CITY AND COUNTY OF SAN FRANCISCO
BOARD OF SUPERVISORS

BUDGET AND LEGISLATIVE ANALYST

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POLICY ANALYSIS REPORT

To: Supervisor Mar

From: Budget and Legislative Analyst

Date: April 15, 2015

Subject: Digital Divide in San Francisco

Summary of Requested Action

You requested a report regarding San Francisco residents' lack of access to high-speed Internet service, known as the "digital divide". Specifically, you asked that the Budget and Legislative Analyst identify the number of San Franciscans without high-speed Internet access, separating those with access at home and those with access at public institutions such as schools and libraries. You asked that we identify obstacles to obtaining high-speed Internet access and identify practices in other cities to help bridge the digital divide.

For further information about this report, contact Fred Brousseau at the Budget and Legislative Analyst's Office.

Executive Summary

- Having high-speed Internet access for a computer at home is increasingly necessary for taking full advantage of the Internet and engaging in activities such as applying for jobs, school homework and communicating with one's health care providers. The Federal Communications Commission describes high-speed Internet access, or broadband, as, "…a platform for opportunity and innovation."[1]
- The City Controller's 2013 survey of San Francisco residents reported that 88 percent of respondents reported an Internet connection at home. Though San Francisco's connectivity rate is higher than the state and U.S. as a whole, 12 percent of City survey respondents reported not having access to the Internet at home. And, of those with access at home, six percent reported using a slow-speed dial-up modem to access the Internet, leaving 82 percent with what they reported as high-speed access. "High speed" was not defined in the survey and may have been consistently defined by respondents.

[1] Federal Communications Commission website, "Broadband" page. Accessed online April 9, 2015.

Terminology:
Digital divide: the division between those who have high-speed computer-based Internet access at home and those who do not.

Megabit: A bit is the basic unit of information in digital communication, with values of either 1 or 0. One megabit represents 1,000,000 bits of data and is the unit of measurement for download/upload Internet speeds per second (Mbps). Megabits are not the same as megabytes, which measure file or storage space. The average connection speed in the U.S. is 10.5 Mbps.

Gigabit: 1,000 megabits. Higher speed than commonly purchased by end users from Internet Service Providers though available**.**

Broadband: High-speed Internet access, defined by the Federal Communications Commission as 25 Mbps for downloading/4 Mbps for uploading in January 2015, up from 4 Mbps download/1 Mbps upload prior to that, reflecting the increased data-intensity of Internet activity and need for higher speeds to fully utilize the Internet.

- Consistent with state and national studies, the Controller's survey found that those without Internet access at home were more likely to be lower income, older, less educated, and people of color. Further, the connectivity rate reported in the Controller's 2013 survey was the same as the Controller's survey results in 2011, indicating a persistent digital divide in San Francisco.

Profile of the digital divide in San Francisco:

- The Controller's 2013 survey found that:
  - Only 69 percent of San Francisco residents over the age of 65 have home Internet access compared to 96 percent under the age of 45.
  - 68 percent of residents with less than a high school education have home Internet access compared to 94 percent of college graduates.
  - 98 percent of households with incomes over $100,000 have home Internet access compared to 75 percent of households with incomes of less than $25,000.
  - 90 percent of Caucasians and 89 percent of Asian/Pacific Islanders have home Internet access compared to 70 percent for African Americans and 84 percent for Latinos.
- Similar results were found in a survey of Internet access at student households conducted by San Francisco Unified School District (SFUSD).

How San Francisco fares relative to barriers to high-speed Internet computer access at home

Availability of Internet Services: While San Francisco has at least 17 different Internet providers offering service, not all providers are available in all areas of the City. For traditional wired Internet access at home, most residents have a choice of just two to three companies. Though better than the national rate of two providers to choose from for 85 percent of Americans, the benefits of competition between a greater number of providers are not being realized by all San Franciscans.

There are more wireless companies to choose from for Internet access for cellular telephones and tablets in San Francisco. However, these companies do not offer the same access speeds as available from wired providers and most plans place caps on the amount of data that can be accessed per month without incurring additional fees. This renders the Internet less accessible through wireless plans compared to wired services for home computers.

While smartphones and tablets offer great flexibility and many other benefits, at present they do not provide the functionality that computers provide for many tasks commonly performed on the Internet such as filling out a job application or student homework.

Affordability of Home Internet: The U.S. Census Bureau estimates the lowest fifth of San Francisco residents have household incomes of $23,526 or less a year. Some households, particularly those with lower incomes, may find home

Internet service unaffordable, particularly for broadband speeds since monthly fees generally are higher for faster speeds and thus serve as one cause of the digital divide.

As of fall 2014, monthly fees for Internet access for the lowest *non-broadband* speeds offered in San Francisco were between $29.95 - $44.95 per month, or $359.40 and $539.40 per year. These amounts are in addition to the one-time cost of purchasing a computer and exclude taxes and any other fees.

For the range of speeds offered that include broadband speeds, monthly fees ranged from $34.95 - $98 per month, or $419.40 - $1,176 per year, as of fall 2014.

The range of wireless Internet access service fees for cellular telephones is generally higher but for slower speeds than those offered by wired Internet Service Providers. Prices in the fall of 2014 in San Francisco ranged from $40 to $100 per month, or $480 to $1,200 per year, excluding taxes, fees and the cost of the cellular phone. These prices are comparable to national average prices as of 2011.

Non-adoption of Home Internet Use: A 2013 survey of Californians found that 14 percent of respondents do not use the Internet, mostly because they do not know how or they lack interest or perceived need. Non-adoption is especially prevalent among older, less educated, and low-income populations, consistent with the digital divide profile for San Francisco.

- For those without home Internet access due to unavailability, non-adoption of Internet use, or unaffordability, surveys show that libraries, schools and friends' homes are commonly used to access the Internet. While such community and personal resources are valuable, they do not substitute for computer-based home broadband access as access is likely limited in some way such as by time or access speed and thus does not allow for taking full advantage of the Internet.

Addressing the barriers to high-speed computer Internet access at home in San Francisco

- The City and County of San Francisco has a number of services and initiatives in place to address the digital divide. However, at this time, the City does not have a comprehensive plan to bridge the digital divide by addressing all three barriers to high-speed Internet access at home described above.
- Both the San Francisco Public Library and the San Francisco Unified School District provide extensive computer hardware, Internet access and digital literacy classes and programs at their facilities.
- Every San Francisco Public Library System (SFPL) branch has an Internet connection of at least 10 Mbps, computer hardware and free Wi-Fi. The Main Library and three branches are connected to the City's fiber network and offer very high-speed Internet access of at least 1 gigabit per second (Gbps). At this time, download speeds at many of the remaining 24 branches is below the

minimum to qualify as broadband though plans are in place to upgrade many facilities in the current fiscal year. SFPL also offers digital training classes and electronic resources such as e-books.

- The San Francisco Unified School District (SFUSD) offers very high speed 1 Gbps Internet access at 132 of its 137 sites and digital literacy training for its students. The City and County of San Francisco currently does not address non-adoption by youth through targeted digital literacy programs though such programs were offered in the past when the City had grant funds for this purpose.
- Addressing issues of broadband affordability and availability, the City has made some of its high-speed fiber-optic network available for free Wi-Fi at San Francisco Housing Authority facilities, at community centers and complexes where digital training and classes are provided to seniors and people with disabilities, at 32 City parks, and along a 3.1 mile stretch of Market Street.
- The telecommunications company Comcast offers *Internet Essentials*, a reduced Internet access fee program for families In San Francisco whose children attend schools where 70 percent or more of the student body is eligible for the National School Lunch Program. Approximately 11,000 SFUSD student families are eligible for the Internet Essentials program but only approximately 1,500 students, or 13.6 percent of those eligible, actually subscribe. Comcast reports that SFUSD's advertising restrictions has made outreach to qualified students and families difficult.
- The City and County of San Francisco's *Department of Aging & Adult Service (DAAS)* addresses non-adoption by seniors and people with disabilities through its SF Connected program, with 26 different community-based organizations providing free computing education and support for seniors and adults with disabilities.
- A number of non-profit organizations in the City and Bay Area offer programs to increase digital literacy, access and affordability. These include organizations that receive funding from the City's Department of Aging and Adult Services and those that are funded separate from the City.

Digital inclusion programs and services offered by other cities

- Besides programs and services similar to those offered in San Francisco to address the digital divide, other cities reviewed also provide assistance to residents to obtain low cost broadband and discounted and refurbished computer hardware, provide grants to organizations that provide digital literacy training or facilitate lower access rates, fund neighborhood-specific digital inclusion programs, and other services and programs.

Some cities have constructed and operate their own broadband networks to provide high-speed access to all residents, increased competition and reasonable costs

- Approximately 150 municipalities in the U.S., including Chatanooga, Tennessee and Cedar Falls, Iowa, have constructed municipal high-speed fiber-optic

networks that have been made available to all residents and businesses in their jurisdictions. These municipal broadband networks generally provide higher speed access at similar or lower costs than those available from competing private sector Internet providers. Municipal broadband networks have been used to helped retain and attract businesses in some jurisdictions. In most cases to date, U.S. cities with their own broadband networks are mid-sized or smaller, operate their own public utilities and have been able to construct fiber-optic networks on their utility grids.

- The U.S. ranks between 11th and 27th in average Internet speeds internationally, depending on which survey is used. Some of this difference is due to most U.S. Internet providers continuing to rely on DSL and cable connections for their connections to end user premises. Communities with higher access speeds in the U.S. and abroad have generally made public investments in fiber networks to the premises.
- Some private companies are also developing and offering fiber or hybrid fiber network options. These companies include Verizon, AT&T and Google, which is now offering high-speed Internet service through fiber-optic networks in Kansas City and Austin, Texas. In some jurisdictions, municipalities construct a fiber network and lease it to one or more companies to provide direct services to the end users. The City of Seattle, for example, operates its own electric utility and is considering creation of a municipal fiber network or possible public-private partnerships to provide broadband Internet service to its residents and businesses.
- Since the City and County of San Francisco already has a fiber network serving part of the City, creation of a full municipal broadband network is an option the Board of Supervisors and City could consider. Though a municipal broadband network would be a costly and ambitious undertaking, it would create a City asset with high market value that could thus provide a revenue stream to cover initial investments and ongoing costs. It could also be used as leverage to address the public policy goals of bridging the digital divide and providing critical digital infrastructure for the City's future.

