Commercial/Industrial Broadband Infrastructure Analysis

City of Union City

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1.1. Infrastructure

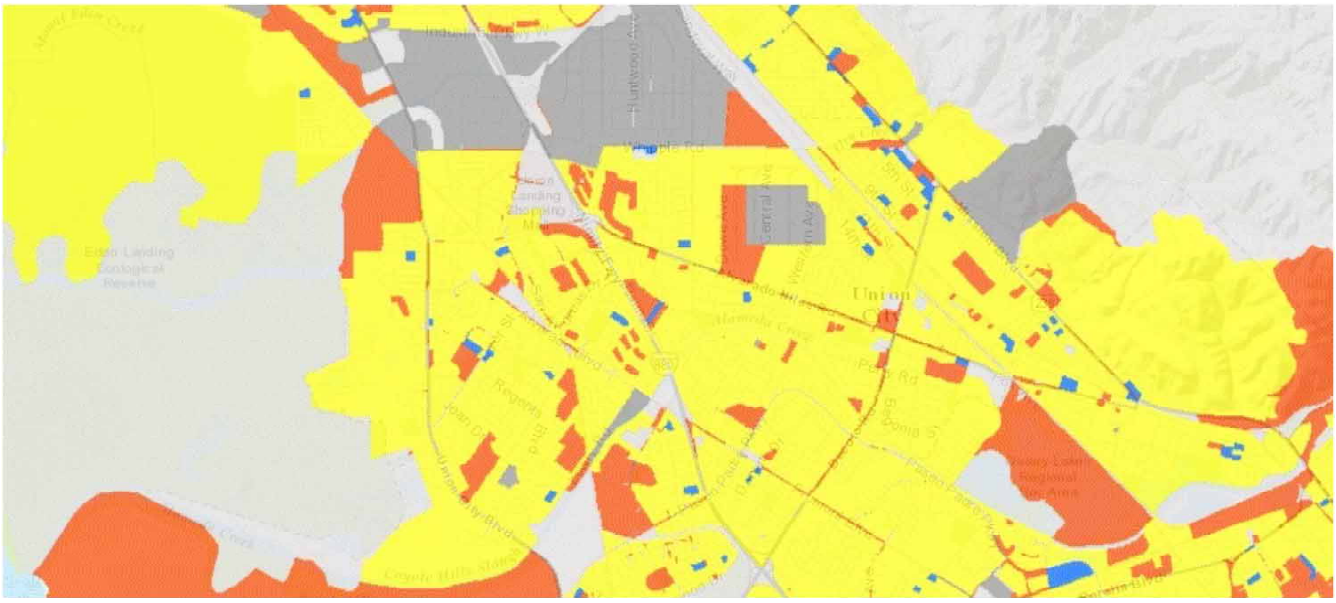


Figure 1.1 – Union city broadband report card. Residential areas are mostly yellow, indicating average "C" grades. Industrial and commercial areas tend toward red and grey, indicating substandard "D" and "F" grades.

AT&T and Comcast are the incumbent telephone and cable companies in Union City, and own and operate the primary broadband infrastructure that provides connectivity to homes and small business throughout. When compared to the statewide average, this primary infrastructure falls a little below average, getting a "C-" grade, which is the typical grade for a city or unincorporated community in the East Bay.

The pattern of deployment, upgrading and maintenance of this infrastructure follows a common pattern among East Bay cities: more infrastructure investment tends to go into residential neighborhoods, where service providers can also sell video services, commercial districts receive less attention and industrial areas least of all. "D" and "F" grades are commonly found in commercial and industrial areas of Union City. This problem is caused by a combination of lack of line extensions by Comcast into commercial and industrial areas, and AT&T's failure to consistently upgrade its DSL infrastructure.

Generally, the maximum broadband download speeds reported by AT&T to the Federal Communications Commission on a census block level range from 768 Kbps to 45 Mbps, with higher speeds generally corresponding to residential neighborhoods where population density is relatively high, with a commensurately higher potential to sell bundles of telephone, broadband and television service. Comcast is not as rigorous in its reporting practices, and simply claims to deliver 150 Mbps download speeds to every location it serves. This claim should not be accepted as a completely accurate description of the service levels experienced by all users.

A number of other companies provide secondary, commercial and industrial grade service in Union City, via infrastructure or facilities they own themselves and/or facilities leased from primary and other secondary providers. Some of this service is delivered using copper lines leased from AT&T with upgraded electronics added by the secondary provider. In other cases, service is provided by a direct fiber connection to the end user. In addition, several fiber network operators have fiber routes running through and connecting to locations in Union City, including Integra, Zayo, Level 3 and BART.

Mobile broadband service in Union City is somewhat poorer than in communities to the north and south. Minimally acceptable service is not available everywhere, but where it is, it ranges from 768 Kbps to 3 Mbps download speeds, according to testing conducted by the California Public Utilities Commission. Fixed wireless operators also provide specialized connectivity services in the Union City area, but reliable coverage, availability and performance information is not available.

1.2. Industrial and commercial areas

Five specific industrial and commercial study areas were selected for particular analysis in this report. The Northwest Industrial Area and the Central Industrial Area have generally poor primary infrastructure which is only partially offset by specialized services offered by secondary companies, including direct fiber to the end user service. The Union Landing and Station District areas also have below average primary infrastructure and little secondary service. Commercial fiber optic lines pass through or near the Northwest Industrial, Central Industrial and Station District areas, but not the Union Landing area. The fifth study area, the Union City Civic Center, has much better primary and secondary infrastructure, and is directly served by commercial fiber lines.

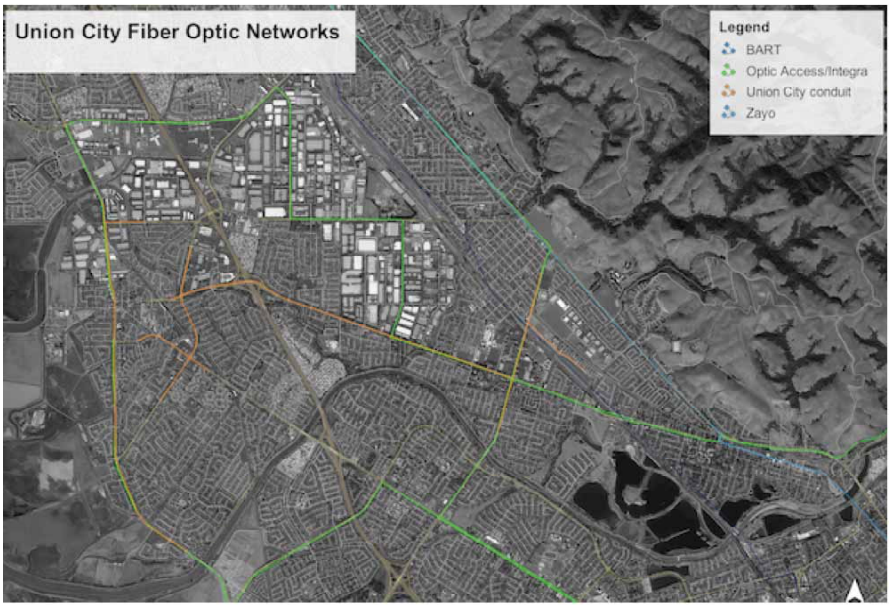


Figure 1.2 – City owned conduit (orange) and fiber networks (green and blue). Larger map in Appendix A.

The City of Union City owns more than ten miles of traffic signal interconnect conduit which complements the existing commercial and BART fiber routes. Use of this conduit to build lateral connections, extensions of existing fiber lines and/or a completely new network would significantly improve Union City's broadband infrastructure and greatly increase the options and service levels available to businesses.

AC Transit is pursuing a project that would involve creating a fiber network along its Number 97 bus route, which runs from the Union City BART station, across town and then north to Hayward and San Leandro. The City's conduit parallels most of this route, creating the potential for a cooperative project.

1.3. Conclusions

This report has three top level recommendations:

- Work with AT&T and Comcast to improve primary broadband infrastructure and service, cooperatively if possible but in a competitive posture if necessary.

- Offer the conduit owned by the City to competitive and/or new telecommunications companies interested in upgrading service to industrial and commercial areas, and consider creating a city-wide network as a municipal enterprise or as a public/private partnership.

- Consider enacting policies that promote telecommunications competition and development.

Specific steps to be considered include:

1. Establish a enquiry and complaint process for businesses that are seeking broadband services or are having problems with current providers. Although the City has limited authority in this regard, collecting this information and making it public is an effective first step toward providing incentives for telecommunications companies to voluntarily cooperate, expanding public knowledge of existing resources and constraints, and building a record for submission to the appropriate regulatory bodies.

2. Develop a detailed geodatabase of existing fiber optic networks, including lateral connections, access points, splice points and information regarding ownership, and make it available for economic development purposes. This effort could also include a more detailed evaluation of fiber availability and application of the Star Rating system on a census block or parcel basis.

3. Included in this database development should be an ongoing assessment of the condition of private utility poles and conduit. Over time, deficiencies can be documented and presented to either the owners or regulatory bodies to address.

4. Determine a preferred business model for management and use of city-owned conduit, including whether to offer it via one-on-one negotiations (as San Leandro and Santa Cruz have done) or develop a request for proposals from interested parties (as Berkeley, Benicia, Salinas and others are doing). More information about possible business models and strategies is in Appendix D.

5. Once a business model has been decided, publicize the availability of the City's conduit and recruit telecommunications companies to participate.

6. Contact AC Transit and BART, and investigate the possibility of creating a partnership for mutual development of publicly owned telecommunications assets.

7. Compare Union City's broadband development policies with those determined and implemented in other jurisdictions, such as Berkeley, Brentwood, Gonzales, Loma Linda, Palo Alto, San Francisco and Santa Cruz. Prepare options for additional policy direction and guidance.

Union City, like other California communities, should consider its policy and program choices not just in terms of municipal authority, which is limited, but also in terms of opportunities to become a partner and an active participant in broadband infrastructure development initiatives.

2. Broadband Infrastructure Overview

2.1. Primary broadband infrastructure

The primary broadband infrastructure in Union City is owned and operated by AT&T and Comcast, which are the incumbent telephone and cable companies. When compared to the primary broadband infrastructure available to the average home or business in California, Union City's is slightly below average, with a grade of “C-”, using criteria developed for the East Bay Broadband Consortium. However, East Bay broadband infrastructure grades are largely consistent, with all nearby cities and unincorporated communities within a tenth of a percent of Union City.

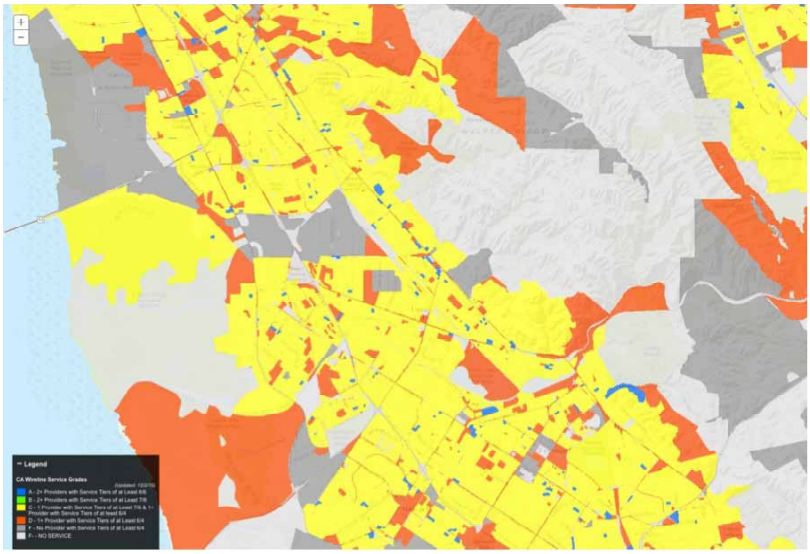


Figure 2.1 – Union City broadband infrastructure grades, by census block. Larger maps are in Appendix A.

AT&T and Comcast, along with three secondary service providers in Union City, file regular availability, technology and service level reports with the Federal Communications Commission. That data is provided to the California Public Utilities Commission, which further refines it. The analysis in this report is based on the most recent data sets published by the CPUC (submitted 31 December 2014) and supplemented with standard census data, unless otherwise indicated.

Table 2.1 - Primary broadband availability in Union City

	Census blocks	Housing units	Population
AT&T	703	20,210	66,780
Comcast	639	19,653	65,599
Combined	736	20,610	67,751
Union City total	898	21,258	69,516
AT&T	78%	95%	96%
Comcast	71%	92%	94%
Combined	82%	97%	97%

“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. There are technical distinctions between the terms “broadband” and “Internet”, but when discussing retail services offered to consumers and small businesses, the two can be used interchangeably.

The infrastructure grade of a census block is determined by the generally available level of service it supports. A “C” grade means a census block has the most common wireline service choices found in California, typical of the standard packages offered by AT&T and Comcast: a minimum of two providers, one just meeting the minimum standard of broadband service set by the CPUC (6 Mbps download and 1.5 Mbps upload) and the other exceeding it. A “D” grade – below the Californian average – is given when wireline service meets but does not exceed this standard or where consumers only have access to one qualifying service provider. If no qualifying service is available, a failing grade – “F” – is given. “A” and “B” grades are given where superior service is offered. Details regarding the grading method are in Appendix B.

Primary broadband infrastructure is designed to provide retail level service, and often supports telephone and television service as well. It is the type of service that consumers buy for consumer-grade home use and small to medium-sized business use for routine, commercial-grade Internet access. The two primary broadband companies in Union City, AT&T and Comcast, have hybrid networks that use copper wires to connect directly to homes and businesses, and fiber optic lines that connect these local distribution networks to the Internet. In some cases, AT&T and Comcast might use fiber optic lines to connect directly to a major customer, but neither report doing so in Union City.

Comcast claims to offer a uniform level of service in most of the city, but its ability to actually deliver promised speeds depends on the level of investment it has made in a particular neighborhood and the usage patterns of residents – the more people accessing the Internet in a given area, the lower the speeds each will receive. Comcast also has a practice of not fully building out its cable systems to marginal residential areas, or to commercial and industrial zones.

Table 2.2 - Broadband infrastructure grades

	Grade	GPA
Oakland	C	2.0
San Lorenzo CDP	C	2.0
Cherryland CDP	C-	1.9
Castro Valley CDP	C-	1.9
San Leandro	C-	1.9
Ashland CDP	C-	1.9
Milpitas	C-	1.9
Union City	C-	1.9
Newark	C-	1.9
Hayward	C-	1.9
Fremont	C-	1.9
Alameda County	C-	1.9
Fairview CDP	C-	1.9
San Jose	C-	1.8
Santa Clara County	C-	1.7

AT&T provides more or less the same landline telephone service throughout Union City, but the level of broadband service it provides also varies greatly by neighborhood.

The quality of the infrastructure that supports broadband service to businesses and homes generally follows a pattern commonly seen in the East Bay: more infrastructure investment tends to go into residential neighborhoods, where service providers can also sell video services, commercial districts receive less attention and industrial areas least of all. Terrain is also a factor, with hilly areas generally presenting more, and more costly, challenges.

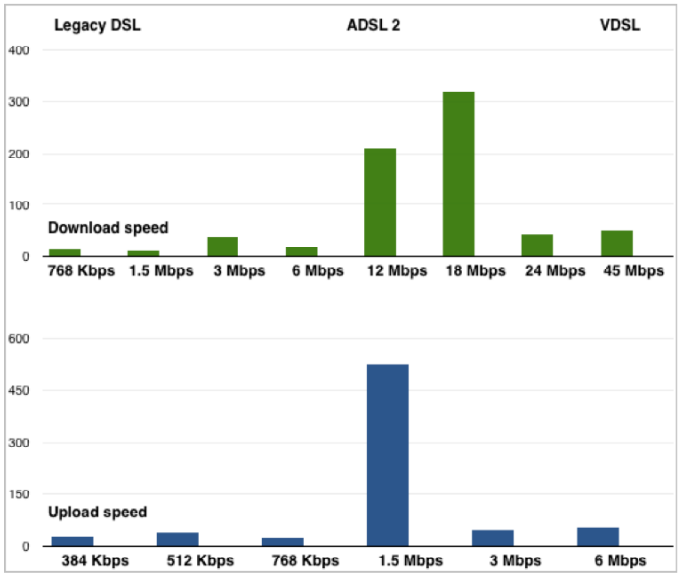


Figure 2.2 – Census block distribution of maximum AT&T download and upload speeds in Union City.

There is a pattern of sub-standard broadband infrastructure in commercial and industrial areas of Union City. “D” and “F” grades are clustered in commercial/industrial zones, and particularly in the five study areas identified for specific evaluation, as discussed below. This problem is caused by a combination of lack of line extensions by Comcast into some commercial and industrial areas, and AT&T’s failure to upgrade its DSL infrastructure consistently throughout the city. In the past five years, AT&T has requested a total of 22 encroachment permits in industrial areas from Union City and Comcast has requested 34 permits. Most of this work appears to be for customer connections into specific locations.

Figure 2.3 shows the pattern of AT&T’s upgrades: faster download speeds can be found in the areas indicated in green, somewhat slower in dark brown areas, and below the CPUC’s minimum 6 Mbps standard in lighter brown and yellow areas.

A comparison of Comcast’s reported broadband service area to its Union City video franchise area shows several gaps as well, as illustrated in Figure 2.4. Comcast has been performing work near some of the gaps identified in orange on the map, but none of the encroachment permit applications requested by Comcast in the past eight years are in these unserved areas. Larger versions of both maps are in Appendix A.

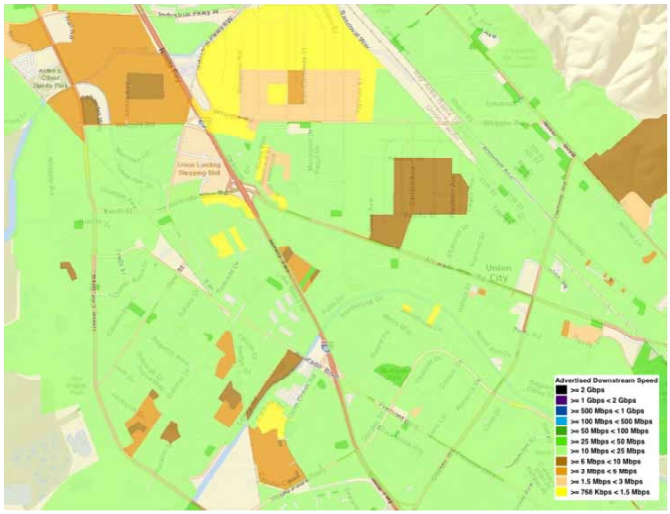


Figure 2.3 – AT&T DSL download speeds in Union City.

In terms of overall availability, both primary providers do better. AT&T reaches approximately 95% of housing units in Union City, and Comcast reaches 92%. Approximately

97% of homes have access to Internet service from one or both of the companies.

Comcast reports that is using DOCSIS 3.0 technology exclusively, and, consistent with common practice in the cable industry, claims to deliver up to 150 Mbps download and 20 Mbps upload speeds everywhere in its broadband service area.

