for dial-up, cable modem and DSL services.
LAN	Local Area Network: A geographically localized network consisting of both hardware and software. The network can link workstations within a building or multiple computers with a single wireless Internet connection.
Last mile	Infrastructure (e.g. fiber optic lines, distribution boxes, equipment vaults, poles, conduit) that provides broadband service to end users or end- user devices (including households, and businesses).
Local Loop	A generic term for the connection between the customer's premises (home, office, etc.) and the provider's serving central office. Historically, this has been a wire connection; however, wireless options are increasingly available for local loop capacity.
MAN	Metropolitan Area Network: A high-speed date intra-city network that links multiple locations with a campus, city or LATA. A MAN typically extends as far as 50 kilometers.
Mbps	Megabits per second: 1,000,000 bits per second. A measure of how fast data can be transmitted.
Middle mile	Broadband infrastructure that does not predominantly provide broadband service to end users or to end-user devices, and may include interoffice transport, backhaul, Internet connectivity, or special access. Middle mile facilities are the link between last mile facilities and major interconnection points, such as those that form the core of the Internet.
Modem	Short for modulator/demodulator. A modem modulates outgoing digital data into analog signals so they can be sent over copper

	phone lines, and demodulates incoming analog signals into digital.
Overbuilders	Building excess capacity. In this context, it involves investment in additional infrastructure project to provide competition.
PON	Passive Optical Network: A Passive Optical Network consists of an optical line terminator located at the Central Office and a set of associated optical network terminals located at the customer's premise. Between them lies the optical distribution network comprised of fibers and passive splitters or couplers. In a PON network, a single piece of fiber can be run from the serving exchange out to a subdivision or office park, and then individual fiber strands to each building or serving equipment can be split from the main fiber using passive splitters / couplers. This allows for an expensive piece of fiber cable from the exchange to the customer to be shared amongst many customers thereby dramatically lowering the overall costs of deployment for fiber to the business (FTTB) or fiber to the home (FTTH) applications.
Rights-of-Way	Legal rights of passage over land owned by another. Carriers and service providers must obtain rights-of-way to dig trenches or plant poles for cable systems, and to place wireless antennae.
Router	An intelligent network device that goes one step beyond bridging by converting address-based protocols that describe how packets move from one place to another. In practice, this generally comes down to translating between IP addresses and MAC addresses for data flowing between your local network and the Internet. Many people use the term interchangeably with "gateway." You must enter the IP address of your router when configuring network settings manually.
Subscribership	Subscribership is how many customers have subscribed for a particular telecommunications service.
Switched Network	A domestic telecommunications network usually accessed by telephones, key telephone systems, private branch exchange trunks, and data arrangements.
T-1	The T-1 standard was introduced in 1961 in order to support a bi-directional speed of 1.5 Mbps at a high quality-of-service level, using the copper wires of the time. Because it is a dedicated and managed circuit, its performance is usually

	substantially better than shared services such as DSL or cable modem, even in cases where the claimed top speed of those shared services is many times higher. A T-1 circuit is generally considered to be the lowest level of service that can be described as industrial or carrier grade.
Telco	An abbreviation for Telephone Company.
Telecommunications	Refers to all types of data transmission, from voice to video.
Throughput	The amount of data that can be transmitted in a given amount of time. Throughput is commonly measured in bits per second. (Although throughput is not really a measurement of speed, most people, including us, use the word "speed" when talking about a high-throughput network.)
Universal Service	The idea of providing every home in the United States with basic telephone service.
Videoconferencing	Conducting a conference between two or more participants at different sites by using computer networks to transmit audio and video data.
VLAN	Virtual Local Area Network. A network of computers that behave as if they are connected to the same wire even though they may actually be physically located on different segments of a LAN.
VoIP	Voice Over Internet Protocol: A new technology that employs a data network (such as a broadband connection) to transmit voice conversations.
VPN	A method of creating an encrypted tunnel through which all traffic passes, preventing anyone from snooping through transmitted and received data. VPN stands for virtual private network.
WAN	Wide Area Network, A collection of local area networks connected by a variety of physical means. The Internet is the largest and most well-known wide area network. Wide area network is generally abbreviated to WAN.
WiFi	Short for wireless fidelity and is meant to be used generically when referring of any type of 802.11 network, whether 802.11b, 802.11a, dual-band, etc. The term is promulgated by the WiFi Alliance. Any products tested and approved as "WiFi Certified" (a registered trademark) by the WiFi Alliance are

	certified as interoperable with each other, even if they are from different manufacturers. A user with a "WiFi Certified" product can use any brand of access point with any other brand of client hardware that also is certified. Typically, however, any WiFi product using the same radio frequency (for example, 2.4 GHz for 802.11b or 11g, 5 GHz for 802.11a) will work with any other, even if not "WiFi Certified." Formerly, the term "WiFi" was used only in place of the 2.4 GHz 802.11b standard, in the same way that "Ethernet" is used in place of IEEE 802.3. The Alliance expanded the generic use of the term in an attempt to stop confusion about wireless LAN interoperability.
WiMAX	Another name for the 802.16 wireless networking specification used for long-haul and backhaul connections.
Wireless ISP	A company that provides wireless Internet access. The term is often abbreviated to WISP.
WLAN	Wireless Local Access Network, a LAN that can be connected to via a wireless connection.

Sources: Tellus Venture Associates, California Public Utilities Commission, Neratech, Wikipedia.