Policy options

In 2010, the Board of Supervisors passed Resolution 554-10, which set a goal of 90 percent home broadband Internet access by 2015, with a focus on connecting seniors and low income households. Should the Board of Supervisors wish to renew efforts to connect more households and address the issues of availability, affordability, and non-adoption, the following policy options are provided for consideration:

1) Institute a Regular Digital Divide Survey and Measure Progress: The Board of Supervisors could advocate for a dedicated survey to analyze what neighborhoods and groups are most affected by the digital divide, what barriers keep them from connecting and what progress has been made in

reducing or eliminating the digital divide. This could be an expanded version of the Controller's existing bi-annual survey or separately conducted with a focus on digital divide issues only.

2) Initiate a Computer Hardware Subsidy Program: The Board of Supervisors should consider advocating for creation of a computer refurbishment program from City surplus hardware or supporting non-profit organization efforts to make affordable computers available to low-income households.

3) Create Third-Party Partnerships to Provide Affordable Internet: The Board of Supervisors should consider requesting that Internet Service Providers in San Francisco create reduced cost Internet access programs for low-income households and other targeted groups in addition to Comcast's current Internet Essentials program for families of students at schools with 70 percent of the students eligible for the National School Lunch Program.

4) Advocate for More Outreach regarding Comcast Internet Essentials at SFUSD: The Board of Supervisors should consider advocating that SFUSD administration consider a waiver to its current policy restricting advertising and outreach efforts at school sites to allow Comcast to better publicize their reduced cost Internet access program to qualified District families.

5) Digital Training for Youth: The City no longer supports digital training programs for youth in San Francisco. The Board of Supervisors should consider providing direct financial support or encouraging City staff to seek grants as were awarded in the past to help train youth in a range of courses such as digital media, workforce development, and computer programming.

6) Mobile Device Training for Seniors and People with Disabilities: As mobile devices become increasingly ubiquitous, more support is needed to train seniors and people with disabilities. Current DAAS training focuses primarily on computers or laptops. Increased support should be provided to seniors for digital training.

7) Make Public Computer Centers Available to Outside Groups: The Housing Authority has computer labs at its facilities that reportedly are largely unused. Computer labs that have excess capacity could be made available to local non-profit organizations for digital literacy training.

8) Expand #SFWiFi and Consider Municipal Broadband Network Alternatives: The Board of Supervisors should consult with the Department of Technology and examine how the City fiber network can be used and expanded to address digital inequality and increase provider competition while advancing the City's digital infrastructure. Alternatives considered should include creation of a Citywide municipal broadband network, with the City either operating or leasing the network to private companies. Public-private partnerships with existing Internet providers and new companies entering the high-speed fiber-optic market should also be considered.

Contents

INTRODUCTION

Internet access is an increasingly necessary and valuable tool for everyday activities covering business, government, education, healthcare and entertainment. For example, to apply for a job, more than 80 percent of Fortune 500 companies require online applications.[2] Schools are more often using the Internet for lesson plans and to provide information to students, parents and guardians, and for homework. California's Common Core standards require San Francisco Unified School District schools to teach digital skills.[3] And in health care, the Internet is increasingly utilized to provide information to patients and for communications between patients and health care providers. The Federal Communications Commission states that:

> "Broadband is a platform for opportunity and innovation in health care, education, energy, job training, civic engagement, commercial transactions, government performance, public safety and other areas."[4]

Though the majority of San Francisco residents have home Internet access, a 2013 survey conducted by the City's Controller's Office found 12 percent of respondents, or approximately 100,493 individuals when applied to the total City 2013 population of 837,442, do not have access to the Internet at home.[5] This disparity in access to the Internet is termed the digital divide.

As the Internet has evolved, so too has the scope of the digital divide. Defining the problem of digital inequality only in terms of home Internet access is no longer sufficient. In order to go online, households need the proper hardware and need sufficient access speeds to make full use of Internet services. The Controller's survey found that in addition to the 12 percent of survey respondents without any access at all, another six percent of respondents, representing 50,247 residents when applied to the total population, use a slow speed dial-up modem to access the Internet, limiting their ability to take full advantage of all Internet content.[6]

The lack of digital literacy is another component of digital inequality and keeps some residents from using the Internet.

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[2] Federal Communications Commission. "FCC & 'Connect to Compete' Tackle Barriers to Broadband Adoption." July 16, 2012. Accessed online October 20, 2014.

[3] Office of Education Fresno County. "Common Core State Standards Digital Literacy and & Technology Skills Flow Chart." Accessed online October 20, 2014.

[4] Federal Communications Commission Website, "Broadband" page. Accessed online April 9,2015.

[5] Office of Controller City Services Auditor, San Francisco, "2013 City Survey Report." City of San Francisco, CA. May 20, 2013. Accessed online October 22, 2014.

[6] Office of Controller City Services Auditor, San Francisco, "2013 City Survey Report." City of San Francisco, CA. May 20, 2013. Accessed online October 22, 2014.

This report first analyzes the state of the digital divide in San Francisco by discussing which residents have home Internet access and what barriers prevent others from connecting. The report also reviews some of the past and current strategies used to close the digital divide in San Francisco, including services and initiatives by: the City and County of San Francisco Department of Technology, the Department of Aging and Adult Services, the San Francisco Public Library system, the San Francisco Unified School District (SFUSD), some community-based organizations, and other cities. Finally, policy alternatives for ensuring that every San Franciscan has the potential for high-speed Internet access at home with a computer are presented.

1. DIGITAL DIVIDE DEFINTIONS

Generally, home Internet service is provided through a wired connection to a computer. Wired Internet connects end user premises (i.e., a residence or business) directly to an ISP's network, primarily through one of three formats.[7]

1. ***Direct Subscriber Lines (DSL) through Copper Wireline***: Telephone and Internet access can be provided over a copper network. Much of the legacy communication infrastructure in the U.S. is copper networks, originally used to provide telephone service. ISPs have upgraded their copper networks to now provide Internet access through Direct Subscriber Lines (DSL). Although DSL is generally available wherever landline telephones are present, Internet connection speeds can vary dramatically depending on a household's proximity to ISP network hubs.[8]
2. ***Cable Modem***: Internet access can be provided by the same wires that provide cable TV service. The current standard to provide high-speed Internet access over cable wires is called Data Over Cable Service Interface Specifications (DOCSIS) 3.0. Cable generally offers higher speeds than DSL and is the most common type of connection to the Internet.[9]
3. ***Fiber-Optic Cable***: Using glass fibers, data can be sent using light signals to provide high-speed access to the Internet. Fiber provides the fastest connection commercially available for residential consumers though full fiber networks have

[7] National Telecommunications & Information Administration, "National Broadband Map: Broadband Classroom." Accessed online October 22, 2014.

[8] Federal Communications Commission, "Measuring Broadband America – 2014: A Report on Consumer Fixed Broadband Performance in the U.S." Washington, D.C. 2014. Accessed online October 22, 2014.

[9] Higginbotham, Stacey, "Broadband is now a bigger business than TV for big cable providers." *Gigaom*. August 15, 2014. Accessed online October 22, 2014.

not been commonly offered or purchased by consumers when available from private sector providers.[10]

While some municipalities, including the City and County of San Francisco, have constructed and operate fiber networks for their own functions, a number of municipalities in the U.S. have created municipal broadband networks by constructing citywide fiber-optic networks and making high-speed Internet access available to all residential and business premises in their jurisdictions (known as "fiber to the premises"), generally at lower cost than offered by private sector providers.

A number of private sector companies are also now developing hybrid systems consisting of a high-speed fiber network brought closer to end user premises, delivering data to "hubs" within a service area, then using existing cable, DSL copper wireline or, in some cases, newly installed wiring to make the "last mile" connection to individual residences and businesses. Many of these systems can provide access speeds of up to 1 Gbps, significantly faster than access speeds currently available from most Internet providers.

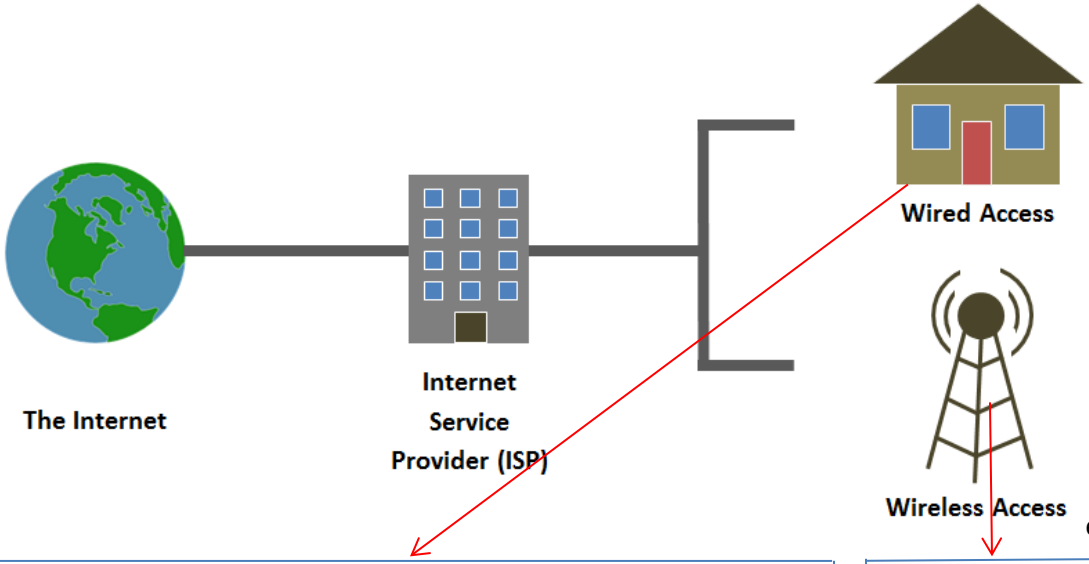
The City and County of San Francisco has installed fiber in certain parts of the City in recent years to provide high-speed Internet access to various City and other facilities.

Internet service has also become increasingly available to consumers through cellular wireless service providers. The Federal Communication Commission's (FCC) allocation of the electromagnetic spectrum allows companies to provide Internet access wirelessly through a mobile device or to a home modem.[11] Generally, wireless connections are offered through a ***cellular*** provider's network or through a ***satellite*** connection. The popularity of wireless Internet has also led many households to purchase Wi-Fi routers. However, home Wi-Fi connections generally are routers connected to an underlying wired connection, usually from a DSL or cable ISP.