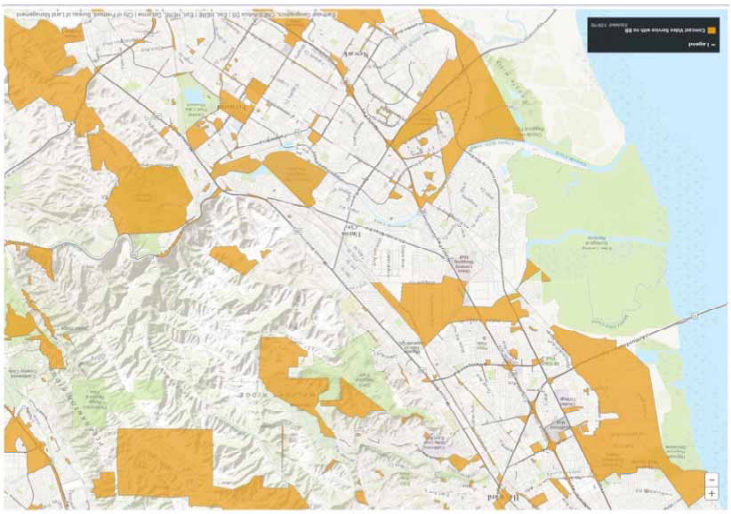


Figure 2.4 – Orange areas indicate census blocks where Comcast does not offer service in Union City.

The key phrase is "up to". It is a term of art in the broadband industry that means, in effect, that the technology that's been deployed in an area is theoretically capable of supporting the indicated service level, but consumers should not expect to experience that maximum service level consistently, if at all. Anecdotal evidence indicates that the total capacity of cable company broadband systems is restricted, due to the relatively large number of homes that share resources such as Internet bandwidth and indirect access to high capacity fiber connections.

AT&T relies solely on copper-based wireline infrastructure in Union City. It does not report having any fiber-to-the-home or business premise systems. Where AT&T has fiber-to-the-home systems, it is usually in new developments where fiber optic cables originally installed instead of copper wires. AT&T claims to be installing fiber to the premise infrastructure in dense commercial areas in California, but there’s no indication that it has done so in Union City.

AT&T’s download speeds range from 768 Kbps to 45 Mbps; its upload speeds range from 384 Kbps to 6 Mbps. These speeds indicate that AT&T’s network in Union City uses three different types of technology. The low end download speeds – 768 Kbps to at least 3 Mbps – are typical of legacy DSL service, the type originally rolled out by Pacific Bell in the 1990s.

The high end download speeds – 24 Mbps and 45 Mbps – are likely provisioned using VDSL technology, which is the most advanced type of DSL service in general use by AT&T. It was originally deployed with the intent of using it to support video service, which it still does. However, AT&T has said its long term objective is to transition video customers to satellite delivery and free up wireline bandwidth for Internet service.

The mid range download speeds – 6 Mbps, 12 Mbps and 18 Mbps – might be delivered via legacy DSL, which can support 6 Mbps, and VDSL, which could be limited to lower-than-normal speeds by poor infrastructure or other network constraints. However a third technology, ADSL2, appears to also be in use and supporting some of the census blocks with mid-range service.

From a consumer standpoint, the difference between the three technologies is readily apparent. If the service being received is branded as Uverse and television service is (or at least was until recently) available, then it is VDSL-based. If it carries the Uverse brand and television service isn't available, it's ADSL2. If it doesn't carry the Uverse brand, it is legacy DSL service. AT&T has made a concerted effort over the past several years to transition customers from legacy service, which is subject to regulation by the California Public Utilities Commission, to unregulated Uverse branded service where it is available.

Table 2.3 - Primary broadband service providers - Union City

AT&T								
Download speed	**768 Kbps**	**1.5 Mbps**	**3 Mbps**	**6 Mbps**	**12 Mbps**	**18 Mbps**	**24 Mbps**	**45 Mbps**
Census blocks	13	11	38	19	211	317	43	51
Upload speed	**384 Kbps**	**512 Kbps**	**768 Kbps**	**1.5 Mbps**	**3 Mbps**	**6 Mbps**		
Census blocks	24	38	23	524	43	51		
Comcast - claimed throughout service area								
Download	150 Mbps							
Upload	20 Mbps							

2.2. Commercial and industrial broadband infrastructure

In addition to the primary, retail level of service provided by AT&T and Comcast, a number of other companies provide secondary, commercial and industrial grade service in Union City, via infrastructure or facilities they own themselves and/or facilities leased from primary and other secondary providers.

It is much easier for primary broadband service providers to generate an acceptable return on investment in residential areas than in commercial or industrial ones, 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 more diverse and less predictable than residential subscribers. One business might need Gigabit speeds at the highest 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 which neighborhoods and business districts 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. Consequently, specialized, secondary companies offer a more diverse range of service to this market.

"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 150 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 situations 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 100 gigabits 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. Large industrial customers frequently buy services directly from middle mile providers.

At this level of service, the distinction between "broadband" and "Internet" facilities becomes important. "Internet" service involves a connection, at whatever speed, to the vast, publicly accessible network of interconnected information technology (IT) resources that's called the Internet. Internet service is usually obtained from a company that provides a connection between the end user and a major Internet exchange facility where data is handed back and forth between various networks, either a dedicated exchange facility or a data center where many companies install servers and other IT equipment. There are several such facilities in the Bay Area, including Fremont and Oakland, but none have been identified in Union City.

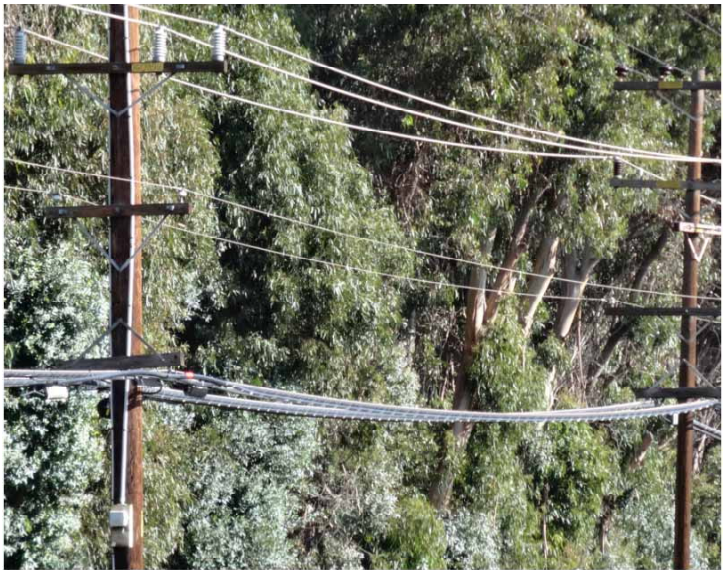


Figure 2.5 – Major fiber trunk route along Whipple Road.

"Broadband" is a more generic term. It simply refers to a high speed data connection. That connection might be between an end user and an Internet exchange point, or it could be only for internal connections within a company. For example, the City of Union City maintains an internal IT network that connects about a dozen remote locations to city hall.

The secondary broadband infrastructure in Union City generally falls into two categories: fiber optic networks and electronic enhancements to traditional copper wireline networks leased from AT&T.

Enhanced wireline service

Three companies – Level 3 Communications, Sonic.net and TW Telecom – report providing business-oriented services via lines leased from AT&T (Level 3 acquired TW Telecom in 2014, but the companies still report service levels to the FCC separately). In accordance with state and federal rules,

these companies are able to install equipment in AT&T's central offices and use it to provide a higher level of service than would ordinarily be available. All three focus primarily on industrial areas of Union City, but also serve commercial districts. Full coverage area maps are in Appendix A.

Sonic.net only provides service in Union City via leased copper lines. It reports being able deliver service levels to 43 census blocks ranging from 12 Mbps to 100 Mbps download and 2 Mbps to 100 Mbps upload speeds using three different copper wireline technologies.

TW Telecom use both fiber and copper wireline infrastructure in Union City, and claims to offer wireline service at 45 Mbps upload and download speeds in 14 census blocks. Level 3's use of copper-based infrastructure in Union City is all but non-existent. The company reports offering low speed, legacy-level service in one census block.

Figure 2.6 – TW Telecom copper-based service in Union City.

Larger enhanced wireline service area maps for Sonic and TW Telecom are in Appendix A. A comparison of those maps with AT&T's and Comcast's coverage maps shows that these specialized companies tend to move into areas that the primary providers have neglected.

Fiber optic networks

Level 3 and TW Telecom both report providing service directly to end users via fiber optic lines. Level 3 serves offers 100 Gbps symmetrical service in four census blocks and 2.5 Gbps symmetrical service in one census block. TW Telecom offers 10 Gbps symmetrical service in three census blocks.

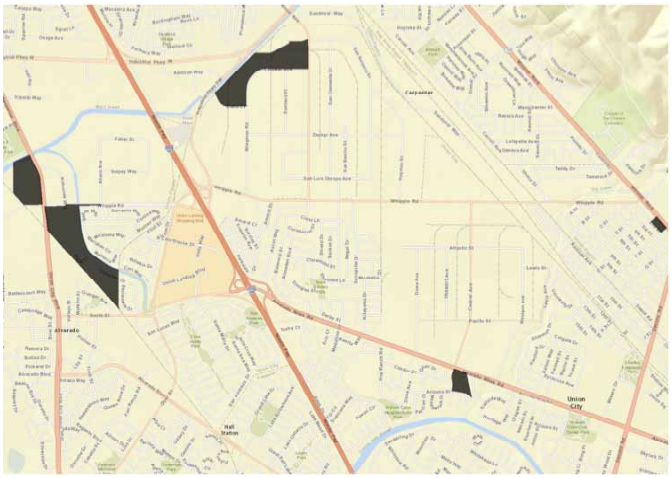


Figure 2.7 – Level 3 direct-to-end-user fiber service in Union City.

Union City is served by at least two providers of "metropolitan" fiber optic network services, Integra and BART. Metropolitan fiber networks are designed to provide service to individual buildings and developments along their routes. Several long haul fiber routes also pass through Union City along railroad right of ways. Access to this fiber is more limited because it is designed to connect to metropolitan networks at major data centers, rather than serve end-users directly.

Integra, which now includes the fiber optic assets formerly owned by OpticAccess, reports having a fiber optic loop that enters Union City from the east on Alvarado-Niles Road, runs west to Central Avenue, then north to Whipple Road, west to Huntwood Avenue, north to Industrial Parkway, southwest to Hesperian Boulevard, continues on Union City Boulevard and then on Ardenwood Boulevard to Paseo Padre Parkway. It then runs northeast, generally paralleling Paseo Padre to Fremont Boulevard, then east into Fremont.

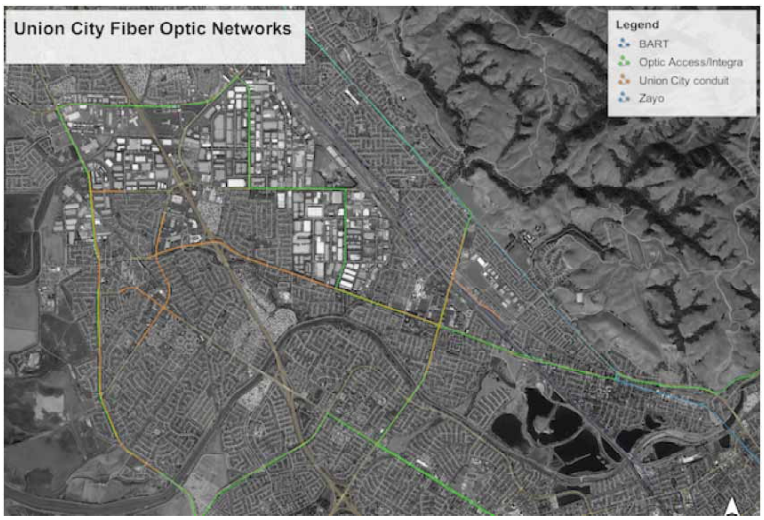


Figure 2.8 – Zayo and Integra fiber routes in Union City. A larger version is in Appendix A.

A second line runs on Fremont Boulevard, coming in from Fremont to the east, then turning north on Decoto Road and continuing to Mission Boulevard. This second line intersects with a fiber route that is owned by BART and runs along its right of way, and with another major fiber route that runs along Mission Boulevard.

For the purposes of this report, these commercial fiber routes will be identified as Integra's because that is the best information available, however other companies, such as Level 3, also appear to use it to provide service and one of those companies might be the actual owner.

Additionally, what appeared to be an underground fiber route installed by XO Communications and an unidentified traffic signal interconnection conduit route was observed on the south side of Whipple Avenue during a site survey on 21 January 2016. Several aerial fiber cables belonging to AT&T and one belonging to Comcast were observed on the north side. It is possible that the fiber route advertised by Integra actually belongs to XO, or to another company. Such leasing arrangements are very common in the telecommunications industry. Regardless of ultimate ownership, Whipple Road appears to be a main fiber trunk route used by several telecommunications companies.

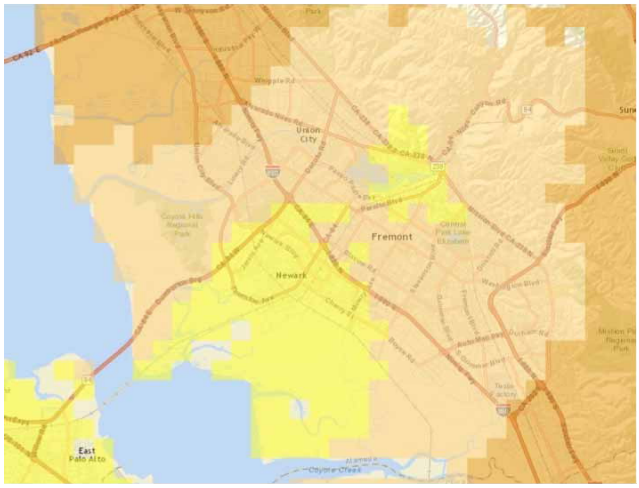


Figure 2.9 – Verizon's mobile broadband coverage in Union City, per CPUC testing. Yellow indicates the lowest level of service, light brown the next tier up. Complete wireless coverage maps are in Appendix A.

2.3. Wireless broadband service

Four mobile broadband companies – AT&T, Sprint, T-Mobile and Verizon – serve Union City, with generally lower service levels than areas to the north and south. According to testing conducted by the California Public Utilities Commission, AT&T's and Verizon's expected mobile download speeds in Union City are in the 1.5 Mbps to 3 Mbps range, Sprint is largely unable to provide reliable service, T-Mobile likewise has gaps but otherwise delivers download speeds of less than 1.5 Mbps.

Fixed wireless Internet service is available in Union City. Two companies – Tekify and Etheric – report offering spotty service in the city, in the 25 Mbps to 100 Mbps range. Both use unlicensed radio frequencies, which are subject to inference and may be preempted by other users. Any and all users have the same legal right to transmit on unlicensed frequencies, and must accept whatever interference or degradation results. Examination of the mapping data provided by the two companies to the California Public Utilities Commission indicates that these reports are based on unsophisticated modelling of relatively few access points and cannot be taken at face value. Prospective customers are best advised to contact the companies to confirm availability and actual service levels.

Other fixed wireless companies operate in the East Bay, but do not report service levels to the FCC or CPUC. The same caveats apply.

3. Broadband Study Areas

The City identified five particular areas of interest for this report. Three of the five are primarily industrial or mixed use, one is primarily retail and one is the City's Civic Center.

Table 3.1 - Census blocks served by primary and secondary providers in study areas

	Census Blocks Served					
	Northwest Industrial	**Union Landing**	**Central Industrial**	**Station District**	**Civic Center**	**Total**
AT&T California	16	1	14	11	2	44
Comcast	2	2	4	10	2	20
Level 3 Communications	3		1			4
Sonic.net			3	3	1	7
tw telecom	3		8	1	1	13
Study area total	27	5	16	16	2	66

	Percentage of Census Blocks Served					
	Northwest Industrial	**Union Landing**	**Central Industrial**	**Station District**	**Civic Center**	**Total**
AT&T California	59%	20%	88%	69%	100%	67%
Comcast	7%	40%	25%	63%	100%	30%
Level 3	11%	0%	6%	0%	0%	6%
Sonic.net	0%	0%	19%	19%	50%	11%
tw telecom	11%	0%	50%	6%	50%	20%

Businesses have a much wider range of broadband needs than residences. Some small businesses are able to get by with slow, consumer-grade connections, while others need direct, high capacity connections to central Internet facilities.

In order to assess the level of broadband infrastructure that is available to businesses, or prospective businesses, in the study areas, a five-star rating system was used. The rating is a combination of primary wireline infrastructure grade and an assessment of fiber optic facilities, both the fiber itself and the service level supported by its network connections and attached electronics. A full explanation of the method used to calculate Star Ratings for commercial and industrial areas is in Appendix C.

Table 3.2 - Commercial/industrial broadband infrastructure

Study Area	Type	Primary Grade	GPA	Star Rating	
Northwest Industrial	Industrial	F+	0.4	★	0.5
Union Landing	Retail	F+	0.6		0.0
Central Industrial	Industrial	D-	0.8	★	0.5
Station District	Industrial/mixed	D-	0.9		0.0
Civic Center	Municipal	C	2.0	★★	2.0

3.1. Area 1 – Northwest Industrial Area

The primary broadband infrastructure maintained by AT&T and Comcast is very poor in this industrial area in the northwest corner of Union City, receiving an “F+” on the primary broadband report card scale described in Appendix B. Of the 27 census blocks in this area that are at least 50% within industrial zones, AT&T provides broadband service to only 16 census blocks, two of which contain some residential zones. Only one of those census blocks appears to have been upgraded to VDSL, which is AT&T’s top of the line broadband technology, and is served with 45 Mbps download speeds. The remaining census blocks are at 18 Mbps download speeds or less, with 10 of those census blocks appearing to be still relying on 1990s vintage legacy DSL infrastructure, with download speeds in the 768 Kbps to 6 Mbps range.

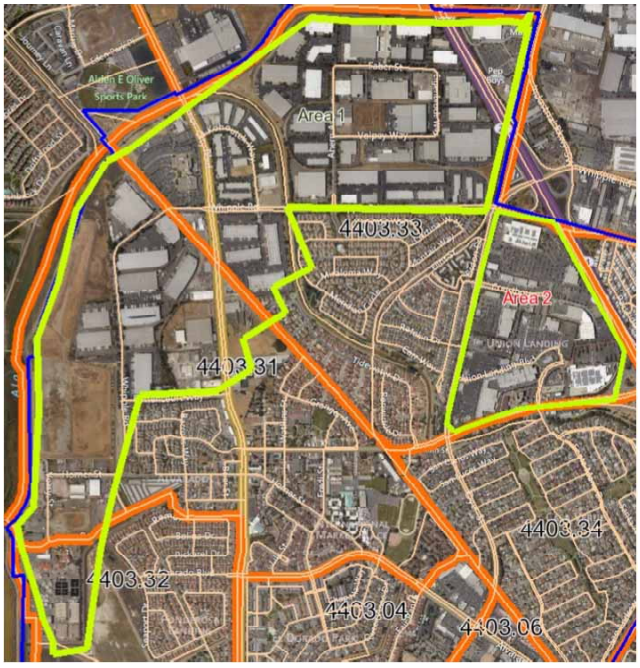


Figure 3.1 – Study areas 1 and 2, Northwest Industrial Area and Union Landing.