[10] Federal Communications Commission, "Measuring Broadband America – 2014: A Report on Consumer Fixed Broadband Performance in the U.S." Washington, D.C. 2014. Accessed online October 22, 2014. Some existing private sector networks may be comprised of a combination of fiber-optics and traditional DSL and/or copper wires, limiting the speed at which Internet access can be provided.

[11] Residential consumers can purchase modems that connect to their laptops for home use. The modems connect to a cellular carrier's network. Accessed online October 22, 2014.

Figure 1: Types of Internet Connections



Wired			Wireless
DSL	**Cable**	**Fiber**	
- Connects to the Internet through legacy telephone network copper wire - Speed dependent on proximity to service provider's facilities	- Internet connection through coaxial cable, the same as cable TV - Supports higher speeds - Most common connection type	- Uses fiber-optic cables - Currently the fastest service commercially available - Limited availability	- Connect to ISP through satellite, mobile, or fixed wireless facilities - Interference can disrupt service - Generally slower speeds

Source: Federal Communications Commission, *Measuring Broadband* 2014

The type of connection an end user has to the Internet often determines the maximum service speed available. Internet connection speeds are described by:

- Download speed,: the speed at which users can retrieve data from the Internet, measured in megabits per second (Mbps).[12]
- Upload speed: the speed at which users can send data to the Internet, measured in megabits per second (Mbps).

Broadband Internet is another term for a connection that can both download and upload data at a high speed. As of January 2015, the Federal Communications

[12] A bit is the basic unit of information in digital communication and can only have one of two values: a 1 or a 0. One megabit represents 1,000,000 bits of data. Some networks even provide gigabit connections, or 1,000 megabits. Megabits are used to measure download/upload speed and not the same as megabytes, which measure file or storage space.

Commission (FCC) defines Internet services that provide a download speed of at least 25 Mbps and an upload speed of at least 4 Mbps as "broadband."[13] Prior to January 2015, the FCC definition of broadband was at least 4 Mbps download and at least 1 Mbps upload. The increase in minimum speeds required by the FCC to qualify as broadband reflects changes in data-intensity of Internet activity such as streaming videos and multimedia content for entertainment and, increasingly, for purposes such as teleconferencing and health care instructions and information.

When a connection's download and upload speed are the same, the connection is termed a symmetrical connection. Typically though, most households have download speeds faster than upload speeds, termed an asymmetrical connection.

While most Internet Service Providers provide broadband service, as technology advances, so will the need for faster download and upload speeds. Figure 2 presents minimum speeds necessary, as determined by the FCC, to access various services on the Internet as of 2014, and prior to the FCC redefinition of the minimum speeds required for broadband in 2015. The amounts shown in Figure 2 may understate current and emerging needs. For example, while the minimum download speed for basic video conferencing established by the FCC is 1 Mbps, Skype recommends a connection of at least 8 Mbps to video conference with seven or more people.[14]

Bandwidth is a connection's capacity to transfer data from one point to another.

[13] Federal Communications Commission, "Measuring Broadband America – 2014: A Report on Consumer Fixed Broadband Performance in the U.S." Washington, D.C. 2014. Accessed online October 22, 2014.

[14] Skype website: "How much broadband does Skype need?" Accessed online, October 22, 2014.

Figure 2: FCC's Minimum Required Download Speeds for Internet Activities

Internet Activity	Minimum Download Speed (Mbps)
Email	0.5
Web Browsing	
Job searching, navigating government websites	0.5
Interactive pages and short educational videos	1
Streaming radio	< 0.5
Phone calls (e.g., Skype)	< 0.5
Watching Video	
Standard streaming video	0.7
Streaming feature movies	1.5
HD-quality streaming movie or university lecture	4
Video Conferencing	
Basic video conferencing	1
HD video conference and tele-learning	4
Gaming	
Game console connecting to the Internet	1
Two-way online gaming in HD	4

Source: Federal Communications Commission, *Broadband Speed Guide* 2014

Beyond minimum speeds required for the activities listed in Figure 2 above, broadband must also be sufficient to connect all end users in a household. For a household of four with access to a 10 Mbps download speed subscription, for example, a single user will have access to the fastest speed available. However, if all four household members were to use the Internet at the same time, bandwidth constraints could lead to significant speed degradation and make many functions inoperable.[15] A 2013 study found that the average American household now has 5.7 connected devices which can render a low-speed broadband connection non-functional.[16] In addition to the number of devices per household affecting Internet access speed, network congestion, particularly between the hours of 7 and 11 p.m. is increasingly affecting the ability of ISPs to provide their full bandwidth to consumers.

Network congestion is a concern for large institutions such as schools, libraries, and even Internet providers who serve hundreds to thousands of people simultaneously.

[15] Federal Communications Commission, "The Facts and Future of Broadband Competition." 1776 Headquarters, Washington, D.C. September 4, 2014. Accessed online October 22, 2014.

[16] NPD Group, "Internet Connected Devices Surpass Half a Billion in U.S. Homes, according to the NPD Group." March 18, 2013. Accessed online October 22, 2014.

During peak usage hours between 7 and 11 pm, ISPs can generally only provide a portion of their maximum bandwidth to consumers. As previously mentioned, the increasing demands on the Internet and increase in multimedia content led the FCC to announce in January 2015 the increase in the minimum speeds required to qualify as broadband from 4 to 25 Mbps for downloading and from 1 to 4 Mbps for uploading, with plans to raise it further in the years to come. [17]

For purposes of this report, the digital divide is defined as households that do not have high-speed, or broadband, home computer-based Internet access. While many cities, including the City and County of San Francisco (the City), provide Internet access at public facilities such as schools and libraries, the Budget and Legislative Analyst has concluded, based on a review of the literature on this topic, that having computer-based Internet access at home is critical to taking full advantage of online resources and digital skill building. Such access allows for an unlimited and exploratory approach to Internet content that cannot be duplicated in a setting such as a library or school which must impose limitations on Internet access. Though many individuals now have Internet access through smartphones and tablets, computer access at home is essential in this definition because of computers' superior ability at this time for performing certain functions on line such as filling out a job application or doing school homework.

2. MEASURING THE DIGITAL DIVIDE IN SAN FRANCISCO

In February 2013, the City's Controller's Office conducted its bi-annual survey to measure residents' satisfaction with various City services.[18] Among the survey questions, respondents were asked if they had a connection to the Internet at home. Approximately 88 percent of respondents, representing approximately 736,949 residents when applied to the total City 2013 population of 837,442[19], stated they had such a connection and 12 percent of respondents, representing 100,493 residents, reporting they did not have an Internet connection at home. The connectivity rate reported in the Controller's 2013 survey was essentially the same as the Controller's survey results in 2011, indicating a persistent digital divide in San Francisco.

[17] Fung, Brian. "The FCC may consider a stricter definition of broadband in the Netflix age", *Washington Post,* May 30, 2014. Accessed online October 22, 2014.

[18] The 2013 City Survey was administered to 3,628 residents by mail. Phone, and online in English, Chinese, and Spanish, out of an original sample of 11,000 randomly selected residents who were initially invited to complete the survey. The survey had a response rate of 27 percent. Responses were weighted to reflect the actual San Francisco population according to the 2010 U.S. Census.

[19] Office of Controller City Services Auditor, San Francisco, "2013 City Survey Report." City of San Francisco, CA. May 20, 2013. Accessed online October 22, 2014. Population statistics provided by the U.S. Census Bureau. Accessed online October 22, 2014.

Of the survey respondents reporting Internet access at home, six percent, or 50,247 residents when applied to the City's 2013 population, reported that they used a slow speed dial-up modem, limiting their ability to take full advantage of all Internet content and services.[20] Including this group reduces those with high-speed access at home to 82 percent of all survey respondents.

"High-speed" was not defined in the Controller's survey instrument so all of the 82 percent of respondents who reported having high-speed Internet access may in fact not have broadband access due to different respondent interpretations of the definition of high-speed. Further, with the Federal Communications Commission's redefinition of broadband in January 2015 to 24 Mbps download/4 Mbps upload (from the prior definition of 1 Mbps download/1Mbps upload), it is possible that some of the respondents who accurately reported having a high speed Internet connection at home in the Controller's 2013 survey would no longer qualify as having broadband access at home.

In recent years, many households have also been able to access the Internet through mobile devices such as phones or tablets. In fact, 10 percent of Americans and eight percent of Californians access the Internet only through a mobile device such as a smartphone or tablet.[21] The City Controller's Office's most recent survey did not measure how many San Francisco residents with Internet access use mobile devices only.

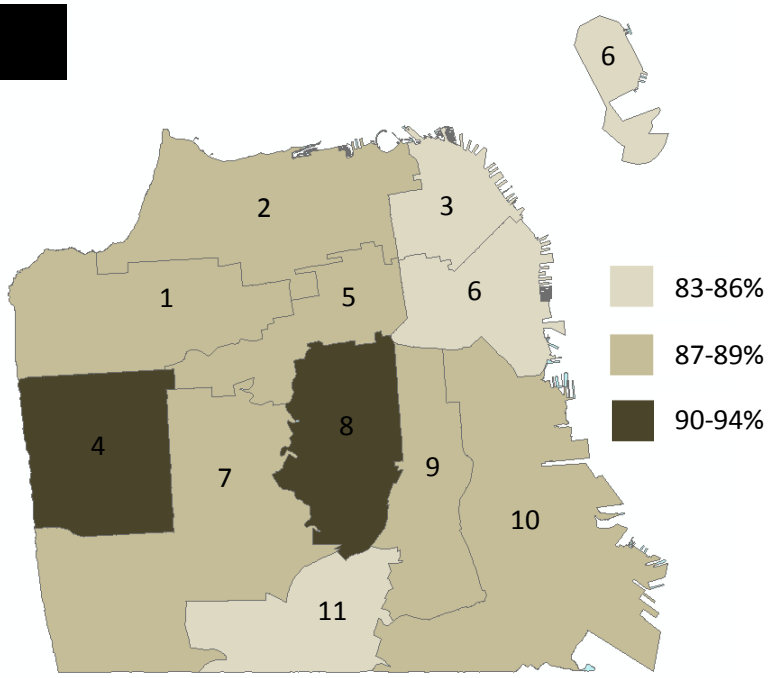
Figure 3 below shows Internet access rates from the Controller's survey applied to the 2012 population for each Supervisorial District.

[20] Office of Controller City Services Auditor, San Francisco, "2013 City Survey Report." City of San Francisco, CA. May 20, 2013. Accessed online October 22, 2014. Population statistics provided by the U.S. Census Bureau. Accessed online October 22, 2014.

[21] Pew Research Center, "Home Broadband 2013." August 26, 2013. Accessed online October 22, 2014.

Figure 3: Home Internet Access Rates by San Francisco Supervisorial District

	Total 2012	Internet at Home		# No Home
District	Population	%	#	Internet
1	69,550	87%	60,509	9,042
2	69,610	88%	61,257	8,353
3	73,520	83%	61,022	12,498
4	72,490	90%	65,241	7,249
5	74,760	88%	65,789	8,971
6	70,790	84%	59,464	11,326
7	72,920	89%	64,899	8,021
8	75,500	94%	70,970	4,530
9	76,720	87%	66,746	9,974
10	72,560	87%	63,127	9,433
11	76,820	84%	64,529	12,291
	805,240	88%	703,552	101,689



Source: San Francisco Controller's Office, *City Survey* 2013

As shown in Figure 3 above, access to the Internet varies across San Francisco. Supervisorial Districts 3, 6, and 11 have relatively lower rates of Internet access at home whereas Supervisorial Districts 4 and 8 have higher access rates. In absolute numbers, Districts 3 and 11 have the most residents without Internet access at home.

Within the City as a whole, the Controller's Office's 2013 survey found the digital divide most affects people of color, low-income, uneducated, and elderly populations. Figure 4 below compares socioeconomic characteristic in San Francisco on the basis of having an Internet connection at home.

The distribution of Internet access varies most by age. For San Francisco residents under the age of 45, 96 percent have access to the Internet at home. Comparatively, only 69 percent of residents over the age of 65 have access at home, a difference of 27 percent. Similar disparities in Internet access exist on the basis of education. The Controller's Office found that 94 percent of college graduates have home Internet access compared to only 68 percent of San Francisco residents with less than a high school education, a difference of 26 percent.

Figure 4: San Francisco Home Internet Access Rates by Socioeconomic Characteristic

Subgroup	% Home Internet Access	Subgroup	% Home Internet Access
Race/Ethnicity		Education	
African American	70%	Less than High School	68%
Asian/Pacific Islander	89%	High School Graduate	78%
Caucasian	90%	Some College	84%
Latino	84%	College Graduate	94%
Household Income		Age	
Under $25,000	75%	Under Age 45	96%
$25,000 to $49,999	84%	Age 45-54	93%
$50,000 to $100,000	93%	Age 55-64	87%
Over $100,000	98%	Age 65+	69%

Source: San Francisco Controller's Office, *City Survey* 2013

San Francisco's overall level of home high-speed Internet access at 82 percent according to the Controller's 2013 survey is higher than for the state and U.S. as a whole, according to two surveys which found that 75 percent of all Californians have broadband home access and 69 percent of all Americans have such access[22]. Further, while some of the subgroups differ in the two surveys, many of the same general trends captured in Figure 4 for San Francisco were also found for California as a whole in a survey conducted by the California Emerging Technology Fund and for the entire U.S. in a survey conducted by the National Telecommunications and Information Administration: Internet access at home generally increases with income and education and generally decreases with age. Race/ethnicity patterns are less consistent between San Francisco compared to California and the U.S. though all racial/ethnic groups in California and the U.S. were found to have lower Internet access rates at home compared to San Francisco.[23] Figure 5 presents some of the key results from the California and U.S. surveys.

[22] California Emerging Technology Fund (CETF), *Field Poll,* 2014. National Telecommunications and Information Administration, *Exploring the Digital Nation*, 2013.

[23] An exception to this pattern was found for African Americans whose home Internet access rate for California as a whole was reported as 88 percent compared to a 70 percent rate in San Francisco reported by the City Controller's survey and a 55 percent access rate reported by the National Telecommunications and Information Administration. The higher rate for California as a whole reported by the California Emerging Technology Fund may be due to a low sample size in their survey, according to the source.

Figure 5: National and State Broadband Home Internet Access Rates by Sub-Population

California		United States	
Subgroup	**CETF Poll 2014**	**Subgroup**	**NTIA 2013 Survey**
Total Population	75%	**Total Population**	69%
By Race/Ethnicity		**By Race/Ethnicity**	
African American	88%*	African American	55%
Asian	74%	Asian	81%
Caucasian	83%	Caucasian	74%
Latinos	63%	Latinos	56%
By Household Income		**By Household Income**	
Under $20,000	53%	Under $25,000	43%
20,000 to $39,999	80%	$25,000 to $49,999	65%
$40,000 to $59,999	81%	$50,000 to $74,999	84%
$60,000 to $99,999	86%	$75,000 to $99,000	90%
Over $100,000	95%	Over $100,000	93%
By Education		**By Education**	
Less than High School	32%	Less than High School	35%
High School Graduate	70%	High School Graduate	58%
Some College	83%	Some College	75%
College Graduate	90%	College Graduate	88%
Age		**Age**	
18-29	91%	16-44	77%
30-39	78%	45-64	73%
40-49	78%	Age 65+	49%
50-64	72%		
65 or older	47%		

Sources: California Emerging Technology Fund (CETF), *Field Poll,* 2014; National Telecommunications and Information Administration, *Exploring the Digital Nation*, 2013.

*The reliability of this statistic is questioned by the source because the report states that the African-American population had a smaller sample base and the results are therefore subject to larger margins of sampling error.

Compared to other cities, San Francisco's home Internet access rate of 88 percent (regardless of whether the access is broadband or not) is slightly higher than the 85

percent rate for the city of Seattle and higher than the 68 percent rate for the city of Chicago. [24] [25]

In 2013, the San Francisco Unified School District (SFUSD) conducted a Family Technology Use Survey to measure how many of its students did not have Internet access at home. The survey found that approximately 86.2 percent of SFUSD students have access to a computer at home connected to the Internet, or an estimated 45,677 students out of a total student body of 52,989.[26] Thus, 7,312 of SFUSD students live in households without a home Internet connection. The survey did not ask respondents to report whether their access was broadband.

Figure 6 below breaks down Internet access at home by racial/ethnic groups.

Figure 6: Percentage of San Francisco Unified School District Students with Access to Computers at Home Connected to the Internet, by Race/Ethnicity

Race/Ethnicity	Have Access % Total	No access % Total
American Indian/Alaskan Native	78.6%	21.4%
African American	72.9%	27.1%
Hispanic/Latino	71.2%	28.8%
Pacific Islander	82.2%	17.8%
Chinese	91.1%	8.9%
Other Asian	88.2%	11.8%
White	91.8%	8.2%
Multi-Racial	88.6%	11.4%
Other	84.1%	15.9%
OVERALL	**86.2%**	**13.8%**

Source: SFUSD Family Technology Use Survey Fall 2013

As Figure 6 above shows, the digital divide among SFUSD student households is more pronounced among certain racial/ethnic groups. While 78.6% of American Indian, 72.9 percent of African American, and 71.2 percent of Hispanic/Latino students reported

[24] Department of Information Technology, City of Seattle, "Information Technology Access and Adoption in Seattle: Progress towards digital opportunity and equity." 2014. Accessed online October 22, 2014.

[25] Mossberger, Dr. Karen, Arizona State University, "Measuring Change in Internet Use and Broadband Adoption: Comparing BTOP Smart Communities and Other Chicago Neighborhoods." April 2013. Accessed online October 22, 2014.

[26] Due to oversampling of certain racial groups in the survey, the Budget and Legislative Analyst's Office recalculated the overall percentage of students with Internet access at home. San Francisco Unified School District, "2013 SFUSD Family Technology Use Survey." May 7, 2014. Accessed online October 22, 2014.

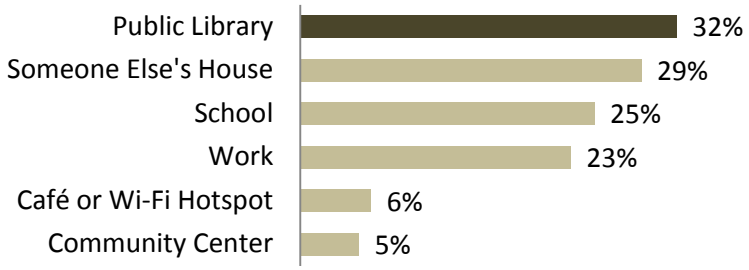
Internet access at home, the survey reported that 91.8 percent of White and 91.1 percent of Chinese students have Internet access at home. With segments of certain SFUSD student populations without home Internet access, SFUSD reports it is committed to ensuring schools have ample resources to access the Internet.

Access to the Internet through schools & libraries

For individuals without broadband Internet access at home, public institutions such as schools and libraries often provide Internet access at no or low cost. While such service can provide Internet access for those who might not otherwise have it, it does not substitute for home access since public access generally has to be rationed or restricted. Broadband access at home best provides the flexibility and unlimited use necessary to take full advantage of the Internet for educational, job-seeking, and interpersonal communication purposes.

Figure 7 presents the distribution of Internet use locations for individuals who do not have Internet access at home according to a national survey conducted by the National Telecommunications and Information Administration (NTIA). As can be seen, the highest percentage of respondents without home Internet access, or 32 percent of all respondents, reported using the library for Internet access, followed by someone else's house, and school.

Figure 7: Internet Use Locations for U.S. Internet Users without Access at Home



Source: National Telecommunications and Information Administration, *Exploring the Digital Nation* 2013

Consistent with national trends, both San Francisco's public libraries and public schools offer Internet access, providing an alternative for those without access at home though Internet access is provided regardless of whether the user has access at home or not. San Francisco Public Library does not have data about how many of its patrons do not have Internet access at home. San Francisco Unified School District knows that 13.8 percent of children in the families survey do not have a computer at home connected to the Internet, as presented in Figure 6 above.

In addition to having to restrict the time any single user can have access to the Internet, public institutions such as schools and libraries may also lack the facilities to meet the needs of their community, or lack the bandwidth to serve their users. Over the last

several years, the San Francisco Unified School District (SFUSD) has developed its technological capacities to help develop students' digital skills and each school in the SFUSD system is now equipped to provide Internet access to all of its students, even if each student may only be able to use a computer for a limited amount of time.

San Francisco's Public Library (SFPL) system makes computers available for Internet access at the Main Library and each of the 27 branches to access the Internet. However, many of the branch libraries do not have broadband Internet access at this time. Also available for check-out at each library are "e-resources" such as movies, audio, digital books and other electronic media resources.