Comcast serves only 2 census blocks in the Northwest Industrial Area, and one of those is approximately 50% residential. Since both AT&T and Comcast prioritize their capital investments to focus on higher revenue residential areas, it’s possible that actual service to industrial parcels is even poorer than these dismal figures would suggest. Comcast claims to deliver 150 Mbps download and 20 Mbps upload service in the census blocks where it is present, everywhere in Union City.

Service from secondary providers is much better. Level 3 reports offering 100 Gbps symmetrical service in three census blocks, out a total of four such census blocks in the entire city. TW Telecom offers symmetrical 45 Mbps enhanced copper wireline service in three census blocks as well. Sonic is not present in this area.

A commercial fiber line, designated as Integra fiber for the purpose of this report, runs through Area 1 along Union City Boulevard. City-owned conduit is also present on Union City Boulevard, as well as a short segment of Whipple Road. Because of the above average availability of high speed fiber service, the Northwest Industrial Area of Union City rates half a Star (out of five possible) on the commercial/ industrial rating scale described in Appendix C.

3.2. Area 2 - Union Landing

Area 2 is the Union Landing shopping center. It is adjacent to Area 1 (Northwest Industrial Area) and its broadband infrastructure shares many of the deficiencies found there. It also receives an “F+” on the primary broadband report card scale.

There are five census blocks in this area that are at least 50% commercial in nature. Of these, AT&T only provides broadband service in one census block, which appears to have been upgraded to VDSL technology. Comcast serves two out of the five with its standard DOCSIS 3.0 cable modem service. It is worth noting that Comcast’s storefront office is in this shopping center.

No secondary provider offers service in the Union Landing area and there are no documented privately-owned fiber routes. The city’s conduit system, however, is present on two sides of this triangular area, and AC Transit’s 97 bus route passes by it as well. AC Transit has plans to establish a fiber optic connection along that route. However, since no direct-to-user fiber optic infrastructure appears to be present at this time, and primary service is so poor, the Union Landing area scores Zero Stars (out of five possible) on the commercial/industrial infrastructure scale.

3.3. Area 3 - Central Industrial Area

This industrial area is generally bounded by Whipple Road on the north, Sherman Drive on the east, Alvarado Niles Road to the south and a railroad spur line on the west. Central Avenue runs north and south through the middle of the area. Primary broadband infrastructure in this area is better than the Northwest Industrial Area, but it still falls far short of benchmark levels found elsewhere in Union City and the East Bay Area. The Central Industrial Area receives a “D-” on the broadband infrastructure report card scale, with an average grade of 0.8, versus a 1.9 average in Union City as whole, as well as most nearby communities.

AT&T offers broadband service in 14 of the 16 census blocks that are at least 50% industrial in nature. Two of those blocks appear to have been upgraded to VDSL technology, which supports download speeds between 24 Mbps and 45 Mbps. Download speeds between 12 Mbps and 18 Mbps are available in five census blocks, indicating upgrades to mid-range ADSL2 technology. The remaining seven

appear to be served by legacy DSL infrastructure, similar to what was originally deployed in the 1990s, although some might also be served by particularly poor ADSL2 infrastructure.

Comcast only reports providing service in four of the 16 census blocks, although it has requested several encroachment permits for the area.

Secondary broadband infrastructure appears to be better. Sonic offers a range of service levels, up to 100 Mbps symmetrical, using enhanced copper wireline technology in three census blocks. TW Telecom offers 45 Mbps symmetrical service via enhanced wireline technology in six census blocks and 10 Gbps symmetrical fiber-based service in 2 census blocks. Level 3 only reports providing legacy DSL service in one census block in the Central Industrial Area.

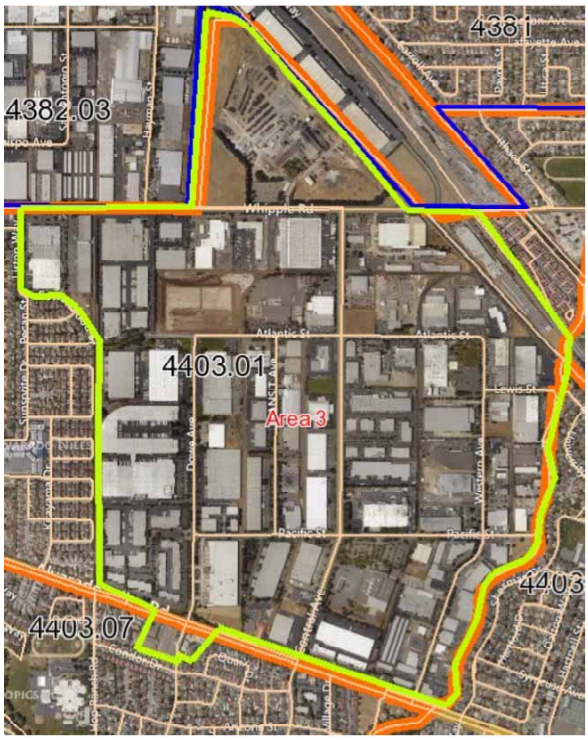


Figure 3.2 – Study area 3, Central.

A fiber optic cable route runs through the middle of the Central Industrial Area, coming in on Alvarado Niles Road from the east, going north up Central Avenue, and continuing west on Whipple Road. A City-owned conduit route and AC Transit's 97 bus route run along Alvarado Niles Road on the south side as well.

Because TW Telecom reports at least some direct-to-user fiber service, the Central Industrial Area gets a half-Star rating (out of five) on the commercial/industrial scale, described in Appendix C.

3.4. Area 4 - Station District

The Station District study area extends beyond the Union Square development, and includes the BART station and nearby residences, and the industrial areas to the north. It is generally bounded by 7th Street on the north, Shilom Drive on the east, Alvarado Niles Road on the south and Decoto Road to the west. The primary broadband infrastructure in this area receives a "D-" grade with an average of 0.9 on the primary broadband infrastructure report card scale.

Although it receives a similar grade, the primary broadband infrastructure in this area is significantly different from Areas 1, 2 and 3. AT&T reports providing broadband service in 11 of the 16 majority-industrial census blocks in this area, with a top download speed of 18 Mbps reported in two of those blocks, and the rest ranging from 3 Mbps to 12 Mbps.

Comcast, on the other hand, reports service in 10 of the 16 majority-industrial census blocks in the area. This higher penetration than is usual in industrial areas is likely due to the mixed-use nature of the

Station District area. It is possible, though, that Comcast primarily serves the residential portions of those census blocks.

Secondary broadband infrastructure appears to be poorer than elsewhere in Union City, with no direct-to-user fiber optic service available and enhanced copper wireline service offered in only four of the 16 census blocks. Sonic offers service at levels up to 100 Mbps symmetrical in three census blocks and TW Telecom offers service at 45 Mbps symmetrical in one census block.

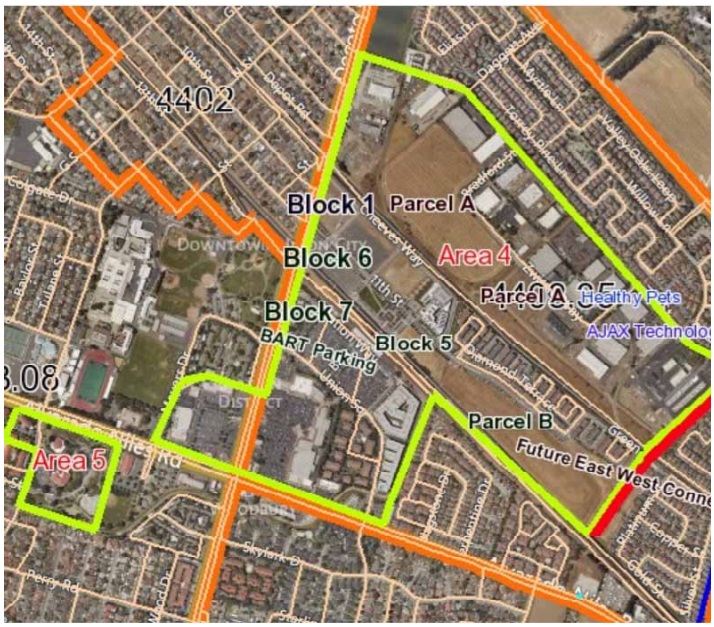


Figure 3.3 – Study areas 4 and 5, Station District and Civic Center.

The lack of access to fiber-based services is not due to a lack of fiber infrastructure. Commercial fiber routes run past the Station District study area on Decoto Road and Alvarado Niles Road, and just to the north on Mission Boulevard. BART-owned fiber runs through the middle of the area and is accessible at the BART station. City-owned conduit is present on Decoto Road and 11th Street. The AC Transit 97 bus route follows Decoto Road to the BART station.

However, none of this fiber and conduit infrastructure has been put to use to directly serve businesses and residents in the Station District study area. That fact, combined with its low primary infrastructure grade, nets the area a Zero Stars rating (out of five possible) on the commercial/industrial infrastructure scale.

3.5. Area 5 - Civic Center

The Civic Center study area is comprised of the municipal buildings along Royal Ann Drive, south of Alvarado Niles Road It touches small portions of two census blocks, which are primarily residential in nature. The primary broadband infrastructure in and around the Civic Center is a little bit above average for Union City but in line with the statewide average, receiving a “C” grade (2.0) on the broadband report card scale.

Comcast and AT&T report providing service to both census blocks, with Comcast filing its typical report of uniform 150 Mbps download and 20 Mbps speeds. AT&T reports offering 12 Mbps download and 1.5 Mbps upload speeds in both census blocks, indicating that it has installed mid-range ADSL2 infrastructure.

Secondary broadband infrastructure is also good, with Sonic reporting speeds of up to 100 Mbps symmetrical in one of the census blocks. TW Telecom reports providing fiber-based service at 10 Gbps symmetrical to the Civic Center, a claim that was verified by city staff. That service comes via the

commercial fiber route that runs along Alvarado Niles Road. City staff also report that AT&T has connected fiber to the Civic Center, and that T-Mobile rents a cell site from the city. Because of the good condition of the primary infrastructure in the Civic Center area and the availability of high speed, direct-to-user fiber service, the area rates 2 Stars (out of five possible) on the commercial/industrial infrastructure scale.

4. Municipal Conduit

The City of Union City owns an extensive system of documented traffic signal interconnect conduit in the western portion of the city, plus undocumented conduit in the eastern portion of the city, and relatively small and isolated sections of conduit elsewhere. These conduit routes intersect and coincide with the privately and publicly owned fiber networks that serve the city, and parallel an AC Transit fiber project that is in the planning stages.

Table 4.1 - Union City Traffic Signal Interconnect Conduit System

	Feet	Miles
Route 1 - Union City Boulevard	16,461	3.1
Route 1 - Whipple Road	1,703	0.3
Route 1 - Total	18,164	3.4
Route 2 - Dyer Street	7,266	1.4
Route 2 - Alvarado Boulevard	3,640	0.7
Route 2 - Alvarado Niles Boulevard	1,837	0.3
Route 2 - Total	12,743	2.4
Route 3 - 11th Street	3,117	0.6
Route 3 - Decoto Road	2,889	0.5
Route 3 - Total	6,006	1.1
Undocumented route - Alvarado Niles Road	13,844	2.6
Undocumented route - Decoto Road	4,266	0.8
System Total	55,023	10.4

Distances are estimates based on Google Earth mapping.

The documented traffic signal conduit system is comprised of two contiguous routes. One runs north on Union City Boulevard from Lowry Road to Kohoutek Way, with a connecting segment extending east on Whipple Road to Ahern Avenue. This route runs alongside a longer fiber route owned by Integra on Union City Boulevard, that continues north into Hayward and south into Fremont.

The other route runs north on Dyer Street from Regents Boulevard to Walmart Drive, with two segments that cross it – one on Alvarado Boulevard running between Fredi Street and Galaxy Drive and one on Alvarado Niles Road running between Tidewater Drive and Santa Maria Drive.

This conduit was described by city staff as varying from 1.5 inches to 2 inches in diameter, containing cables comprised of 12 strands (6 twisted pairs) of copper wire, with 250 feet being a typical distance between hand holes. A site survey on 21 January 2016 generally confirmed this information. Several hand holes along these two routes were opened and visually inspected, and all appeared to be in good condition. Up to four copper wire cables were present in the risers, but those were loosely placed and there appeared to be room for additional cables.

The two routes are separated by an approximately 950 foot gap on Alvarado Boulevard, between Fredi Street and Union City Boulevard. The City current uses a line leased from AT&T to bridge the gap.

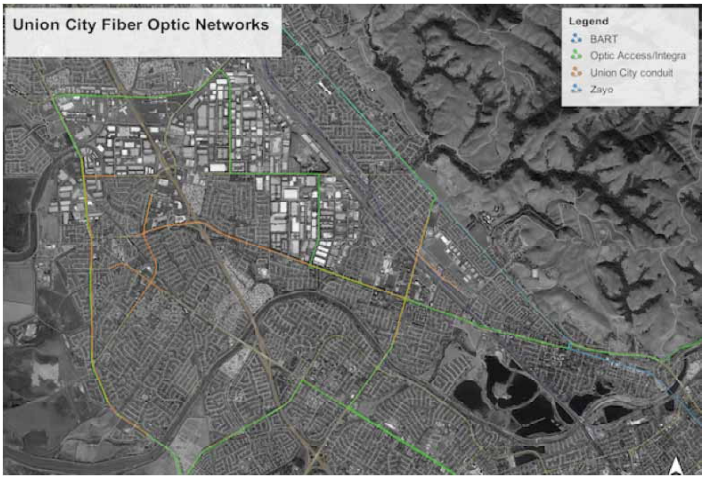


Figure 4.1 – City owned conduit (orange) and fiber networks (green and blue). Larger map in Appendix A.

The City also owns approximately 6,000 feet of 2-inch diameter PVC interconnect conduit installed near the BART station, about half of it running east on 11th Street from Decoto Road to the end of 11th Street, and the other half running on Decoto Road. From Station Way to 5th Street. This conduit appears to contain a single, copper wire cable. The segment of this conduit route on 11th Street parallels the BART fiber route, and the segment on Decoto runs alongside the Integra fiber route on Decoto Street. It also intersects the BART fiber route, and City plans indicate that connecting conduit will be built in conjunction wth an intermodal station upgrade project.

There are additional traffic signal interconnection routes along additional Alvarado Niles Road and on Decoto Road which are not currently documented in the City geodatabase. One route is believed to run on Alvarado Niles Road from Santa Maria Drive to Decoto Road and the other to run on Decoto Road from Royal Ann Drive to Station Way. These routes are approximately 14,000 feet and 4,000 feet, respectively. The route on Alvarado Nile Road runs alongside the Integra fiber route from Central Avenue to Decoto Road, and the Decoto Road route runs alongside the Integra fiber route for its entire distance.

Figure 4.2 – Traffic signal interconnect system hand hole.

There is City-owned conduit that connects the Civic Center to fiber routes owned and/or operated by AT&T and Level 3 on Alvarado Niles Road. T-Mobile operates a cell site at the Civic Center as well.

The City also owns the streetlights along its streets and roads, and the electrical conduit that provides power to those lights. However, city staff believes that there is a significant amount of streetlight power cable that is direct buried – i.e. not in conduit – particularly in industrial areas.

During the site survey, facilities belonging to the Alameda County Transit Commission were identified on Union City Boulevard. These facilities were installed approximately 15 years ago as part of a Smart Corridor program but appear to be no longer in use. An equipment cabinet containing old networking equipment, including what appeared to be a dial-up data modem, was observed, along with communications vaults placed in the ground. The vaults were locked and could not inspected at that time. Subsequent research indicated that road intersections included in the Smart Corridor system were linked to the central datacenter via AT&T lines, and the communications vaults were likely used only to connect components, such as video cameras, to the equipment cabinet.

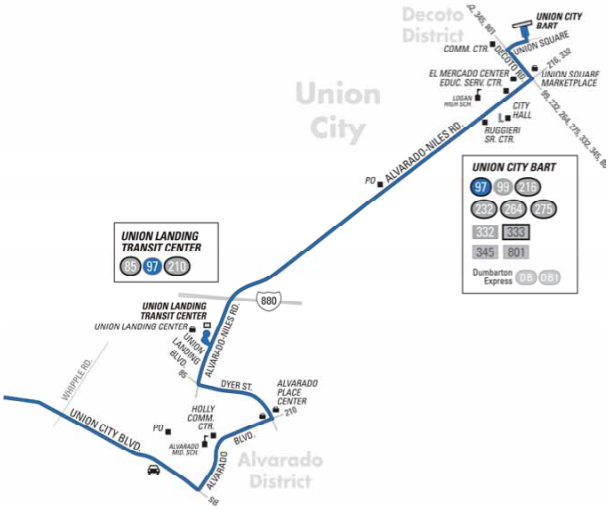


Figure 4.3 – AC Transit Bus Route 97.

There is, however, another project pending that's headed by AC Transit and involves creating a fiber connection along Bus Route 97, which runs from the Bay Fair BART station in San Leandro, through Hayward and unincorporated areas of Alameda County to the Union City BART station. This bus route follows Hesperian Boulevard into Union City and continues on Union City Boulevard to Alvarado Boulevard, then goes east to Dyer Street and then east on Alvarado Niles Road to Decoto Road, and north to the BART station.

It should be noted that the City's traffic signal interconnect conduit is present along nearly the entire portion of the route within Union City. The only gaps are on Union City Boulevard between Kohoutek Way and the city limits just to the north, and on Alvarado Boulevard between Fredi Street and Union City Boulevard. City plans indicate that connecting conduit will be built at the BART station in conjunction wth an intermodal station upgrade project.

5. Conclusions and Recommendations

5.1. Broadband infrastructure

The infrastructure maintained by the two primary broadband companies in Union City – AT&T and Comcast – is generally on a par with other East Bay cities, and follows a similar pattern: residential neighborhoods are given higher priority for upgrades than commercial and industrial districts. As a result, average consumer-grade service is widely available from both primary broadband providers, but businesses often find it difficult and/or to costly to obtain Internet connectivity.

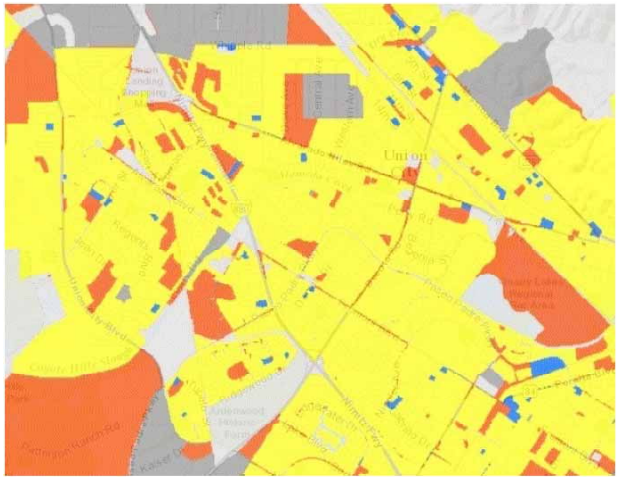


Figure 5.1 – Union City broadband infrastructure report card. Yellow is "C" grade. Red and grey are substandard "D" and "F" grades.