As discussed further below, a network of senior centers, adult day care centers and community centers in San Francisco make computers, computer-related training and tutoring available at multiples sites throughout the City in numerous languages.

3. Reasons for Digital Divide: *Availability, Affordability and User Non-Adoption*

Research on the topic of the digital divide often cites three factors that keep people from accessing the Internet from a computer at home:

1. Availability: Internet service isn't provided to residence
2. Affordability: Internet fees are too high
3. Adoption: end user does not have skills and/or interest in using computers or Internet

The role of each of these three causes of the digital divide in San Francisco is now addressed.

1. Availability of Internet Access in San Francisco

A potential barrier that keeps households from connecting to the Internet is the availability of service, or the absence of Internet infrastructure available to households and public institutions. Due to the high cost of constructing Internet infrastructure, it is common throughout the country for residential consumers to only have between one or two ISPs to choose from. However, in recent years, ISPs have built out their networks to provide service to more than 98 percent of Americans.[27]

According to the FCC, 85 percent of Americans have a maximum of two broadband Internet service providers to choose from that offer broadband speed, as defined prior to January 2015, as 4 Mbps download speeds of and 1 Mbps upload. In comparison,

[27] Office of Science and Technology Policy & the National Economic Council, The White House, "Four Years of Broadband Growth." Washington, D.C. June 2013. Accessed online October 22, 2014.

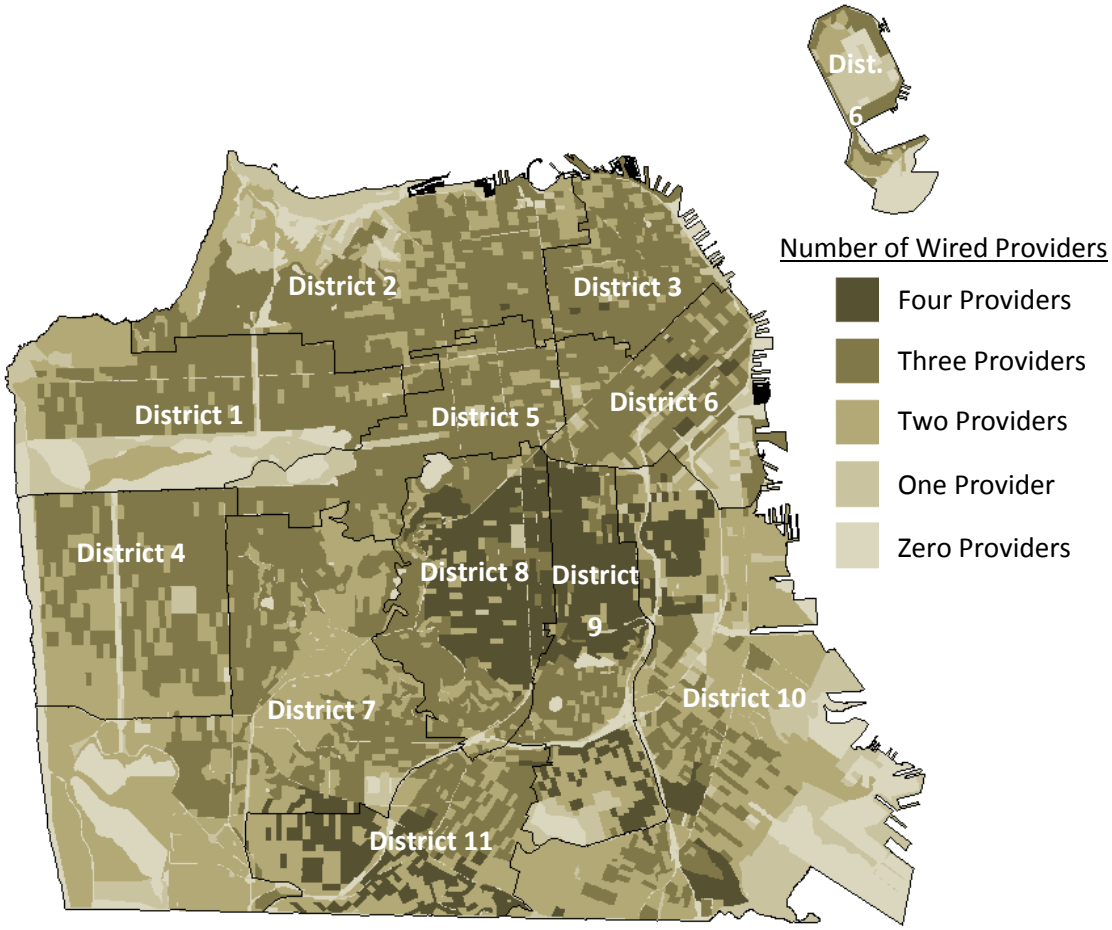
most San Franciscans have a choice of at least two wired Internet Service Providers to choose from, and in many areas of the City, residents have three or, in some cases, four choices.[28]

Not all Internet Service Providers offer their services to all parts of the City. Figure 8 below presents a graphic depiction of where four wired ISPs - AT&T, Astound, Comcast, and Sonic.net - offer services in San Francisco. The table in Figure 9 following the map shows the percentage of the City where six wired ISPs and eleven wireless providers offer service. As can be seen in the subsequent Figure 9, only two of the six wired Internet Service Providers, AT&T California and Comcast, provide service to most areas of the City, at 88.1 and 85.7 percent of the City area, respectively. A third provider - Sonic.net covers 55.2 percent of the City area, or slightly more than half the area of the City. In other words, the wired ISP choice for most San Franciscans is between two to three companies.

For wireless service, Figure 9 shows that there is more competition for consumers as most of the eleven wireless providers offer coverage to nearly all the City. While this means more choices for accessing the Internet, wireless access through smartphones and tablets has limitations in speed and functionality for performing functions such as school homework or completing a job application, compared to desktop or laptop computers.

[28] According to the FCC, only 14.6% of Americans has more than two providers to choose between that offer the minimum broadband speed of 4 Mbps down and 1 Mbps up. Federal Communications Commission, "The Facts and Future of Broadband Competition." 1776 Headquarters, Washington, D.C. September 4, 2014. Accessed online October 22, 2014.

Figure 8: Distribution of Internet Access Services Provided by Four of the Six Wired Internet Service Providers in San Francisco



* This map does not include every wired ISP in San Francisco. Because coverage data from the National Broadband Map is only submitted voluntarily, residents may be able to purchase wired Internet Service from more than the four providers shown here: Comcast, AT&T, Sonic.net, and Astound Cable.
Source: National Broadband Map, December 2013 Dataset

Figure 9: Area Covered by Wired and Wireless Internet Providers in San Francisco[29]

Wired	Service Type	Square Miles Served	Percentage Served
Astound Broadband	Cable	12.7	27.10%
AT&T California	DSL, Fiber	41.3	88.10%
Comcast	Cable	40.2	85.70%
i-Step Communications	DSL	No Information	--
Raw Bandwidth Telecom	DSL	0.0144	0.00%
Sonic.net	DSL	25.9	55.20%
Wireless			
AT&T Mobility	Cellular	44.2	94.20%
Hughes.net	Satellite	46.9	100.00%
MetroPCS AWS	Cellular	46.7	99.60%
Monkeybrains	Fixed Wireless	No Information	--
Skycasters	Satellite	46.9	100.00%
Sprint Corp.	Cellular	43.8	93.40%
Starbrand	Satellite	46.9	100.00%
T-Mobile USA	Cellular	44.2	94.20%
Verizon Wireless	Cellular	44.2	94.20%
ViaSat Communications	Satellite	46.9	100.00%

Source: National Broadband Map, December 2013 Dataset

Besides having service available to all residents, another key factor affecting the digital divide is the speeds offered by Internet providers. A customer may have access to the Internet in their neighborhood but it may not be broadband speed.

In San Francisco, all areas with Internet service are able to obtain broadband through a wired ISP since all of them offer a package with speeds exceeding the current broadband minimum of 25 Mbps download and 4 Mbps upload. However, higher speeds generally require higher monthly fees and thus may not be affordable to all households.

[29] The Internet providers discussed in this report provide service to residential consumers but do not reflect a complete a complete list of wired providers in San Francisco. There are several ISP's that provide Internet service to businesses only, or are part of the worldwide Internet infrastructure. For a more complete list, please refer to the California Public Utility Commission's Broadband Availability Map at http://www.broadbandmap.ca.gov/map/.

Not all wireless Internet providers offer broadband speeds for cellular telephones and tablets, though six of the eleven providers for whom prices and speeds were obtained do offer broadband.

Figure 10 shows the minimum and maximum speeds San Francisco Internet companies offer for wired and wireless service, as reported by the National Broadband Map.[30] Some information not listed by the National Broadband Map was obtained by the Budget and Legislative Analyst from sales representatives of some Internet providers.

Figure 10: Maximum Advertised Speeds for San Francisco's Wired Internet Providers

	Download speed Minimum - Maximum	Upload speed Minimum-Maximum
Wired Providers	<50 Mbps - <1 gbps	<6 Mbps - <50 Mbps
Wireless Providers	<1.5 Mbps - 200 Mbps	<768 kbps - 200 Mbps

Source: National Broadband Map, December 2013 Dataset and Budget and Legislative Analyst inquiries to some Internet providers.

As shown in Figure 11 above, there is a great range of maximum speeds available in San Francisco. Generally, DSL networks, or those based on the copper telephone system, advertise slower speeds than cable or fiber networks. This difference is due to the constraints of DSL networks which degrade Internet speeds the farther end user premises are from network hubs.[31] Alternatively, cable and fiber networks are more reliable and consistently provide higher speed access to the Internet.[32] As Internet services become more data-intensive, cable and especially fiber networks will be better suited to provide sufficient bandwidth.

Figure 10 also shows that, even at their maximums, wireless networks are generally slower than wired connections. Although advances in 4G LTE technology have allowed some cellular companies to provide much faster Internet, the speeds still are slower than a wired connection. Combined with issues of reliability and the high cost of wireless plans, wireless connections are not adequate substitutes for an at home wired connection for a computer.

[30] Only companies that offer residential broadband service of at least 4 Mbps in download speeds were reviewed. Internet service providers not discussed include: Starband, a satellite ISP, provides a maximum Internet speed of 1.5 Mbps downstream, 256 kbps upstream.

[31] Federal Communications Commission, "Measuring Broadband America – 2014: A Report on Consumer Fixed Broadband Performance in the U.S." Washington, D.C. 2014. Accessed online October 22, 2014.

[32] Federal Communications Commission, "Measuring Broadband America – 2014: A Report on Consumer Fixed Broadband Performance in the U.S." Washington, D.C. 2014. Accessed online October 22, 2014.

Internet access speeds can also be measured by end users who voluntarily participate in third party speed tests. One company that allows users to test their computers' Internet access speeds is Ookla, which then gathers speed test results by city. For San Francisco, the 2014 average speed tested was 33 Mbps download and 9 Mbps upload. While these results appear to show that average access speeds in San Francisco are above the current definition of broadband, the results are not collected through a random sample of all end users. Instead, users themselves voluntarily choose to test their speeds and the individuals testing can be more technologically astute and not representative of the whole population.

2. Price and Affordability of Internet Access in San Francisco

The affordability of Internet access keeps some households from broadband Internet access at home and is a key factor explaining the digital divide. According to a national survey conducted by the Public Policy Institute of California, 23 percent of Californians do not use the Internet because of high cost.[33] Given that the cost of living in San Francisco is already among the highest in the U.S., the issue of affordability is especially pertinent to digital divide issues.[34] The U.S. Census Bureau estimates the lowest fifth of San Francisco residents have household incomes of $23,526 or less a year. For these households in particular, Internet access fees can be unaffordable.

In terms of the actual costs to connect to the Internet, consumers must first purchase a computer. While prices for computers vary from approximately $100 for netbooks to approximately $1,000 for desktops and laptops which offer greater functionality, purchasing a computer is a one-time only expenditure. However to purchase home Internet service, ongoing monthly costs are incurred. In San Francisco, households have a choice among several different Internet providers for the type of service and speed they want.

There are four primary categories of Internet service available to San Franciscans:

1. Wired access for service for desktop and laptop computers, provided through copper wire, cable or fiber,
2. Wireless access for service provided for cellular telephones and tablets
3. Satellite-based Internet access, and
4. Fixed wireless service, which provides Internet access through radio or other wireless communications rather than copper wire, cable or fiber.

[33] Public Policy Institute of California, "PPIC Statewide Survey: Californians & Information Technology." June, 2013. Accessed online October 22, 2014.

[34] Payscale, "Cost of Living Calculator." Accessed online October 22, 2014.

There are a range of prices and access speeds available to San Francisco consumers. Currently, the most common source of Internet access offering the greatest speeds and functionality is provided through wired service rather than wireless or satellite. Fixed wireless service may prove cost-effective but is less commonly used at this time as it requires providers obtaining rights-of-way to use utility poles or other infrastructure for needed equipment.

Figure 11 below shows the range of Internet access speeds and monthly prices available in San Francisco as of October/November 2014 for wireless Internet Service Providers, wireless providers, satellite service, and fixed wireless access packages, the latter two using radio or other wireless communications rather than cable or fiber.

The wired and wireless provider categories in Figure 11 are broken down into subgroups to show various options available. For example, wired Internet Service Provider costs are shown for the lowest download speed and prices and for those that are within range of the FCC's current definition of broadband. Prices shown were in effect as of the fall of 2014 and are subject to change.

Figure 11: Average Monthly and Annual Cost of Internet Service in San Francisco by Connection Type

Connection Type	Tier	Download Speed Range	Range: Monthly Cost	Range: Annual Cost
Wired	Lowest Download Speed/Price	1.5 - 5 Mbps	$29.95 – $44.95	$359.40 – $539.40
	Range covering FCC broadband definition	15 - 55 Mbps	$34.95 – 98.00	$419.40 – 1,176.00
Wireless: Cell Phone	1-3 Gigabyte Plans	1.5 - 25 Mbps	$40.00 - 80.00	$480.00 – 960.00
	4-6 Gigabyte Plans	1.5 - 25 Mbps	$60.00 – 100.00	$720.00 – 1,200.00
Wireless: Tablet	1-3 Gigabyte Plans	10 - 25 Mbps	$30.00 – 34.99	$360.00 – 419.88
	4-6 Gigabyte Plans	11 - 25 Mbps	$40.00 – 50.00	$480.00 – 600.00
Satellite	All packages	5 -15 Mbps	$49.99 – 129.99	$599.98 – 1,559.88
Fixed Wireless	All packages	20 - 200 Mbps	$35.00 – $41.67	$420.00 – $500.04

Source: Budget and Legislative Analyst survey

As shown in Figure 11 above, lower cost, low-speed non-broadband plans offered at the time this report was prepared started at $29.95 per month but provided download speeds of only 1.5 Mbps, lower than the minimum for broadband as defined at the time these prices were obtained. Higher rates generally mean higher speeds and monthly fees increase to a minimum of $34.95 per month for speeds bracketing the FCC's

broadband definition of 25 Mbps download and 4 Mbps upload to as high as $98 per month. Though higher priced plans often offer better value in terms of download speed, higher monthly fees can be unaffordable and thus rule out obtaining broadband at home for some end users.

Figure 11 shows that wireless Internet service for cellular telephones is generally more expensive than wired Internet service in San Francisco. Wireless service also generally comes with data restrictions, with the amount of data that is downloaded and uploaded generally limited depending on the plan purchased. Under certain plans, consumers who exceed their data allotment in a month are charged a fee per excess gigabyte (GB). Other mobile wireless companies just restrict the speeds once a data cap has been exceeded rather than charge additional fees.

Because the average American mobile user only consumes 1.38 GB of data per month, monthly charges for only two data plans are presented: 1) plans that offer between 1-3 gigabytes (GB) of data use a month, and 2) plans offering 4-6 GB a month.[35] The prices displayed do not include any activation fees, taxes, or any other additional fees.[36] When enrolling with a carrier, many consumers sign a longer term contract to also purchase a phone through installments, increasing the monthly cost. The range of monthly fees shown in Figure 11 above are only the prices for cellular Internet service and do not reflect the total cost for consumers.

Data limits like the ones instituted by cellular companies can change how consumers use the Internet. Part of the reason data caps were put in place was to help reduce network congestion, especially during peak hours. However, the effect of data caps has been to reduce use at all times and change how people use the Internet. For instance, when data caps are in place, people tend to avoid watching online videos due to their higher data requirements.[37] Just as significant, research by Microsoft has also shown that data caps lead to users avoiding software updates which are critical to online security.[38] For those in the digital divide, data caps which limit the use of the Internet are another

[35] National statistics show Americans average 1.38 GB of data use per user each month. Fitchard, Kevin. "Cisco: The U.S. officially enters the gigabyte era of mobile data consumption." *Gigaom*. Feburary 5, 2014. Accessed online October 22, 2014.

[36] All telephone service in the United States also incorporates fees for the Universal Service Fund which helps subsidize the cost for universal service across the country. For more information, please see http://www.fcc.gov/encyclopedia/universal-service.

[37] Lucey, Patrick. "How Data Caps Are Bad for Cybersecurity." *New America Foundation*. July 10, 2014. Accessed online October 22, 2014.

[38] Microsoft Research, " 'You're Capped!' Understanding the Effects of Bandwidth Caps on Broadband Use in the Home." May, 2012. Accessed online October 22, 2014.

hurdle to overcome. In contrast, a cable or DSL connection does not set data limits, allowing the free range of the Internet to be utilized.[39]

Figure 11 also shows that tablet plans are relatively less costly than cellular plans, but they still come with data cap restrictions and the potential for added monthly fees. For both cell phones and tablets, using a local Wi-Fi connection can reduce the amount of charged data but consumers would need a home Internet connection or ongoing access to free public Wi-Fi for their tablet use to be comparable to computer-based broadband access at home.

As shown in Figure 11 above, satellite Internet providers offer an expensive alternative to wired services. Like the cellular companies, satellite companies impose data caps on Internet use. However, rather than charge additional fees for exceeding the data cap, the companies for whom information is presented slow down access speeds when end users reach the cap.[40] Further, the speeds offered by satellite companies are far slower than the speeds offered through a cable connection.

Alternatively, fixed wireless services offer high speeds at relatively lower prices. Should a residential complex order service, the providers in San Francisco construct an antenna on a building to receive Internet and then connect each residential unit. Of all the different residential Internet providers available in San Francisco, one of the fixed wireless companies offers the lowest price for the fastest speed at $5 per megabit under its low-speed plan. However, the two fixed wireless service companies only offer service in limited areas of San Francisco and are therefore not a viable option for most households at this time.

Compared to national statistics, the price for Internet access in San Francisco is relatively on par. The FCC reported in 2011 that the national average monthly price for a 1-5 Mbps download connection was $35, the average cost of a 5-15 Mbps download connection was $44, and the average price of a 15-25 Mbps connection was $56.50.[41] These rates are roughly similar to prices in San Francisco where an average wired plan with speeds between 1.5 and 5 Mbps is $34.76 per month and $58.97 for wired plans with speeds between 15 and 55 Mbps.

[39] Comcast is beginning to install 300 GB data caps nationwide. Higginbotham, Stacey. "Looks like Comcast is quietly pushing a 300 GB cap and overage charges." *Gigaom*. November 8, 2013. Accessed online October 22, 2014.

[40] Both satellite services only slow down service during peak use times of 7 – 11 pm on weeknights should data caps be exceeded. At all other times, consumers can utilize the full subscribed speed.

[41] Federal Communications Commission, "International Broadband Data Report." August 21, 2012. Accessed online October 22, 2014.

Comcast Internet Essentials

The broadcasting and cable company Comcast offers a discounted Internet service to families with children in school called Internet Essentials. Comcast initially began the Internet Essentials program in 2011 as part of a voluntary commitment to the Federal Communications Commission to get approval for its merger with NBC Universal. Under Comcast's Internet Essentials program, families can subscribe to home Internet service for $9.95 a month, and receive download speeds of 5 Mbps and upload speeds of 1 Mbps.

Originally, a student would also need to be eligible for the National School Lunch Program to qualify for the discount program. However, Comcast has recently expanded the service to any family whose children attend schools with 70 percent or more of the student body in the National School Lunch Program.

In San Francisco, approximately 11,000 students are eligible for the Internet Essentials program. However, only approximately 1,500 students, or 13.56 percent of those eligible, actually subscribe.

According to the Director of Government Affairs at Comcast, the low subscription rate is largely due to a non-solicitation policy enforced by SFUSD. Normally Comcast sends flyers out to students' families in back-to-school packets. However, the Internet Essentials program has also been criticized for an overly burdensome enrollment

process.[42] As a potential consequence, subscription rates across California are relatively low. Only approximately 15 percent of eligible students in school districts across California subscribe to the Internet Essentials program. With broadband redefined by the FCC in January 2015 to 25 Mbps download and 4 Mbps upload, the Internet Essentials program no longer qualifies as broadband service with the speeds offered as of the fall of 2014.