Secondary companies, such as Level 3, Sonic and TW Telecom, have moved in to fill some of the gaps left by the primary providers with more specialized services, including via direct fiber optic network connections to end users. Other fiber network operators, such as Zayo, Integra and BART, also provide connectivity in Union City.

Mobile broadband coverage is generally poorer in Union City than in areas to the north and south, but the level of service experienced by users will vary depending on the carrier, location and the number of users accessing service at the same time. Internet service is also offered in some locations from fixed wireless system operators, but little reliable information is available regarding actual coverage, availability and true service levels.

5.2. Study areas

Broadband infrastructure and service availability in two of the five study areas – the Northwest and Central Industrial Areas – is a particular problem. The primary broadband infrastructure in those areas is generally poor and availability at any given location is uncertain. A new business that is considering moving to one of those areas would have to do a significant amount of due diligence research to determine whether or not an acceptable level of service is available at a reasonable price.

For commercial grade service, it might not even be sufficient to ask AT&T and Comcast if it is available, because answers received from customer service representatives and commercial market sales staff are often based on poor information or on undisclosed assumptions, such as requirements that new customers pay several thousand dollars in connection fees. Companies often move into new offices on the basis of brief and undocumented conversations with customer contact staff or on the basis of promises made by leasing agents, only to be presented with a costly installation estimate or be told that service isn't available after all. Standard industry practice, followed by incumbent telephone

and cable companies as well as independent ISPs, is to charge the business that first requests service for the entire cost of any new construction required, although there are many exceptions.

Industrial grade service is equally problematic. Although several companies already offer various levels of service and facilities to businesses in the area, and many others could, obtaining the proper level of service from the most appropriate company requires a certain degree of technical expertise and a willingness to expend considerable time in the process.

Figure 5.2 – Broadband infrastructure study areas.

The Union Landing and Station District areas have less severe problems, but are by no means in good shape when it comes to broadband infrastructure and service availability. The same problems with poor primary infrastructure that affect the Northwest and Central Industrial Areas are present but at a lesser degree of magnitude. On the other hand, the areas suffer from a lack of secondary, business-focused broadband services. The level of service that's currently available is probably sufficient to support current retail store needs at this time, but will act as a constraint on future growth and diversification of businesses.

By contrast, the Civic Center area has excellent access to broadband services at all levels. It is a small area that is occupied by a single anchor customer – the City of Union City – and has developed into a telecommunications hub of sorts, with connections to major fiber networks and the presence of cellular facilities. Although the Civic Center is a unique case, some of the characteristics that make it a good location for telecommunications services can be replicated elsewhere. These include establishing direct connections to major fiber networks, connecting main conduit in the public right of way to buildings via lateral conduit, and aggregating a sufficiently large user base.

5.3. Municipal conduit

The City of Union City owns an extensive system of traffic signal interconnect conduit that stretches more than ten miles through commercial and industrial areas of the city. Newer conduit in the western and northeastern parts of the city appears to be in good condition and is a valuable asset that can be used to support the expansion of broadband infrastructure and service. Older, undocumented conduit in the central and southeastern areas of the city is also useful in this regard and for now should be assumed to be equally valuable.

Taken as a whole, the City's traffic signal conduit system would be expense to duplicate. If you assume that the cost of installing new conduit in the public right of way is between $50 and $60 per foot, then the cost of duplicating it would be in the $3 million range.

Two types of telecommunications companies would be interested in using the City's conduit. An existing secondary provider or fiber network company, such as Level 3, Integra or Zayo, would find segments of the City's conduit to be an effective way to solve connectivity problems in certain circumstances or for specific customers. The conduit could be used to extend or provide lateral connections to an existing network.

A new entrant in the market would be more interested in the City's system as a whole. As an example, the City of San Leandro reached an agreement with a local company that used traffic signal conduit to build a completely new network that was specifically designed to serve local businesses.

Figure 5.3 – City owned conduit (orange) and fiber networks (green, blue). Larger map in Appendix A.

There are number of issues to consider when deciding whether or not to use traffic signal conduit for telecommunications purposes. The City would have to maintain and operate its conduit in partnership with a private company, and establish clear lines of responsibility and operational roles and rules. A business model needs to be determined, and decisions made as to whether the conduit will be simply leased out at market rates or if a closer partnership should be created in order to pursue other City objectives and priorities. Creating a municipal conduit enterprise will require coordination between several different departments, as well as with private operators. Finally, the City will incur costs to implement a conduit business model and operational plan, and for ongoing development of the system to meet future needs.

5.4. Recommendations

The City should consider three general initiatives to upgrade commercial and industrial broadband infrastructure and service availability:

- Work with AT&T and Comcast to identify service deficiencies and gaps, develop and implement plans to address those problems, and provide ongoing information regarding service conditions to existing and prospective businesses. If AT&T and/or Comcast are not willing to meaningfully engage – as is their usual practice – then the City will have to find remedies on its own, including pursuing regulatory options and creating opportunities for competitors to enter the market.

- Offer surplus space in the existing city-owned conduit system to interested telecommunications companies, and develop and implement a program to operate and extend the system in order to maximize economic development benefits. Alternatively, the City can consider creating a municipal broadband utility using these assets.

- Consider enacting policies that promote telecommunications competition and development. These include dig once, open trench and shadow conduit policies, master lease agreements for use of city telecommunications assets, development standards for new or major remodel construction, asset management procedures such as routine GIS logging of broadband infrastructure, standard specifications for conduit and broadband facilities, permitting procedures and master plans.

Specific steps to be considered include:

1. Establish a enquiry and complaint process for businesses that are seeking broadband services or are having problems with current providers. Although the City has limited authority in this regard, collecting this information and making it public is an effective first step toward providing incentives for telecommunications companies to voluntarily cooperate, expanding public knowledge of existing resources and constraints, and building a record for submission to the appropriate regulatory bodies.

2. Develop a detailed geodatabase of existing fiber optic networks, including lateral connections, access points, splice points and information regarding ownership, and make it available for economic development purposes. This effort could also include a more detailed evaluation of fiber availability and application of the Star Rating system on a census block or parcel basis.

3. Included in this database development should be an ongoing assessment of the condition of private utility poles and conduit. Over time, deficiencies can be documented and presented to either the owners or regulatory bodies to address.

4. Determine a preferred business model for management and use of city-owned conduit, including whether to offer it via one-on-one negotiations (as San Leandro and Santa Cruz have done) or develop a request for proposals from interested parties (as Berkeley, Benicia, Salinas and others are doing). More information about possible business models and strategies is in Appendix D.

5. Once a business model has been decided, publicize the availability of the City's conduit and recruit telecommunications companies to participate.

6. Contact AC Transit and BART, and investigate the possibility of creating a partnership for mutual development of publicly owned telecommunications assets.

7. Compare Union City's broadband development policies with those determined and implemented in other jurisdictions, such as Berkeley, Brentwood, Gonzales, Loma Linda, Palo Alto, San Francisco and Santa Cruz. Prepare options for additional policy direction and guidance.

Overall, the trend at the state and federal level is toward less regulation of telecommunications companies. Local governments in California no longer manage franchises for video service and state regulation is minimal. Pending legislation in Sacramento would transition landline telephone service away from its current regulatory regime, which is based on assumptions regarding legacy analog technology, and toward a less restrictive environment that might or might not be in keeping with

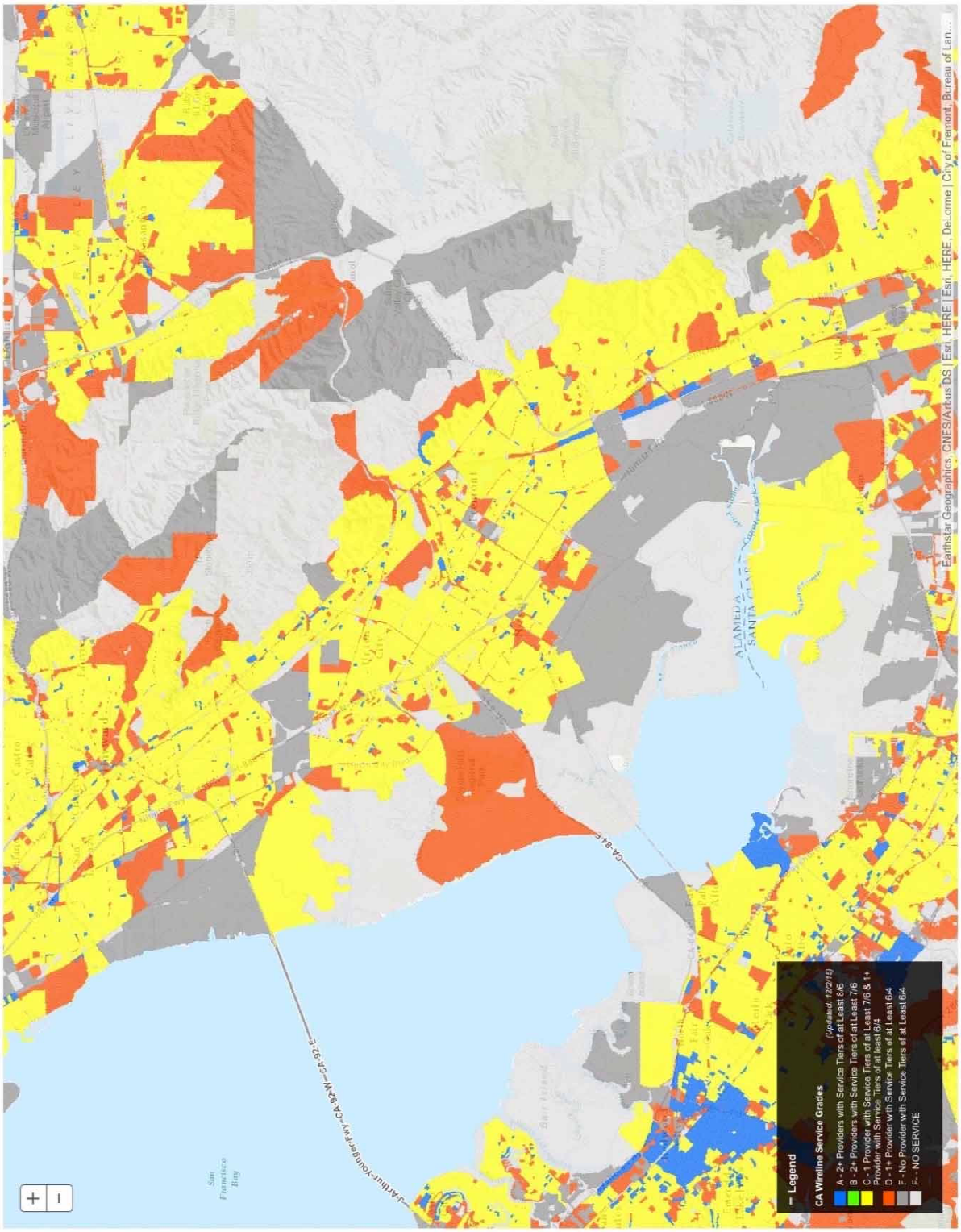
current digital technology trends. Broadband and Internet service is not directly regulated at the state level at all, and federal agencies have adopted a “light touch” approach, where they have considered intervention at all.

Union City, like other California communities, should consider its policy and program choices not just in terms of municipal authority, which is limited, but also in terms of opportunities to become a partner and an active participant in broadband infrastructure development initiatives.

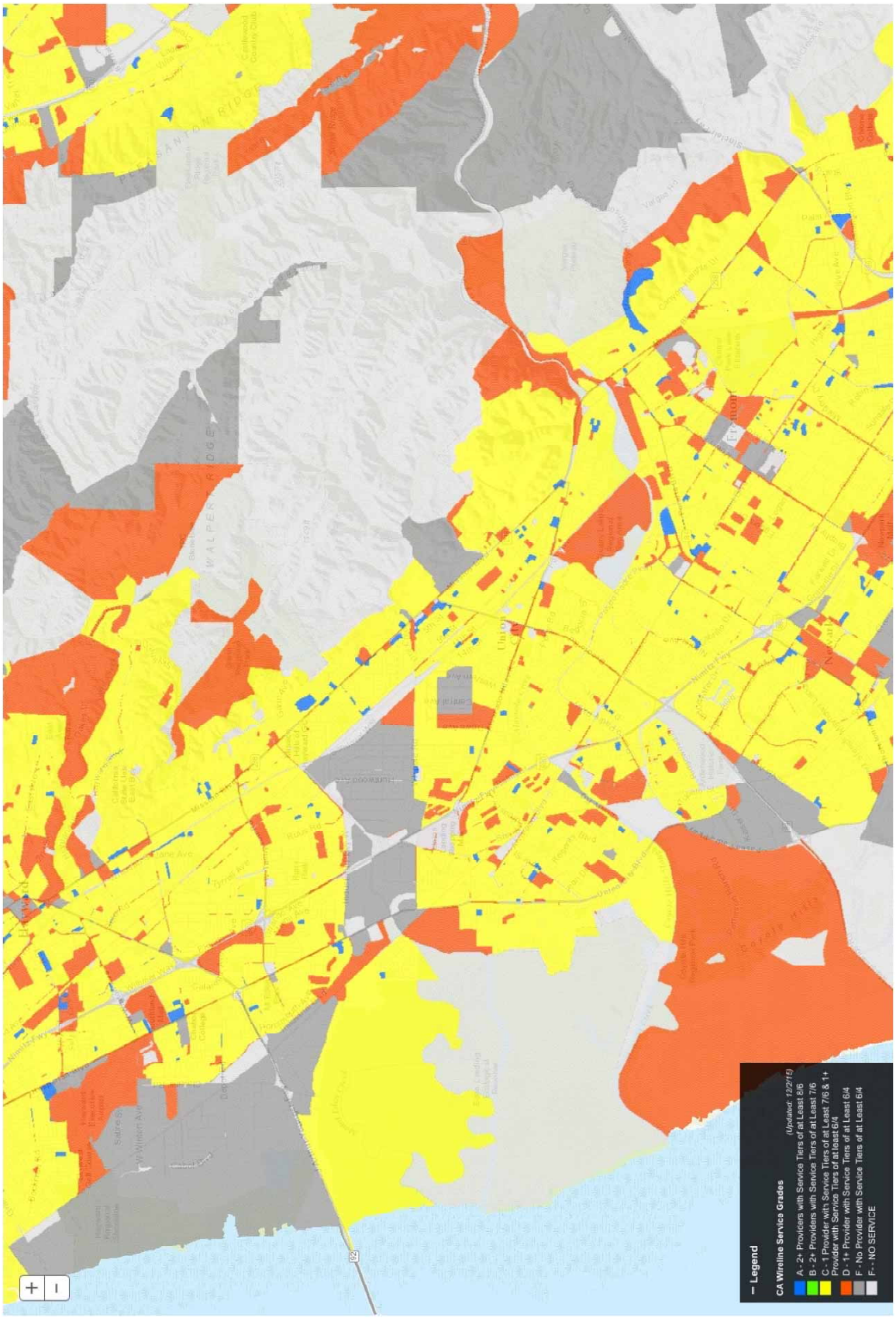
Appendix A - Maps

1. Infrastructure grading maps

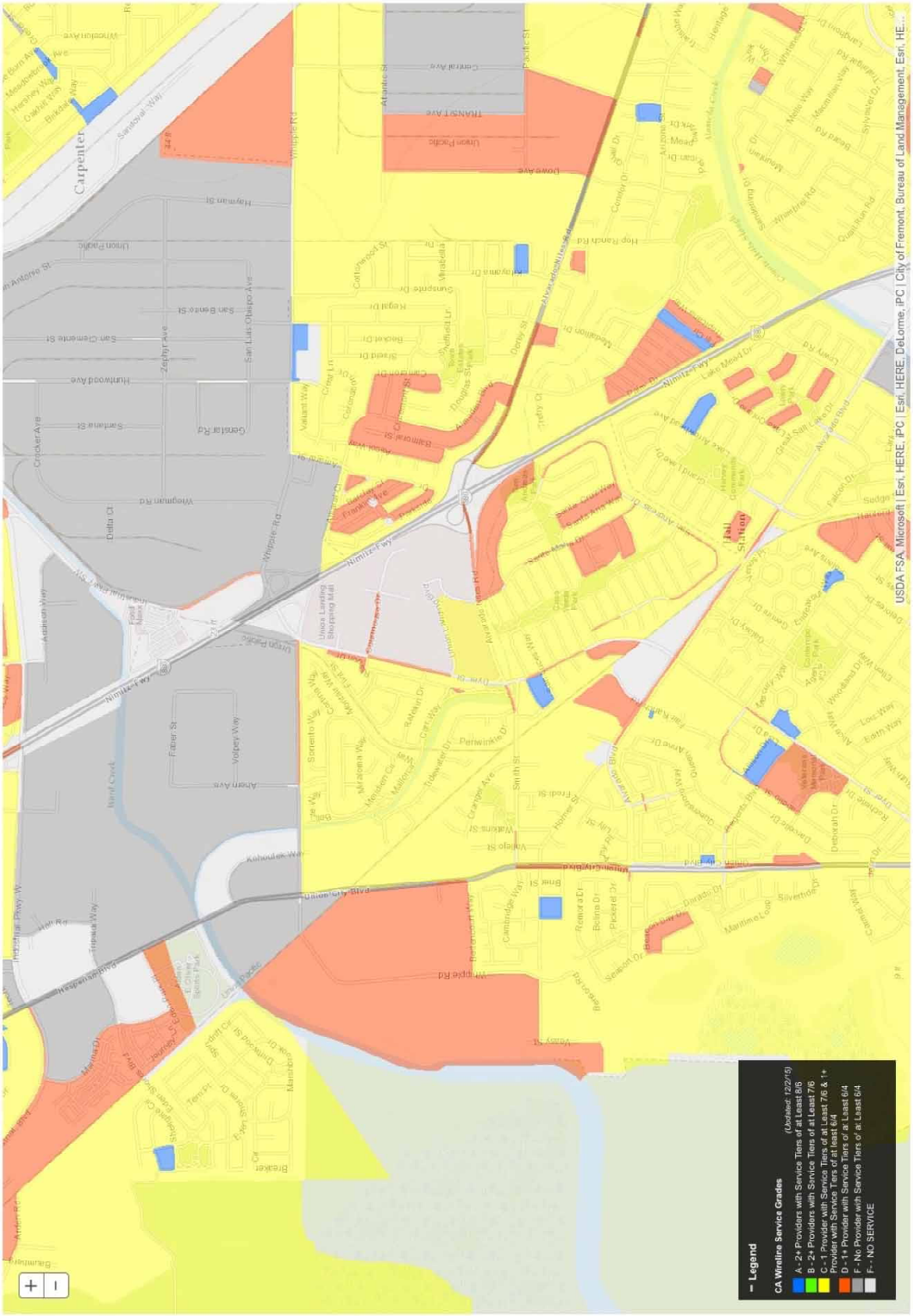
East Bay Area



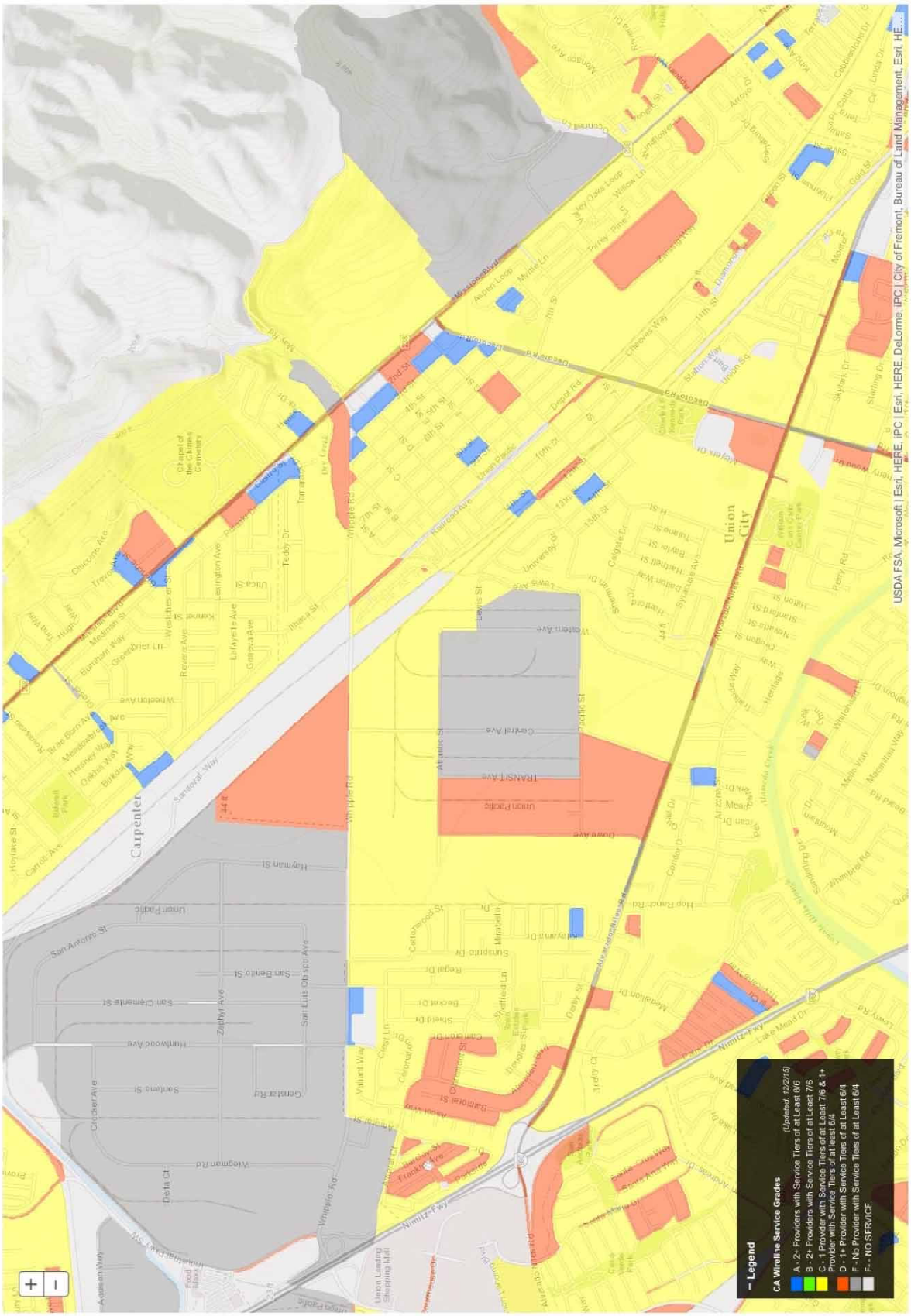
Union City


Legend
CA Wireline Service Grades
(Updated: 12/2/15)
A - 2+ Providers with Service Tiers of at Least 8/6
B - 2+ Providers with Service Tiers of at Least 7/6
C - 1 Provider with Service Tiers of at Least 7/6 & 1+ Provider with Service Tiers of at Least 6/4
D - 1+ Provider with Service Tiers of at Least 6/4
F - No Provider with Service Tiers of at Least 6/4
F - NO SERVICE

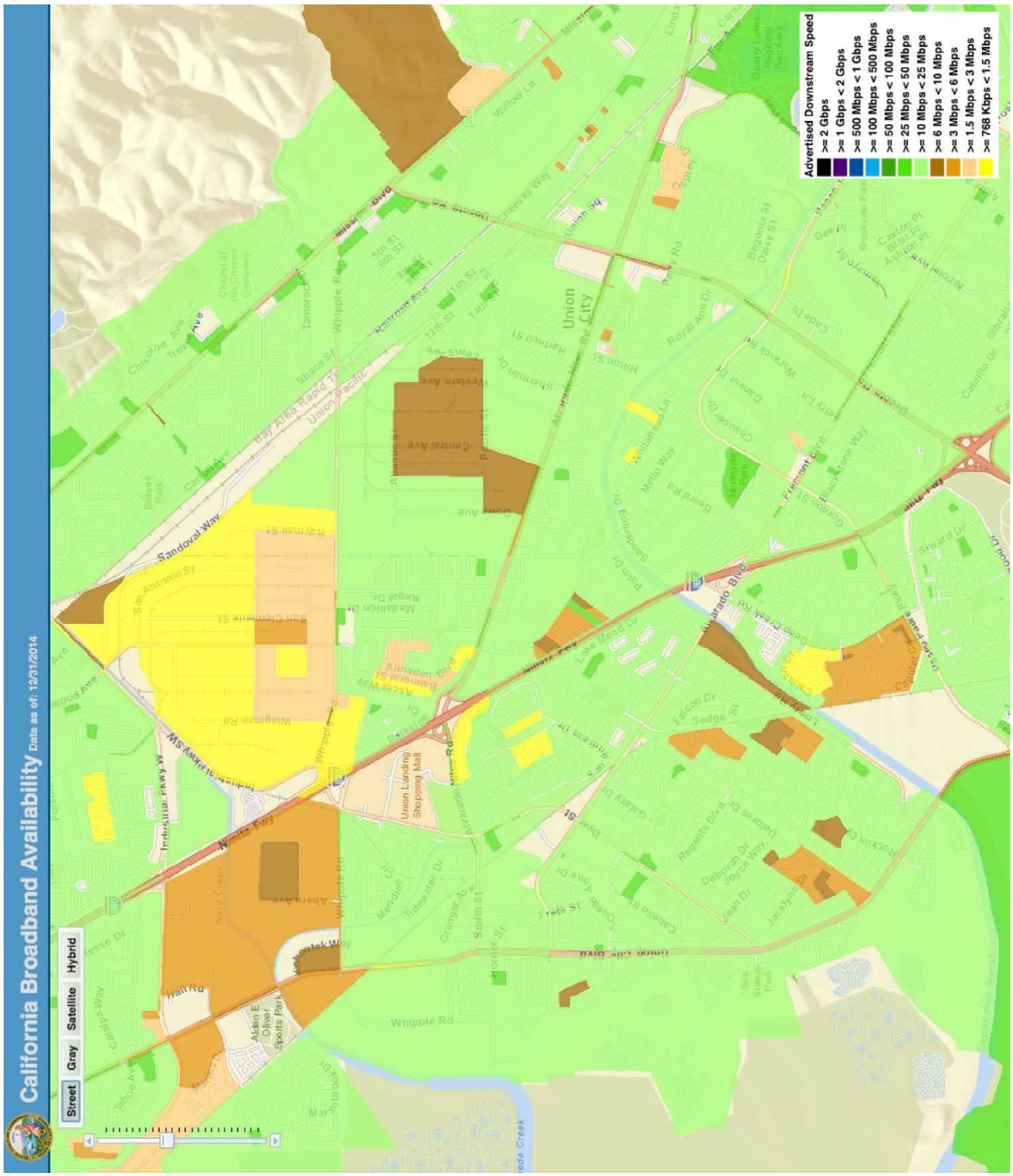
Study Areas 1 and 2 – Northwest Industrial Area and Union Landing



Study Areas 3, 4 and 5 – Central Industrial Area, Station District and Civic Center