In addition to discounted Internet service, Comcast offers discounted computers for purchase. Families can purchase a computer for $150 through the Internet Essentials program. Comcast also offers online digital literacy resources available to use by the public. Combined, these programs help underserved families obtain access at home in terms of both hardware and Internet service.

3. Internet Adoption Rates in San Francisco

Even when the needed infrastructure is in place to make the Internet available and the price of Internet access is affordable for all income levels, there are still people who do not adopt Internet use due to a perceived lack of need or due to the lack of digital skills. Unfortunately, reliable data on the number of people in San Francisco lacking the skills or interest in adopting Internet use was not found for this analysis. However, national and state surveys do provide estimates of how many people in the digital divide are non-adopters. According to a 2013 national survey conducted by the National Telecommunications and Information Administration (NTIA), 72 percent of Americans use the Internet. Of the group of Americans who do not use the Internet, 48 percent do not use it due to a perceived lack of need or lack of interest.[43]

In another 2013 survey, the Public Policy Institute of California found 86 percent of Californians use the Internet.[44] Of the 14 percent of Californians who do not use the Internet, 32 percent reported not using it because they do not know how. Another 34 percent reported a lack of interest or perceived need. Combined, these groups represent 66 percent of the Californians who do not use the Internet. Non-adoption is especially prevalent among older, less educated, and low-income populations. Digital literacy courses and focused community engagement can potentially help connect these groups.

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[42] Brodkin, John. "Comcast's Internet for the poor too hard to sign up for, advocates say." *Ars Technica*. July 23, 2014. Accessed online October 22, 2014.

[43] National Telecommunications and Information Administration, U.S. Department of Commerce, "Exploring the Digital Nation: America's Emerging Online Experience." June 2013. Accessed online October 22, 2014.

[44] Public Policy Institute of California, "PPIC Statewide Survey: Californians & Information Technology." June 2013. Accessed online October 22, 2014.

Over the last several years, the growth of mobile device adoption may have helped spread the popularity of Internet services and led to improved digital literacy.[45] Smartphones and tablets are intuitive and do not require knowledge of how to operate a mouse, keyboard, or operating system. Using one's finger to run a program or search online requires only minimal training. For these and other reasons, mobile devices continue to be extremely popular, with over 50 percent of Americans already owning some type of mobile device as of 2013.[46]

Though use of mobile devices is more intuitive, the devices do not build the same digital skills as a desktop or laptop computer. While mobile device capacities are increasingly powerful and tablets can serve as substitutes for books, desktop and laptop computers are still the basis for advanced computing and offer the highest functionality. Using a laptop or desktop computer allows users to conduct in-depth online research or take online classes. Filling out a job application may be possible on a cellular phone or tablet but it is significantly easier on a computer.

4. STRATEGIES TO OVERCOME THE DIGITAL DIVIDE IN SAN FRANCISCO

Since at least 2006 through the present, the City and County of San Francisco, the San Francisco Unified School District, community non-profit organizations, and other groups have implemented different strategies to tackle the digital divide.

San Francisco's Digital Inclusion Program

In 2006, Mayor Gavin Newsom launched a Digital Inclusion Strategy to close the digital divide and provide universal access to all San Francisco residents.[47] A comprehensive strategy was proposed to address Internet access disparities. The Digital Inclusion program had three major components:

1. Provide free and affordable wireless Internet access Citywide,
2. Enhance digital literacy programs,
3. Expand computer ownership.

Mr. Brian Roberts at the Department of Technology (DT) led the City's Digital Inclusion efforts between 2009 and 2013. Mr. Roberts's role was to coordinate the City's efforts with local non-profit organizations and to continually track the City's progress towards reaching its digital expansion goals. Although some of the programs still exist in some form, DT no longer has staff dedicated to digital inclusion efforts.

[45] Cisco, "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013–2018." February 5, 2014. Accessed online October 22, 2014.

[46] Pew Research Center, "Home Broadband 2013." August 26, 2013. Accessed online October 22, 2014.

[47] Department of Technology, City and County of San Francisco, "Digital Inclusion." Accessed online October 22, 2014.

To address the problem of disparate Internet access, creation of a Citywide Wi-Fi network that would provide free and/or affordable Internet access was attempted in 2006. At that time, the City explored the option of providing Citywide wireless Internet access through a partnership with Earthlink and Google. Although Earthlink's proposal actually did not involve the use of City fiber, the goal of a Citywide wireless network was to provide universally accessible Internet to all San Francisco residents.

Three tiers of service were originally envisioned: 1) a free tier with a download speed of 300 kilobits per second (kbps), 2) a discounted tier of $12.95 per month for low-income residents that would offer a download speed of 1 Mbps, and 3) a standard tier for $21.95 per month available for all residents, with a download speed of 1 Mbps. However, before final City approval for the project could be reached, Earthlink withdrew its support for the project.[48]

Though this initial attempt at Citywide access did not succeed, the City has made Internet access free in a number of locations in the ensuing years. The impetus for these efforts was the City's creation of its own fiber network.

1) Community Broadband Network and Citywide Wi-Fi

Starting in 2001, the City installed a fiber network for the purpose of creating high speed access between public safety institutions in the City. However, creation of the network also provided an opportunity for the Department of Technology (DT) to address digital divide issues by using the network's excess capacity to provide broadband Internet access to certain sites.

Following large expansions of the City fiber network to connect City College campuses in 2006 and to connect public safety radio towers in 2007, DT expanded the use of the fiber to provide Internet connections to some low-income households through the Community Broadband Network, a segment of the City fiber network that relies on separate strands of fiber than those used for City business. In 2010, the City coordinated with the San Francisco Housing Authority (SFHA) to begin offering free high-speed Internet services to residents living in Housing Authority properties though the Community Broadband Network. The intended purpose of extending the City fiber to SFHA buildings was to overcome the affordability barrier for those households by offering free Internet access. By 2011, DT finished connecting all 42 SFHA buildings to the City network for a total of 6,050 residential units covered.

DT also provided the Community Broadband Network to various non-profit organizations and public computing centers across San Francisco. In particular, community centers that host digital literacy training courses sponsored by the

[48] Associated Press. "EarthLink Abandons San Francisco Wi-Fi Project." *New York Times*. August 31, 2007. Accessed online October 22, 2014.

Department of Aging and Adult Services (DAAS) were connected to the City network. Twenty-two different DAAS community centers, apartments, and senior centers now make use of the City's fiber network. (A full list of SFHA and DAAS sites connected to the City fiber network is provided in Appendix A).

DT also resurrected the idea of a publicly available Wi-Fi network starting with the creation of #SFWiFi on a 3.1 mile stretch of Market Street in December 2013.[49] Market Street was chosen in part because of its location as one of the City's largest and most prominent commercial corridors.[50] The service is intended for use by anyone on that segment of Market Street with a mobile device. DT advises that users on Market Street could receive download and upload speeds of 50 Mbps, depending on congestion and proximity to the network.

In October 2014, DT also began offering #SFWiFi service at 32 public parks in San Francisco.[51] DT pursued the park expansion following receipt of a $600,000 grant from Google. As with the Market Street wireless network, the public parks are connected to the City's fiber network and available free of charge to anyone in the parks with a laptop or mobile device with Internet access functionality. According to DT, download and upload speeds will be 50 Mbps at peak performance. Figure 13 below shows the 32 parks with free #SFWiFi in San Francisco.

[49] Gannes, Liz. "San Francisco Gets Fast, Free Public Wi-Fi on Market Street." *All Things D*. December 16, 2013. Accessed online October 22, 2014.

[50] City and County of San Francisco, "San Francisco Wi-Fi." Accessed online October 22, 2014.

[51] Dolores Park and Boeddeker Park will receive service once park construction is completed. For a full list of parks with Wi-Fi access, see City and County of San Francisco, "San Francisco Wi-Fi." Accessed online October 22, 2014.

Figure 13: San Francisco Parks with Free Wi-Fi			
1	Alamo Square	17	Marina Green
2	Balboa Park	18	Minnie & Lovie Ward Rec Center
3	Bernal Heights Recreation Center	19	Mission Dolores Park**
4	Boeddeker Park**	20	Mission Rec Center
5	Chinese Recreation Center	21	Palega Recreation Center
6	Civic Center Plaza	22	Portsmouth Square
7	Corona Heights	23	Richmond Recreation Center
8	Crocker Amazon Playground	24	St Mary's Playground
9	Duboce Park	25	St Mary's Square
10	Eureka Valley Rec Center	26	Sue Bierman Park
11	Gene Friend Rec Center/SoMa	27	Sunnyside Playground
12	Hamilton Rec Center	28	Sunset Playground
13	Huntington Park	29	Tenderloin Children's Rec Center
14	Joseph Lee Recreation Center	30	Union Square
15	Justin Herman Plaza	31	Upper Noe Recreation Center
16	Margaret Hayward	32	Washington Square

Source: Department of Technology, *San Francisco Wi-Fi* 2014

According to Mr. Miguel Gamiño, Chief Information Officer for the City and County of San Francisco, DT is currently discussing plans to expand the City's fiber network in the coming years. Currently, DT has prioritized connecting fire stations and San Francisco Public Library facilities across San Francisco to the City's fiber network. Plans are also being considered by DT to provide Internet access through the City's fiber network to SFUSD schools.

#SFWiFi, which runs off the City fiber network, will also be extended, according to DT plans. Initially, DT plans to prioritize preparation of certain City locations for later inclusion as #SFWiFi spots. DT will also evaluate where to expand #SFWiFi to include other parks across San Francisco. DT is considering third party partnerships to help extend #SFWiFi's coverage area. For instance, DT has installed Hotspot 2.0 technology with #SFWiFi which allows users to travel across San Francisco using the same log-in credentials to access wireless service in cafés, AT&T Park, or wherever a high-quality wireless service is available. Eventually, DT envisions wireless connectivity will be available for the entire City.

By providing Wi-Fi service free of charge, the City is providing those without access at home another way to access the Internet in community centers, public parks, or on Market Street. However, free Wi-Fi requires owning a laptop or mobile device with Internet access capability. While providing greater Internet access to all, #SFWiFi on Market Street and in public parks does not at this time offset the limitations of not having broadband Internet access at home, the key characteristic defining the digital divide.