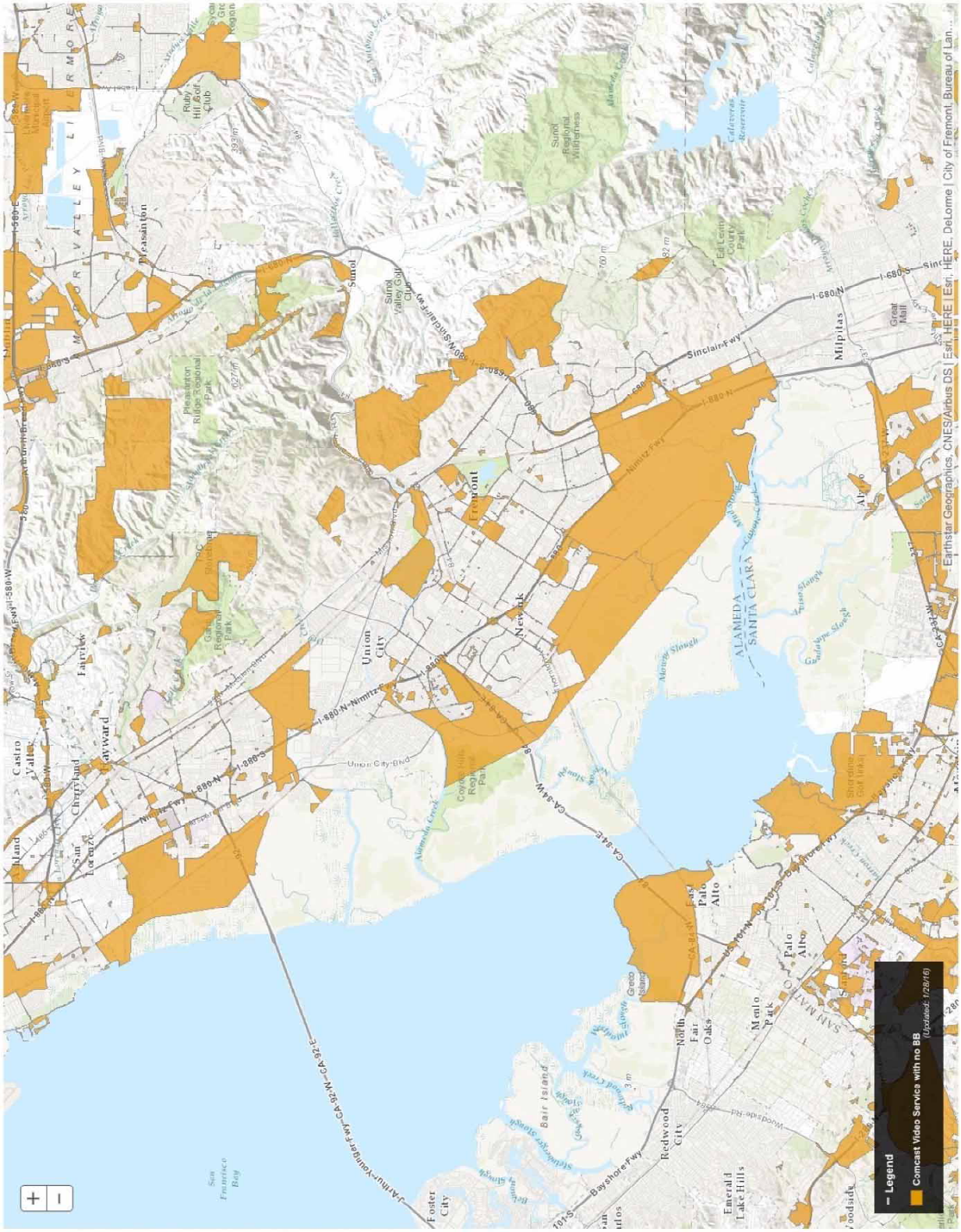


2. AT&T DSL service

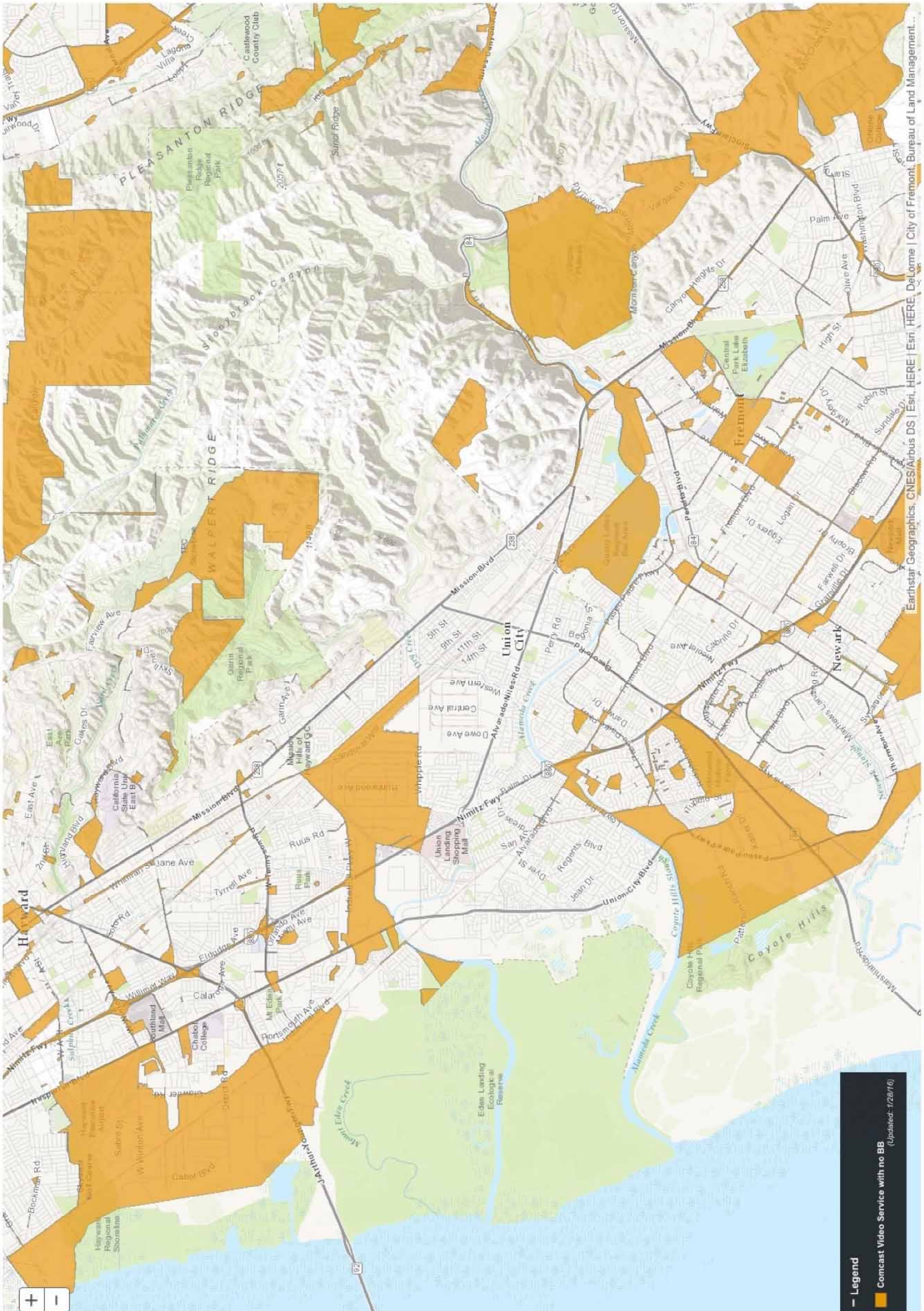


3. Comcast service gaps

East Bay Area



Union city

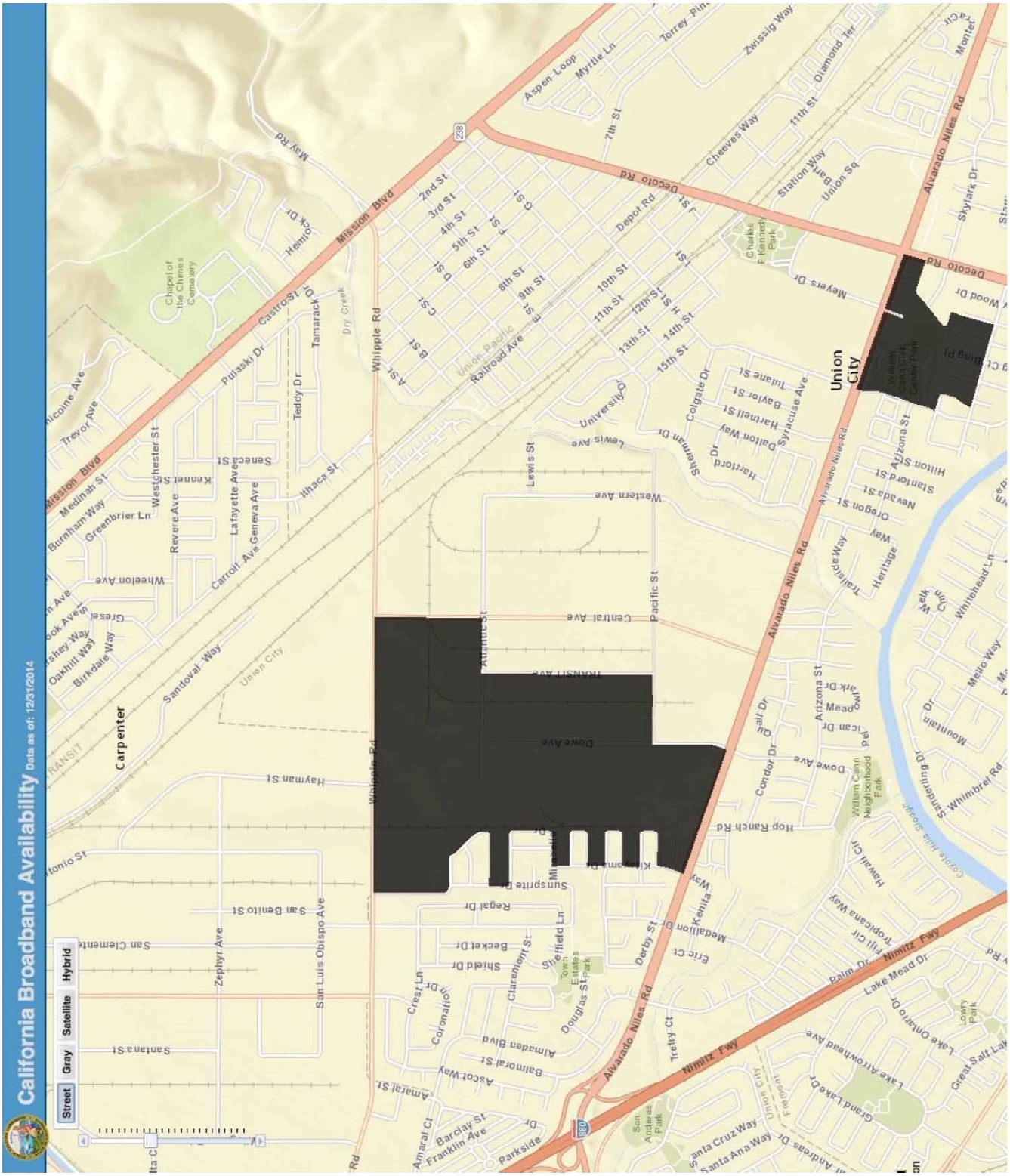


4. Union City conduit and fiber routes

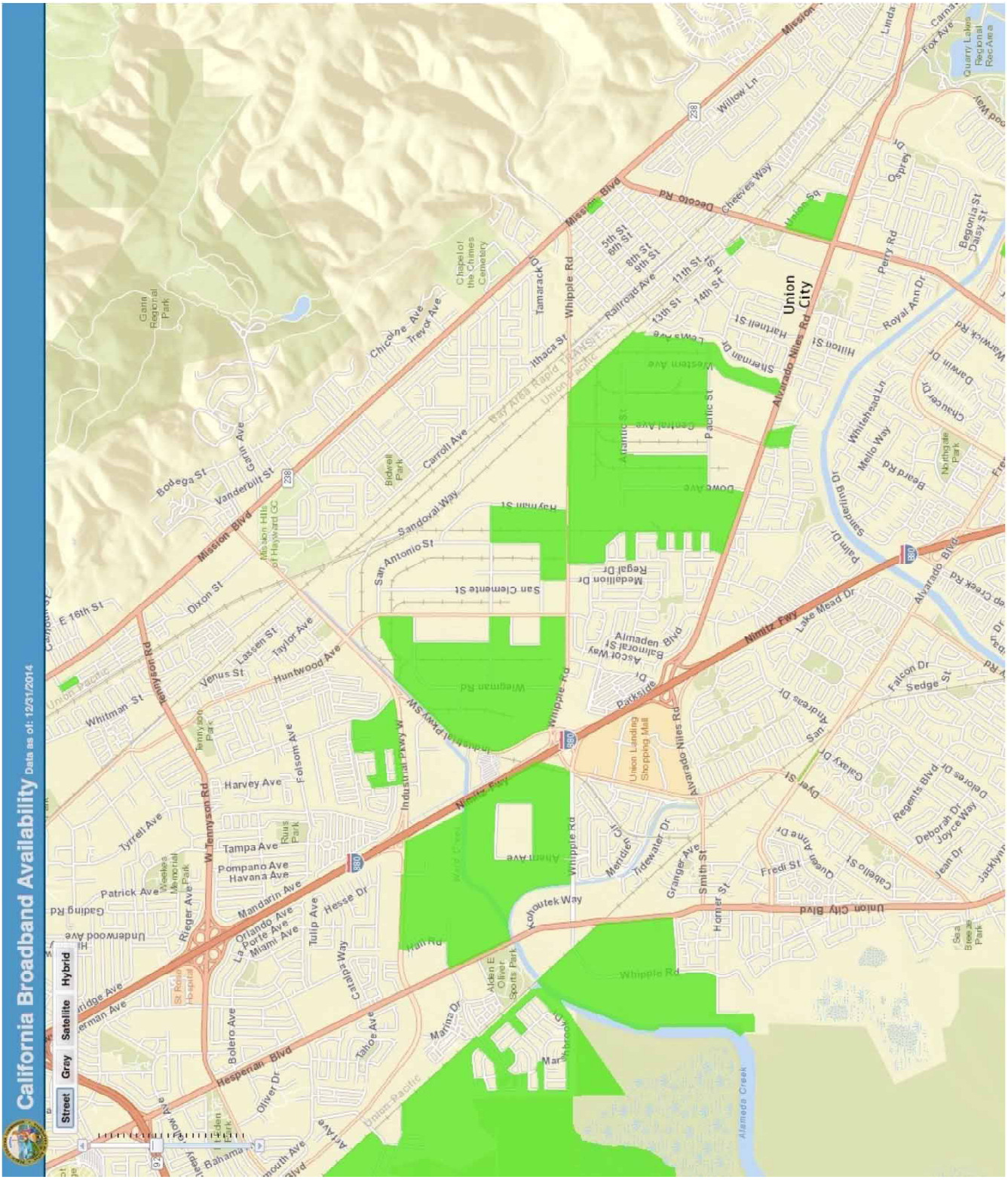
5. Secondary providers

Level 3 fiber locations

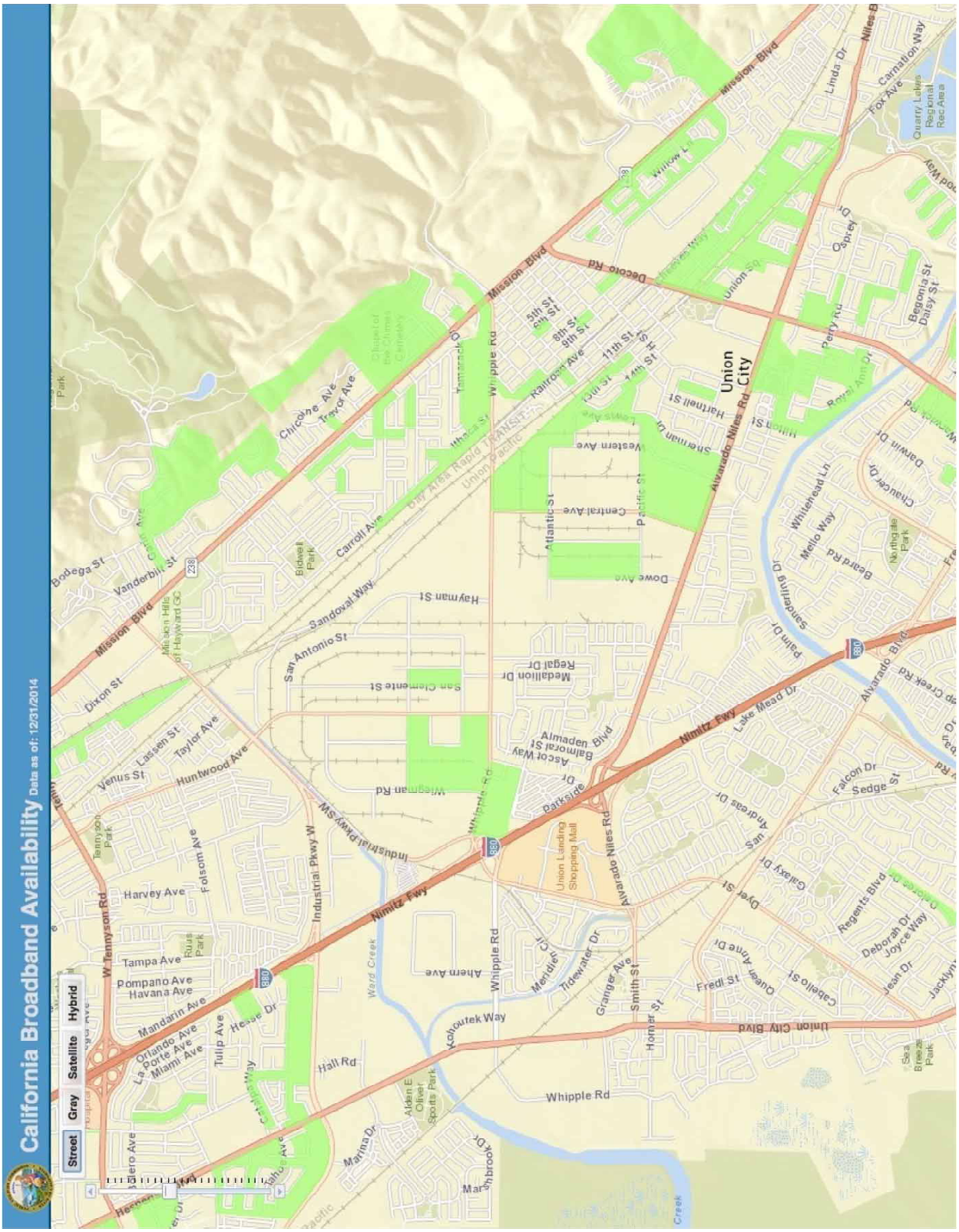
TW Telecom fiber locations



TW Telecom enhanced copper locations

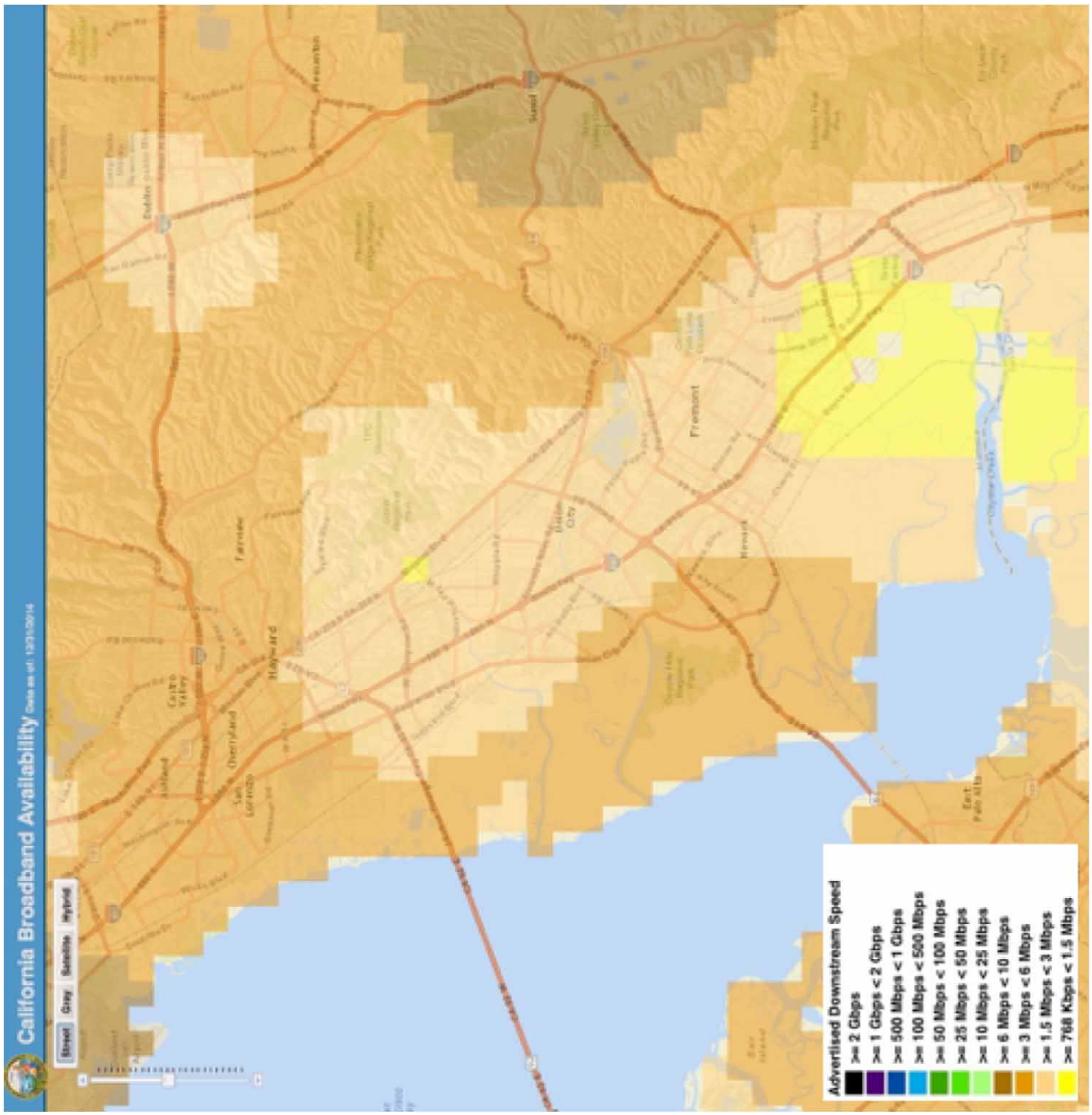


Sonic.net enhanced copper locations

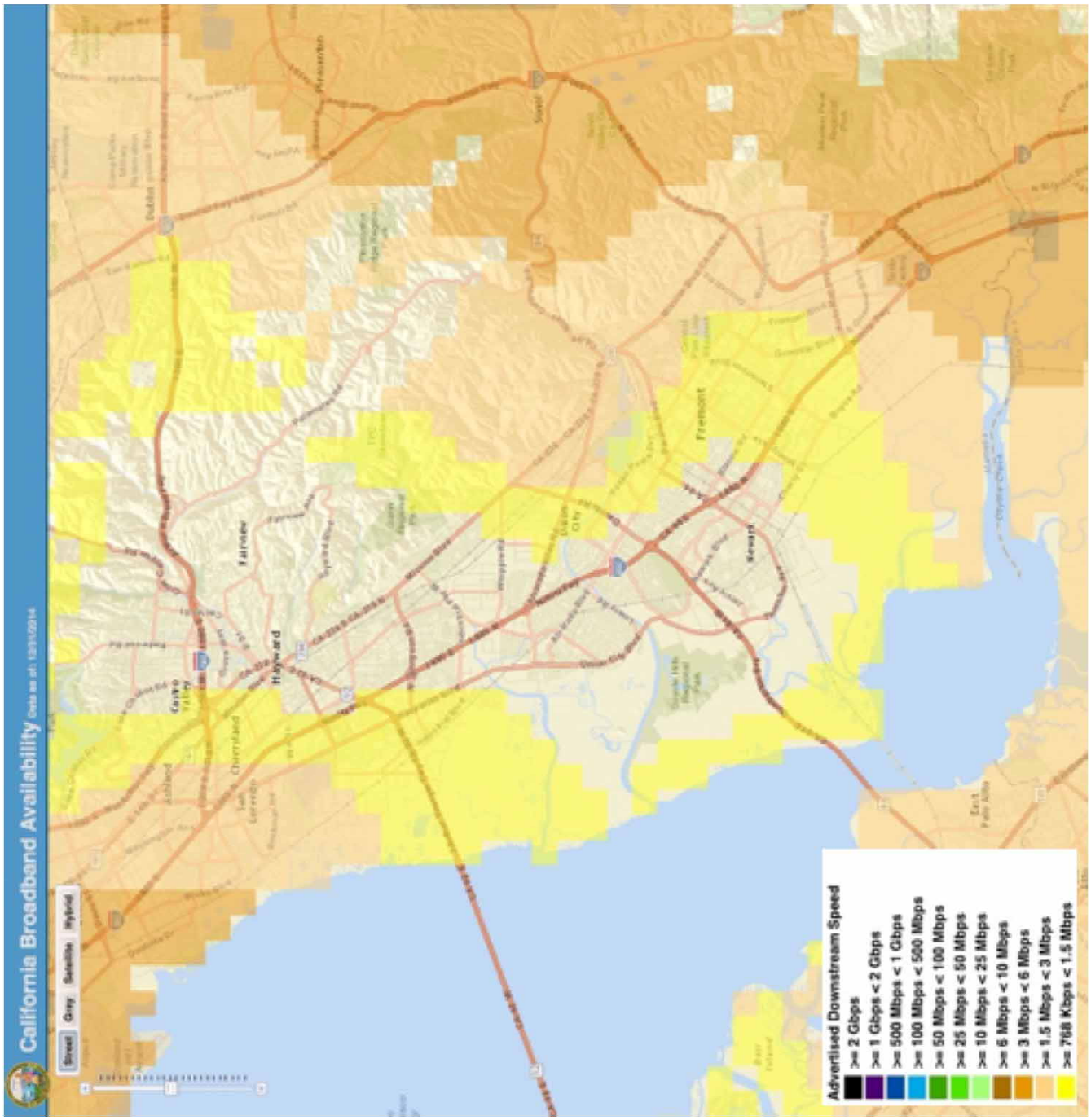


6. Wireless broadband availability

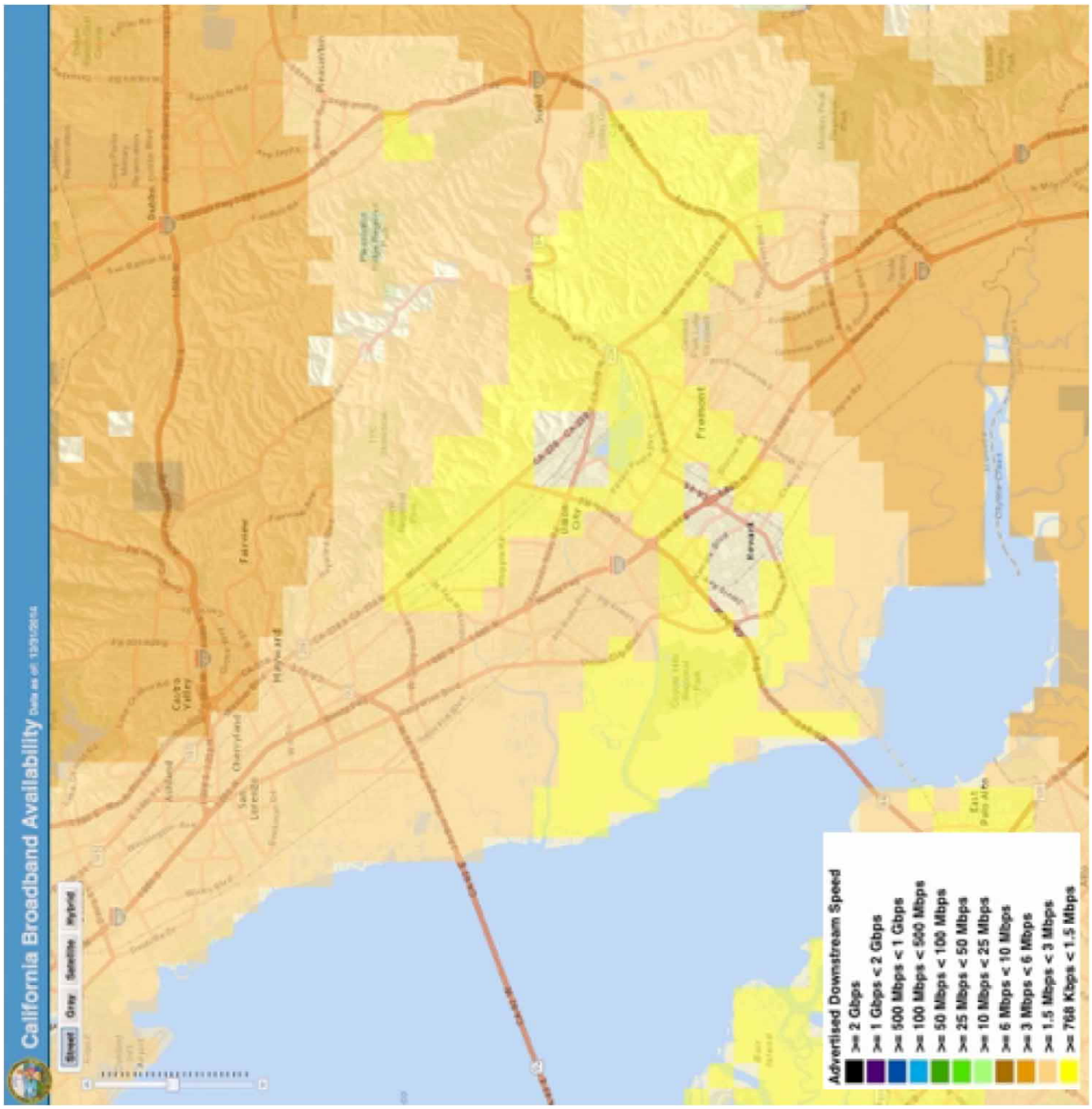
AT&T mobile broadband service



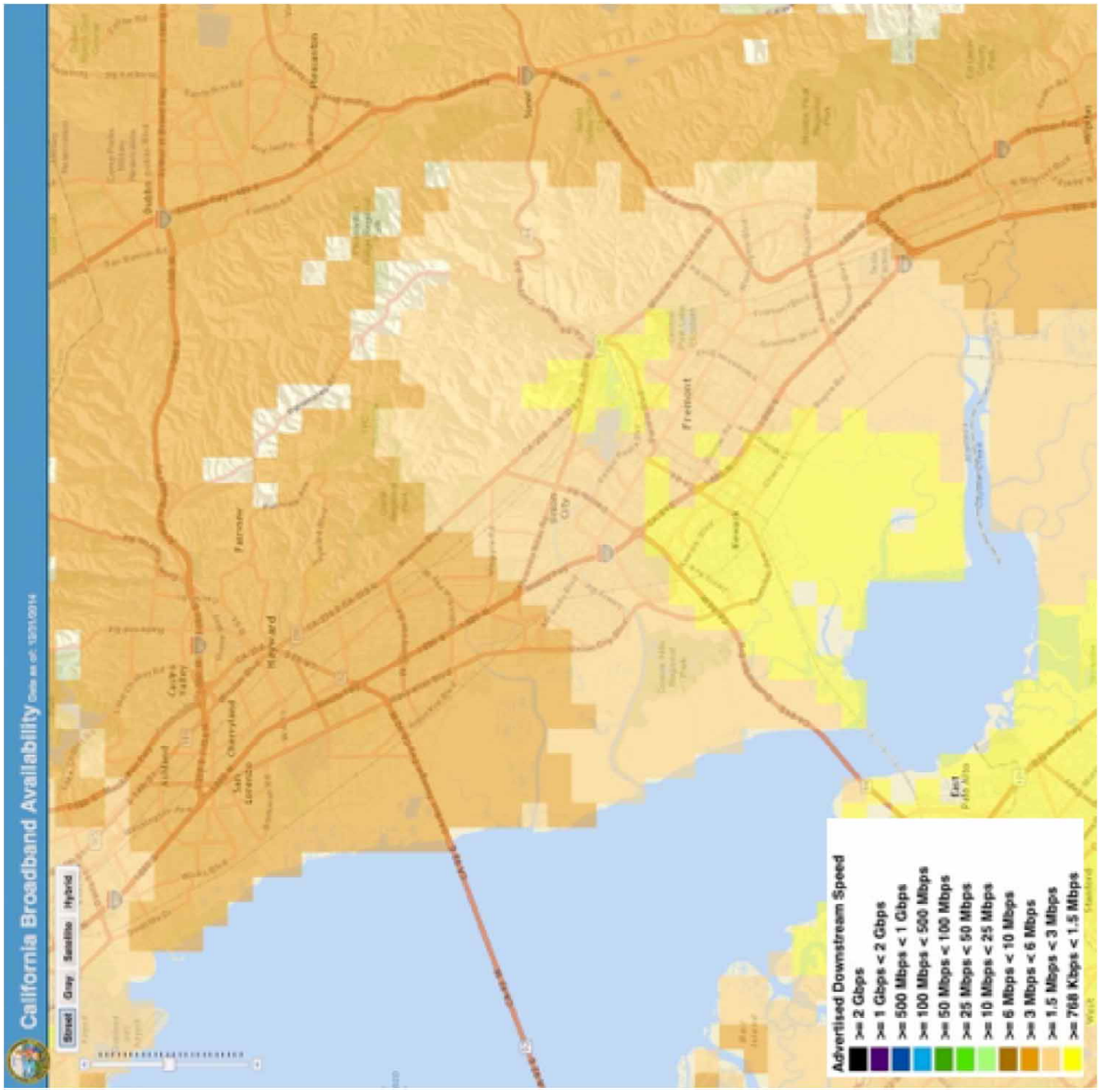
Sprint mobile broadband service



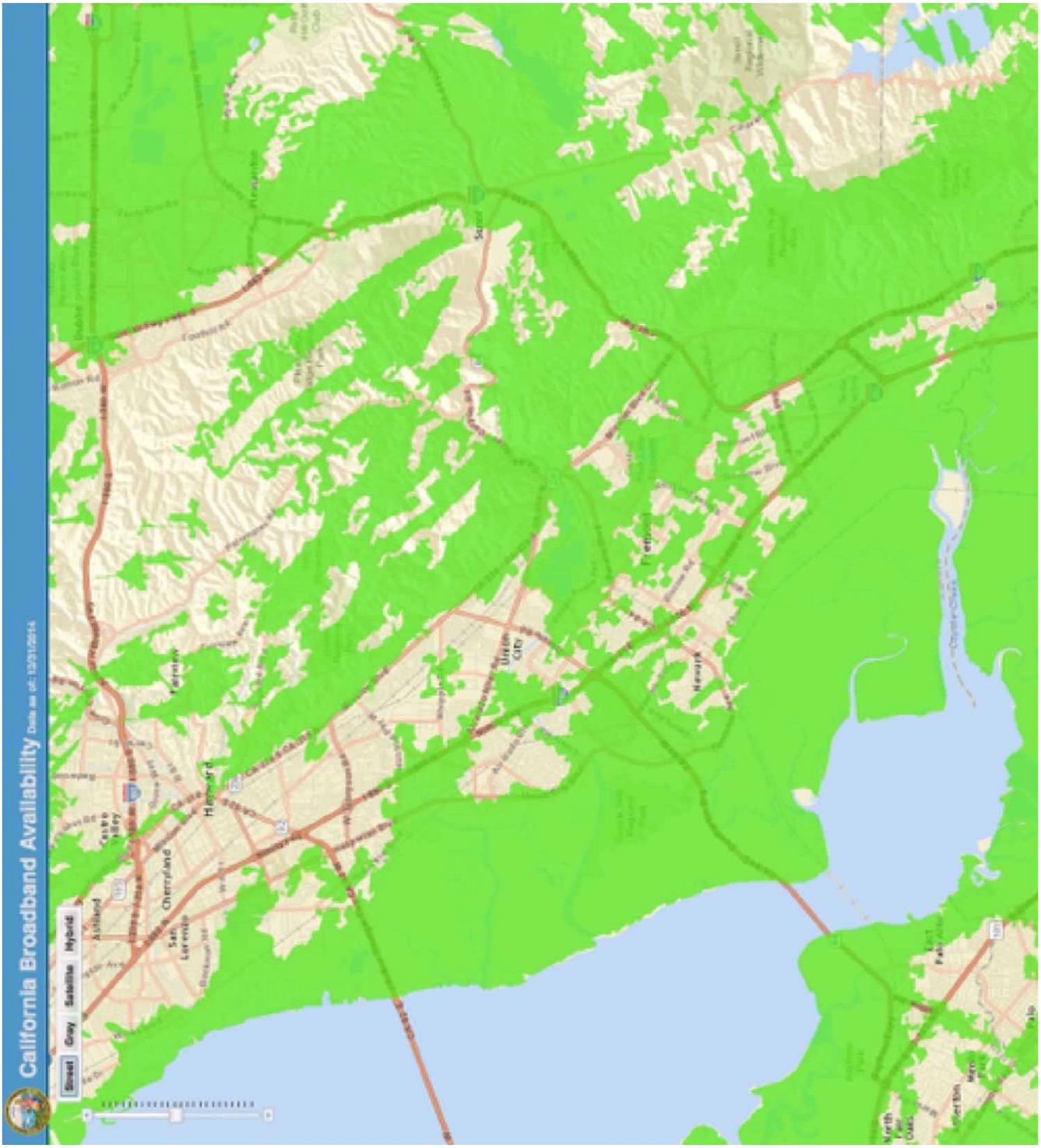
T-Mobile mobile broadband service



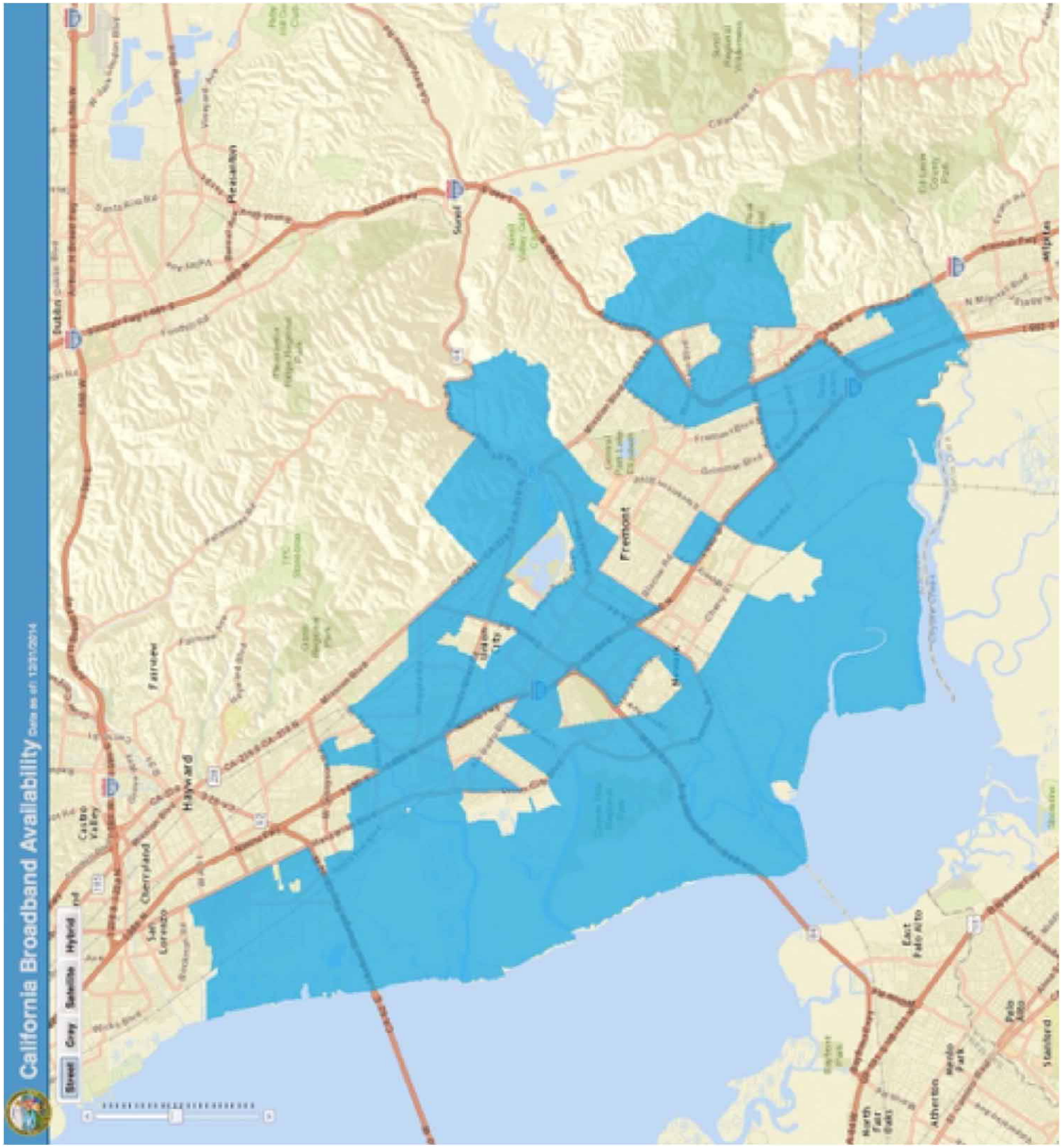
Verizon mobile broadband service



Etheric fixed wireless service area (unlicensed)



Tekify fixed wireless service area (unlicensed)



Appendix B - Infrastructure grades

Methodology

In a study conducted for the East Bay Broadband Consortium (EBBC) in 2013[1], in cooperation with the Central Coast Broadband Consortium, core broadband infrastructure was evaluated in Alameda, Contra Costa and Solano Counties using data submitted to the California Public Utilities Commission by Internet service providers. A comparative report card was developed, with the average grade – "C" – set at the most prevalent infrastructure, and corresponding service levels, in the state: a combination of relatively high speed cable modem and mid-range telephone company DSL facilities.

This methodology was subsequently used by the Central Coast Broadband Consortium to evaluate California broadband infrastructure and service on a statewide basis, on behalf of the California Emerging Technology Fund.

The primary data for assessing the quantity and quality of broadband infrastructure in the East Bay region (Alameda, Contra Costa and Solano counties) comes from the California Public Utilities Commission, which collects service level reports from providers throughout the state. This data can be broken down to the census block level, and shows what level of service Internet companies claim to provide, but not necessarily what they deliver. The accuracy of this data and the definition of service levels varies from company to company, although it is generally consistent within any given company. In other words, if Company Z exaggerates the speeds and availability of home Internet service, it tends to do so to more or less the same extent everywhere. By using a comparative system for ranking, rather than using the absolute values provided, the variation in the accuracy of the data can be smoothed out and an apples-to-apples comparison can be achieved.

The data collected by CPUC was divided into three categories: core wireline service, commercial broadband service providers and mobile carriers.

Consumer-grade service throughout California was assessed, and used as one of the two primary grading benchmarks, the other being the CPUC's standard for minimum acceptable service of 6 Mbps download/1.5 Mbps upload speed. Upload speed was given equal weight to download speed, even though it's generally less critical for consumers, because upload speed gives a good indication of the capacity of the underlying infrastructure. When a service provider skimps on upload speeds, as frequently happens, it is usually because its cables and other core equipment have a limited capacity.

Grades were then assigned as follows:

A - Two competing providers, both advertising maximum download speeds of at least 25 Mbps and maximum uploads speeds of 6 Mbps, or 3 or more competing providers offering that standard of service in combination.

[1] *East Bay Broadband Report Card*, Tellus Venture Associates, 28 January 2014.

B - Competing providers, both advertising maximum download speeds of at least 10 Mbps and maximum uploads speeds of 6 Mbps.

C - Competing providers, one advertising max down/up speeds of at least 10/6 Mbps and the remainder meeting CPUC's minimum 6 down/1.5 up standard.

D - At least one provider advertising speeds that meet the CPUC's minimum standards of 6 Mbps down and 1.5 Mbps up.

F - At least one provider offers service, but no service is available that meets the CPUC's minimum standard of 6 Mbps down and 1.5 Mbps up (meets CPUC's definition of underserved).

F- - No broadband service available (meets CPUC's definition of unserved).

A "C" grade indicates that the consumer grade broadband services, and consequently the underlying core infrastructure, in a given area meets the statewide average. A "D" grade means it meets the minimum passing service standard set by the CPUC. "F" grades indicate full or partial failure, which also means the area is eligible for infrastructure construction subsidies from the Commission. "A" and "B" grades show that service in an area is superior to the California average.

The first step in grading was to give a letter grade to each census block in the three counties. Then, the grade points were tallied, weighted by population and averaged for the census blocks within cities, counties and unincorporated areas, to produce a numerical grade on a four point scale, which was rounded to the nearest tenth.

The numerical grade point average for an area was then converted to a letter grade on the following scale:

A	4.0
A-	3.7-3.9
B+	3.3-3.6
B	3.0-3.2
B-	2.7-2.9
C+	2.3-2.6
C	2.0-2.2
C-	1.7-1.9
D+	1.3-1.6
D	1.0-1.2
D-	0.7-0.9
F+	0.3-0.6
F	0.0-0.2
F-	No service available

Appendix C - Commercial/industrial infrastructure ratings

Methodology

The purpose of the commercial/industrial broadband infrastructure rating system is to assess the availability of business-focused facilities and service within commercially and industrially zoned areas of cities and counties. The infrastructure grading system (see above) assesses primary broadband infrastructure, which is owned by incumbent telephone and cable companies, and supports retail voice, television and/or broadband service for both residential and business customers. However, when deciding whether to locate or remain in an area, businesses often assess the availability of commercial and industrial grade broadband facilities, in addition to the consumer grade services provided by primary carriers.

Commercial and industrial grade service may be provided both by primary carriers and by independent telecommunications companies. This type of service is broken down into four categories:

Commercial grade commodity Internet service delivered via primary infrastructure (i.e., telephone or cable systems) offered on standard terms and resembling, to one degree or another, the retail service offered to residences. Sometimes referred to as "business class" packages, these services are typically more expensive than residential service and may meet higher quality of service standards, but generally deliver similar upload and download speeds.

Enhanced commercial grade broadband service delivered via fiber to the premise or, less commonly, advanced copper-based technologies. This service might be offered on a commodity basis, with fixed terms and rates, or on an individually negotiated and provisioned basis. For the purposes of this analysis, this type of service is referred to as "megabit-class fiber" service and defined as any fiber-based (or advanced copper-based) service that supports a minimum *upload* speed of 10 Mbps. This service may included standard Internet access at the minimum speed or better, or simply be a "lit" service (i.e.,i.e., Layer 2) that provides a high bandwidth connection between two points without necessarily connecting to the Internet.

Industrial grade broadband service delivered via fiber to the premise technology. Referred to as "gigabit class" service for the purpose of this analysis, this category of service is similar to megabit class fiber service, but provides symmetrical connections at a minimum speed of 1 Gbps.

Dark fiber. This type of service involves only the rental of fiber optic strands between two points. The customer takes responsibility for providing the electronics (i.e., "lighting" it) and any other connectivity or provisioning that might be required, for example Internet bandwidth. The primary difference between dark fiber service and the three types of "lit" services is that customers pay a flat rate for the lease of the fiber and then determine how much bandwidth is used, based on equipment and related services that they purchase separately. A pair of dark fiber strands can typically support bi-directional speeds well above the 10 Terabit per second range, if desired.

The system for rating the infrastructure available in a given location is as follows:

Zero stars: no fiber-to-the-premise infrastructure is present and the primary infrastructure grade is "F" or "D", indicating that there is either no business class service available at all or there is only one primary carrier offering service of any kind.

1 Star: either business class service is available from a primary carrier and a second primary carrier offers service that meets CPUC minimum standards (i.e., a primary infrastructure grade of at least "C"), or megabit class service is available and the primary infrastructure grade is "D".

2 Stars: either the primary infrastructure grade is at least a "C" and megabit class service is available, or the primary infrastructure grade is at least a "D" and gigabit class service is available.

3 Stars: either the primary infrastructure grade is at least a "C" and gigabit class service is available, or the primary infrastructure grade is at least a "D" and both megabit and gigabit class service is available.

4 Stars: the primary infrastructure grade is at least a "C" and both megabit and gigabit class service is available.

5 Stars: meets the criteria for 4 Stars and open access dark fiber is available on standardised and published terms.

This rating system is based on the principle that the greater the range and variety of competitive services that are available in a given location, the greater its attractiveness to a greater range of businesses, and therefore the greater its value as commercial real estate.

For the purposes of this analysis, a location is defined as a census block or partial census block that is contained within an area zoned for commercial or industrial use. Census blocks are used to define boundaries because broadband availability data is reported on a census block level. Although not all parcels within a census block necessarily have access to all of the services as reported, the basic infrastructure to provide such service is present.

A Star rating is given to each location (i.e., full or partial census block in a commercial or industrial zone) and represented on a map. Aggregate community ratings are calculated by averaging the Star Ratings for census blocks that have a centroid within a commercial and/or industrial zone in cities and census designated places, and rounding to the nearest half Star.

Because census block and zone boundaries do not coincide, many census blocks are incidentally touched by a commercial and/or industrial zone. Using only those census blocks with a centroid inside of commercial and/or industrial zone reduces the noise level of the data and provides a clearer analysis of the available broadband infrastructure within those zones. For visual representation purposes, any portion of a census block that falls outside of a commercial and/or industrial zone is "clipped" out of the picture, producing a complete picture.

It should be noted that this report is the first to include commercial/industrial broadband infrastructure ratings and as time goes on, the techniques used will be refined and some of the above methodology might change. Also, since primary broadband infrastructure grades and other metrics also change, due to improvement or degradation of infrastructure, some of the data upon which these ratings are based may change as well. It would be prudent to regard the above Star Ratings as the result from a "Beta" version of the rating system.

Appendix D - Initiative options and business models

Initiative options

There are several ways of pursuing any priorities established. Possibilities include:

Evaluate using existing city conduit as the basis for a commercial and industrial grade fiber network. Although costs would depend on a number of unknown factors, such as the condition of some of the city's conduit and the type and extent of the desired network, installing fiber optic lines in existing conduit and building the necessary supporting infrastructure could cost in the millions of dollars range. A network that used most of the city's existing conduit and filled relatively minor gaps with new construction might cost less than $10 million.

Conduct a fiber-to-the-home feasibility study. The cost of building a full, fiber to the home system that serves every Berkeley home and business would be in the tens of millions of dollars range[2], perhaps approaching the $100 million point. A feasibility study can be used to assess such a project, from the point of view of operating it as a municipal enterprise as well as an opportunity to present to potential private sector partners.

Issue an RFP. In line with the priorities set, a request for proposal (or similar) could be used to ask private sector companies to submit ideas for using the City's broadband facilities, and particularly its downtown, traffic signal and other conduit. The request could be structured around a public-private partnership, or a straight lease arrangement, or simply left open.

Develop a broadband master plan. This document could be developed and adopted on a standalone basis, or incorporated into the City's existing general plan. The plan could set out overall policy and establish a roadmap for broadband infrastructure development, for both the public and private sector.

Develop a phased build out plan. There are steps the City can take immediately with its existing conduit and fiber resources, steps that can taken in the near future in conjunction with existing projects, such as street maintenance, and steps that are difficult to implement now but could be done over time. These phases could, if desired, mix municipal and private sector projects, and commercial and residential development.

Assess interest in and capacity for financing broadband infrastructure. Although it can be difficult to gain approval for bond measures, new legislation enacted in 2014 (Senate Bill 628) gave local agencies the ability to form enhanced infrastructure financing districts and issue tax increment financed bonds with 55% voter approval. These districts can also use incremental property tax gains to pay back other kinds of financing, including private loans. Additionally, Assembly Bill 2292 added broadband infrastructure to list of allowable projects that may be pursued by traditional infrastructure financing districts. It is possible to pursue grant money from both the State of California and the federal

[2] *Financial analysis of user-financed residential broadband service in Palo Alto*, Tellus Venture Associates, June 2012.

government. For example, the California Public Utilities Commission offers grants for the installation and/or upgrading of broadband facilities in public housing.

Assess the potential for using existing City funds. This option is likely to be limited in scope, but, for example, the City could be an anchor tenant on new infrastructure built by a private carrier. Even a small amount of guaranteed revenue at the beginning of a capital-intensive project can make a big difference in the attractiveness of the business model to investors.

Investigate mutual use agreements with BART, AC Transit and other agencies. Local agencies in the East Bay have been receptive to low cost or no cost agreements to share broadband facilities. The City could enter into such discussions either to develop facilities for its own use, or to make its existing infrastructure more attractive to private sector investors.

Discuss joint fiber ventures with nearby cities. Oakland, San Leandro, Hayward, Fremont Alameda and San Jose have either pursued or are pursuing municipal broadband projects of various kinds. Although each city has its own, unique objectives and circumstances, there are commonalities in any kind of broadband development, and significant advantages to be gained from creating economies of scale.

Survey conduit. The City's existing conduit system is only partially mapped, and its condition and available capacity is unknown. Conducting an engineering survey will increase the specificity, and consequently the attractiveness, of any partnerships or leases that might be proposed. Alternatively, survey work could be determined by the City to be the responsibility of prospective users.

Inventory other City assets. Either in conjunction with any of the studies described above or as a standalone project, evaluate city owned real estate to determine if it might be available to a broadband development project.

Municipal broadband case studies

Some cities, such as Palo Alto, San Leandro, Benicia and Santa Monica, are involved to one degree or another in developing broadband facilities and services for commercial and industrial areas. Other cities, for example Alameda, Loma Linda, Lompoc and Provo, Utah, have pursued broadband projects that are focused on providing consumer-grade Internet service to homes. Still others, such as Santa Cruz, Brentwood, Kansas City and Austin, Texas, have used policy initiatives to attract private fiber-to-the-home projects.

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 and social equity as water or electricity – and that there is a public interest in encouraging its development.

Municipal broadband business models include city or county owned and operated networks, partnerships with private companies, and facilitation of the development of completely private systems (see Appendix D for more details).

Examples (in California unless otherwise indicated) include:

City of Palo Alto – the municipal electric utility has installed more than 40 miles of fiber optic cables, which it makes available to business and industrial customers, and is supplementing this coverage with publicly available, amenity grade WiFi access (i.e. intended to meet occasional, on-the-spot needs of tourists and shoppers, for example, rather than daily household, business or educational needs). No residential service is offered. The system generates more than $2 million in surplus revenue a year.

City of Santa Clara - similar to Palo Alto, the city's electric utility provides access to fiber optic lines to businesses, and also uses the smart meter infrastructure it has installed to support amenity grade WiFi service. This system also generates an annual surplus.

City of San Leandro - the city entered into an agreement with a local company, Lit San Leandro, to provide access to city-owned conduit. This private company installed fiber optic lines in the city's conduit, to support commercial and industrial customers as well as public uses. In the second phase of this project, the city applied for and received a grant from the federal Economic Development Administration to install additional conduit in order to extend the fiber network. In exchange, the city receives access to the network for its own use and, eventually, will receive conduit lease revenue. The city incurs costs to support the project and currently generates no direct revenue, but has had significant success in attracting new, high technology businesses.

City of Benicia - the city has awarded a contract to Lit San Leandro to provide industrial-grade Internet service to a local industrial and a nearby redevelopment area. This project is funded via a re-purposed transportation grant, and supported by city facilities such as its corporation yard.

City of Santa Monica - the city's information technology department provides ethernet connectivity between local businesses and nearby data centers, where high capacity Internet bandwidth can be obtained relatively inexpensively.

City of Loma Linda - the city requires newly built and remodeled homes to include fiber optic connections to the city-run network, which offers optional Internet service to residents.

City of Provo, Utah - the city's municipal electric utility built a fiber-to-the-home system using bonds that were to be paid back via the revenue generated. However, the revenue was insufficient to meet bond obligations and a mandatory $5.25 monthly fee was added to residential and commercial electric bills. The system was subsequently sold to Google for a nominal amount, although the bond obligations remain with the city and local electric ratepayers.

City of Alameda - the city's electric utility built a cable system offering video and Internet service which competed for customers with the incumbent private telephone and cable companies. It could not generate sufficient revenue to meet its bond obligations and the system was sold at a loss to the local private cable operator, Comcast. Because the bonds were only backed by revenue from the cable system, and not the electric utility or the city's general fund, bondholders bore the loss. The city was able to successfully defend the subsequent lawsuits.

City of Lompoc - the city's electric utility department built and continues to operate a municipal WiFi utility which was originally intended to provide ubiquitous Internet access to homes and businesses. Although using WiFi to provide primary Internet access to homes proved problematic, the system provides a valuable, albeit low speed, lifeline option for residents and access for visitors. The revenue generated by this service is not sufficient to meet costs, and it is currently subsidized by other city funds.

City and County of San Francisco - a policy is under development to require inclusion of broadband conduit in public projects and to provide an option for placement of publicly-owned conduit in private projects which involve cutting into streets and other right of ways.

City of Santa Cruz - the city council adopted a package of broadband development policies, including a "dig once" ordinance and a master lease template for use of city-owned assets.

City of Watsonville - since the end of local cable television franchising in California, cable companies have begun charging cities for the use of institutional networks – INETs – originally provided at little or no cost. Charter Communications initially wanted to charge the City of Watsonville $150,000 a year for the use of its INET, which connected critical city facilities. Because the city had a policy of routinely keeping an inventory of conduit and other network assets that had been installed on a prospective basis as well as for specific projects over the year, it was able to use conduit routes it already owned to duplicate all but a few segments, totalling a mile, of the INET system. The remaining gaps were connected via conduit installed by the city for less than the cost of two years service from Charter.

City of Brentwood - for the past 15 years, the city has required new home construction to include empty conduits which are deeded over to the city. An agreement has been reached with an independent Internet service provider, Sonic.net, to use the city-owned conduit to install fiber lines and provide fiber-to-the-home service to homes already served by conduit, and extend the system over time throughout the city.

City of Pacific Grove - a contract was approved with SiFi Networks, a U.K.-based company, which provides provide the company with access to city streets, right of ways and sewers in order to build a fiber-to-the-home network. The project is still in the planning stages and the ultimate source of funding is yet to be identified.

Kansas City, Kansas and Missouri and Austin, Texas – local governments have worked with Google Fiber to facilitate construction of privately-owned, competitive fiber-to-the-home systems. This facilitation includes access to government owned facilities, such as right of ways and pole access for fiber installation and real estate leases for equipment huts, as well as a high degree of cooperation in granting permits and carrying out inspections.

Municipal Broadband Case Studies

City	Business Model	Municipal Utility?	Markets Served					Financial Notes
			Business	Industrial	Public uses	Amenity WiFi	Homes	
Alameda	City sold system to Comcast after failure of City-run model.	Yes, broadband & electric	●		●		●	Funded by revenue bonds, bondholders lost money when system was sold at 50% of bond value.
Austin, TX	Google Fiber, no direct city involvement.		●	?	●		●	No direct city investment, provided concessions regarding access to city assets and permits.
Benicia	City partners with private company.	No	●	●				Under development, funded by transportation grant
Brentwood	City partners with private company.	No	●	?	●		●	City requires conduit to be laid in new construction, and then deeded to the city. City leases conduit to 3rd party provider.
Kansas City	Google Fiber, no direct city involvement.		●	?	●		●	No direct city investment, provided concessions regarding access to city assets and permits.
Loma Linda	City provides service to homes and businesses.	Yes, operated by IT dept.	●	●	●		●	Conduit attached to city system required in new & major remodel construction. Service is optional & fee-based.
Lompoc	City provides WiFi-based service on a fee basis to homes.	Yes, broadband & electric			●	●	●	WiFi-only system, funded by 10 year lease-back and subsidized by utility department.
Pacific Grove	City partners with private company.	No	●		●		●	Under development. Either city or private service provider will have to pay monthly fee to company that funds/builds system.
Palo Alto	City provides dark fiber service.	Yes, broadband & electric	●	●	●	●		$2 million surplus revenue/year, initially funded as electric utility infrastructure, now self supporting.

Municipal Broadband Case Studies

City	Business Model	Municipal Utility?	Markets Served					Financial Notes
			Business	Industrial	Public uses	Amenity WiFi	Homes	
Provo, Utah	City sold system to Google Fiber after failure of City-run model.	Yes, operated by IT dept.	●	?	●		●	Sold to Google for $2; rate payers still paying off electric revenue bond obligations incurred to build network.
San Francisco	Ad hoc use of CCSF fiber and conduit by businesses.	Informal		●	●			City conduit and fiber originally installed for public purposes; funded out of agency budgets.
San Leandro	City partners with private company.	No	●	●	●	●		Uses city traffic signal conduit, plus extension funded by EDA grant. City will receive revenue in future years.
Santa Clara	City provides dark fiber service.	Yes, broadband & electric	●	●	●	●		$500K surplus revenue/year, initially funded as electric utility infrastructure, now self supporting.
Santa Monica	City provides "lit" connections between businesses and wholesale ISPs.	Yes, operated by IT dept.	●	●	●	●		System built for public purposes & funded by IT budget. Revenue appears to be at or above break even level.
Watsonville	City provides dark fiber service & conduit access on an ad hoc basis.	No		●	●			Saved the City $150,000/year in telecoms costs, funded by IT budget.

Business Models

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 some 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.

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 given above include the cities of Palo Alto, Santa Clara, Santa Monica, Lompoc and Alameda.

The City of Chattanooga, Tennessee is another example. It received approximately $100 million in grants through the American Recovery and Reinvestment Act of 2009 (ARRA) and, via its municipal electric utility, used it to build a fiber-to-the-home system.

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.

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 above include the cities of San Leandro and Brentwood. Another example is the 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.

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 ARRA grants in 2009 and 2010. Examples include the City of Oakland and the City of Watsonville, which did not receive funds.

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.

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 ARRA grant to build a public access fiber network throughout Nevada. OneCommunity received a similar 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.

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. This ARRA grant recipient built and is now operating 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 ARRA 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.

Requests for Proposals

California cities have used a number of different strategies to solicit interest in infrastructure partnerships, conduit leases and other broadband initiatives. Some examples are:

Benicia - The city targeted a specific industrial area, put $750,000 on the table and asked companies to bid to build a system that would provide service to the area. Several proposals were received and the city is in the final stages of negotiating a contract with one of the proposers. The advantage is that the city gets the economic development boost it wants at a defined cost and no additional risk or operational involvement.

Los Angeles - The city put some assets – mostly existing middle mile fiber – on the table, offered good will efforts to obtain other assets, such as pole routes that the city also owns, and asked for what amounts to a full fiber to the home system. Proposals were due last November, and there's been no word of what came of it. Advantage is that it focuses attention on the city's goal of improving broadband access for all residents. Downside, so far, is that it doesn't appear much of anything will actually get built.

Salinas - The city put its conduit on the table (but no money) and asked companies for proposals to build out a broadband network in two targeted areas: downtown and a mostly greenfield area that's designated as an agricultural technology corridor. The RFP is still in process. The intended advantage is that the city will encourage economic development in two depressed areas and improve the city's overall infrastructure, and perhaps gain the benefit of better a better internal IT network, without incurring significant costs.

Watsonville - The city stitched 3 miles of existing conduit and fiber together with a mile of new conduit. It built, owns and operates the system. It was done as a standard public works build-to-spec

bid (not a formal RFP), and the city went with the low bidder. The system was built with the intention of using it as a replacement for the INET formerly provided by Charter Communications. It serves that purpose now and the city is in the process of developing a standard rate card for leasing out surplus capacity to ISPs. Advantage is that the city has complete control over the network with guaranteed completion, and a much lower cost of operation for its IT infrastructure. Disadvantage is that the city pays the full construction cost (~$300K) and ongoing operating expense (and responsibility).

Inyo County - The county asked for someone to both build a fiber to the home network and find the money to do it. Nothing substantial was on the table. Only two responses came back. One was from a construction company that basically said "if you give us enough money we'll build it for you". The other was from a respectable enough fiber company that offered to look for grant funding. Nothing has come of it yet, and it doesn't appear anything will. Advantage is zero risk. Disadvantage, to date, is zero gain.

Seattle - An RFP to lease out a short section (~200 feet) of city-owned conduit was issued. Advantage is the city gains revenue, and some economic development benefit. Disadvantage is that it's limited.

San Leandro - An exclusive negotiating rights agreement was entered into with a major local company, OSI Soft, to build a fiber enterprise called Lit San Leandro. No public RFP was published; the ENRA was in response to an offer made by a local company for use of city-owned conduit. A similar process was used in the City of Brentwood and the City of Santa Cruz. The advantage is that the city can quickly take advantage of a firm offer made by an interested party, and have greater control over the negotiating process. The disadvantage is that it requires an interested party at the beginning.

San Luis Obispo - An RFP to lease out two miles of city-owned conduit was issued. Similar to Seattle, but for a longer distance.

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. ADSL2 is the second generation of ADSL technology and provides higher service levels.
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.
Copper	Most telephone and cable lines are built using copper wires, which is a telecommunications technology that has been in use since the 19th century. the term is to distinguish lower capacity copper wires (and cables) from higher capacity fiber optic strands (and cables) that are made from glass or plastic.
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.
Dark fiber	Fiber optic cables are comprised of many, very thin fiber optic strands made of glass. A laser is used to send a beam of light through a fiber optic strand, and this beam carries data from one end to the other. If no electronic equipment (i.e. the laser) is connected to a strand, it is literally dark, and cannot carry data. Dark fiber is sought after and used by telecommunications carriers and large

	companies that prefer to install and operate their own electronic equipment at either end.
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	Broadband systems based on fixed wireless technology provide 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 to compensate for poor wireline service in urban areas. Fixed wireless systems can provide services between two specific locations – i.e. point to point – or from a central access point to many locations in the surrounding areas – i.e. point to multipoint.
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.
I-Net	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).
Lit fiber	Fiber optic cables are comprised of many, very thin fiber optic strands made of glass. A laser is used to send a beam of light through a fiber optic strand, and this beam carries data from one end to the other. When this kind of electronic equipment (i.e. the laser) is installed and operating, then the fiber strand is literally "lit" and ready to transmit data, either for the company that operates it or for third-party customers.
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.
Managed services	The type of service provided by dominant incumbent providers, such as AT&T and Comcast. Rather than providing a simple connection between points – via lit or dark fiber – these companies provide full Internet bandwidth services, at a speed and quality of service level they specify, and sometimes with quantity limits, i.e. data caps. It is analogous to water service: these companies sell "water" and don't rent out access to their "pipes".
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.
VDSL	Very-high-bit-rate digital subscriber line (VDSL or VHDSL)[1] is a digital subscriber line (DSL) technology providing data transmission faster than asymmetric digital subscriber line (ADSL) over a single flat untwisted or twisted pair of copper wires (up to 52 Mbit/s downstream and 16 Mbit/s upstream),[2] and on coaxial cable (up to 85 Mbit/s down- and upstream)[3] using the frequency band from 25 kHz to 12 MHz.[4] These rates mean that VDSL is capable of supporting applications such as high-definition television, as well as telephone services (voice over IP) and general Internet access, over a single connection. VDSL is deployed over existing wiring used for analog telephone service and lower-speed DSL connections. This standard was approved by ITU in November 2001.
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.