The City's proposed Information and Community Technology Plan for Fiscal Years 2016-20 includes a Connectivity Plan with the goal of increasing the infrastructure capacity of the City's fiber-optic network. While intended to improve the needs of City departments by connecting all eligible City buildings to the City's fiber network, the Connectivity Plan also addresses Dig Once legislation[52] and the build-out of SFWiFi. With a broader network, the City will be able to offer more Wi-Fi. The Connectivity Plan outlines where conduit and SFWiFi will expand in the coming five years. It calls for adding approximately 178 City buildings that are not connected to the fiber network to the 231 City buildings that are already connected so that all buildings will be connected and benefit from higher performance, higher speed access than private providers offer and greater security and reliability.

The Connectivity Plan also proposes a two year plan for deploying #SFWiFi in selected City buildings and pursuing public-private partnerships for other sites such as small businesses and museums.

2) Digital Literacy Programs

Another major component of the City's Digital Inclusion Strategy of 2006 was funding digital literacy programs focused especially on Internet non-adopters. Digital literacy programs are intended to provide the digital skills necessary to make full use of the Internet. Courses can range from basic computing skills like how to use a mouse and keyboard to more advanced lessons like resume building or how to use social media. Engaging non-adopters with hands-on instruction, either through a classroom setting or one-on-one, is an important element to achieving greater Internet use.

Funding for digital literacy programs in San Francisco has come from different sources in recent years. In 2010, the National Telecommunications and Information Administration (NTIA) awarded the Department of Technology (DT) $3,618,000 for youth digital literacy programs and $2,949,637 to the Department of Aging and Adult Services (DAAS) for

[52] "Dig Once" legislation was adopted by the Board of Supervisors in 2014 and requires that public and private agencies digging up streets for other purposes allow for placement of conduits that the City can use for fiber-optic cables.

digital literacy programs focused on senior and elderly education.[53] NTIA funds were used in a City-led grant program to local non-profits in their digital literacy efforts until September 2013. Following the end of NTIA funding, the City continued to fund DAAS programs but did not continue funding for DT's youth programs.

Digital Literacy Programs for Seniors and Adults with Disabilities

Currently, the Department of Aging and Adult Services (DAAS) runs the SF Connected program that provides free computing education and support for seniors and adults with disabilities. DAAS targets its services towards a specific subset of non-adopters in senior centers, senior and supported housing, adult day health centers and community centers across San Francisco. DAAS's typical demographic differs from other digital literacy programs such as those offered by the San Francisco Public Library which, according to Mr. Aaron Low, Program Manager at SF Connected, generally serve a more proficient, younger population.

DAAS works with 26 different community-based organizations and separately funded training partners to help underserved seniors gain Internet access, support, and training.[54] Through these partners, DAAS has 245 computers in 54 computing centers Citywide for use by San Francisco seniors. Each computer is equipped with assistive technology including keyboards for the visually impaired, headphones, scanning w/ pen pad, touch monitors, and a mouse. DAAS's budget for the SF Connected program is $412,086 in FY 2014-15, excluding the salaries and benefits of two support staff Full-time Equivalent positions (FTEs). Current grants were awarded on a 21-month cycle with a 1-year option to extend. Each grant is formally evaluated annually by the effectiveness and number of people educated through the program.

While curriculums vary between the 26 different community groups, SF Connected encourages the use of DigitalLearn.org to guide seniors and adults with disabilities on learning how to use a computer. DigitalLearn.org is an online platform that allows seniors and adults with disabilities to choose a variety of lessons to learn at their own pace. As shown in Figure 14, participants can choose to take basic lessons like how to use a computer or more advanced tasks like using an application such as Microsoft Word. Through the 26 different community groups and education platforms like these, DAAS helped educated 1,541 seniors in 2013.

[53] In addition, $1,313,995 was spent on in-direct costs managing the programs and another $50,000 was unused for a total grant of $7,931,632. National Telecommunications and Information Administration, U.S. Department of Commerce, "BroadbandUSA: Connecting America's Communities City and County of San Francisco." Accessed online October 22, 2014.

[54] For a full list of partners, see SF Connected, "Partners." Accessed online October 22, 2014.

Figure 14: DigitalLearn.org Course Selection

- Getting started on the Comuter
- Using a PC (Windows 7)
- Using a Mac (OS X)
- Basic Search
- Navigating a Website
- Intro to Email
- Intro to Email (part 2)
- Intro to Microsoft Word
- Creating a Resume

Digital Literacy Programs for Youths

Although National Telecommunications and Information Administration funding for DT's youth services programs ended in 2013, many of the online education services are still available. According to DT's Mr. Roberts, because youths generally are more adept at learning new technologies, DT had emphasized more advanced skills for youths such as creating multimedia projects and workforce development. DT previously hosted program activities through their web portal GoConnectSF.org, directing users to various community organizations that offer training for youths, seniors, and anyone else interested in building their digital skills.[55] GoConnectSF.org also provides basic information on how to subscribe to broadband services at home. Although outdated, DT's online portal continues to provide a resource to help San Franciscans build their computing skills.

Computer Ownership

According to Mr. Roberts of DT, the City only offered a limited computer subsidy program in the past. However, several non-profits in the Bay Area do offer computer subsidy and assistance programs. Goodwill helps low-income households purchase affordable computers and ReliaTech in Oakland also provides discounted computers and laptops.[56]

Building Digital Capacity and Skills at SFUSD

The San Francisco Unified School District (SFUSD) is actively using its facilities to teach its students digital skills. A major theme of the District's five-year Technology Plan is to personalize education, especially through the use of technology. The goal of bringing

[55] City and County of San Francisco, "GOCONNECTSF: Get Training." Accessed online October 22, 2014.

[56] Relia-Tech, "Low Cost Broadband." Accessed online October 22, 2014.

more technology in to lesson plans is to allow curriculums to shift from being teacher-led towards one allowing students to develop their individual interests more fully.[57]

SFUSD's school sites are all connected to the Internet and provide sufficient bandwidth to meet student needs. Figure 15 below presents a summary of connection speeds for all SFUSD buildings. As can be seen, all but seven District buildings provide high speeds greatly in excess of the current FCC definition of broadband as 25 Mbps download and 4 Mbps upload.

Figure 15: San Francisco Unified School District Internet Connection Types[58]

Internet Speed	San Francisco Unified School District Building
10 Gigabit	3 schools 1 administration
1 Gigabit	119 schools 9 administration
1.5 Mbps	7 early education schools

Source: San Francisco Unified School District

According to Mr. Matthew Kinzie, Chief Technology Officer at SFUSD, 132 of the 139 SFUSD buildings are connected to AT&T's fiber network and have at least a 1 Gbps symmetrical Internet connection. Shown in figure 15 above, three SFUSD school sites and one administrative building have a very high speed 10 Gbps download speed.[59] An additional 119 SFUSD schools and 9 administrative buildings have 1 Gbps connections through AT&T. The remaining seven have connections to the Internet through DSL lines with downloads speeds of 1.5 Mbps.[60] Mr. Kinzie also states that with SFUSD achieving its goal of 1 Gbps connectivity for each classroom, SFUSD is now aiming to provide at least 10 Mbps to every device.

No SFUSD school site is currently connected to the City and County of San Francisco's fiber network. Connecting to City fiber would provide SFUSD the primary benefit of

[57] San Francisco Unified School District, "Building the Digital District: Preparing Students for the Digital World 2014-2019 Technology Plan." October 1, 2014. Accessed online October 22, 2014.

[58] SFUSD is comprised of 139 different sites which include: 12 Early Education Schools, 8 Transitional Kindergarten Sites, 71 Elementary & K-8 Schools, 12 Middle Schools, 15 High Schools, 7 County and Court Schools, 4 Continuation/Alternative Schools, and 10 Administrative sites.

[59] The SFUSD sites with 10 GB connections are SFUSD's District Office, Thurgood Marshall High School, Lincoln High School, and Washington High School.

[60] All seven of the SFUSD sites with DSL connections are early education schools: Junipero Serra Early Education School, Noriega Early Education Center, Presidio Early Education School, Theresa S. Mahler Early Education School, Tule Elk Park Early Education School, Zaida T. Rodriguez Early Education School, Mission Early Education School.

potentially lower costs, higher Internet access speeds and excess bandwidth with which to prepare for future data demands. Currently, AT&T restricts the bandwidth provided to SFUSD under the specific subscription tier. Should SFUSD need more data, the school district could pay AT&T for greater bandwidth. Mr. Kinzie states connecting to the City network may occur in the future but, at present, AT&T sufficiently addresses SFUSD's needs.

SFUSD has set a goal of providing wireless Internet access to every classroom. Mr. Kinzie advises that currently only 25 percent of classrooms in the SFUSD system have Wi-Fi access. However, as the five year District Technology Plan illustrates, SFUSD's goal is to create an educational environment where students can be arranged by instructional need and not by how technology is installed. The increasingly common use of laptops, mobile devices, and, especially, tablets are key factors driving the expansion of wireless in SFUSD buildings.

SFUSD's Internet connection speeds are higher than the average nationally for schools. The non-profit Education Superhighway, which tracks school connectivity across the country states that each school should have at least a 1 Gbps symmetrical Internet connection within 5 years to provide sufficient access to every student.[61] The Education Superhighway has found that schools nationally average 33 Mbps, far short of the projected goal.[62]

SFUSD has a total of 7,191 computers for use among 52,989 students, or a ratio of one computer for every seven students, approximately 60 percent of which were purchased within the last four years, according to the District. SFUSD reports that maintaining a modern fleet of computers to address students' needs is a top priority for the District. However, as a result of the student to computer ratio of one to seven, student access to computers and the Internet has to be rationed in a away that would not occur with Internet access at home.

SFUSD's strong technological capabilities reflect the growing importance of digital skills in the Common Core State Standards. These standards require schools to create at least a minimum level of digital proficiency and to measure computer proficiency for each grade. For instance, by grades 6-8, students should have at least an intermediate proficiency in word processing, including using many of the features in common applications.[63] The Common Core State Standards are also increasingly requiring

[61] Education Superhighway, "Connecting America's Students: Opportunities for Action." April, 2014. Accessed online October 22, 2014.

[62] Education Superhighway, "Connecting America's Students: Opportunities for Action." April, 2014. Accessed online October 22, 2014.

[63] San Francisco Unified School District, "Recommended Digital Literacy & Technology Skills to Support the California Common Core State Standards." Accessed online October 22, 2014.

"anchor standards," or evidence-based analysis which often requires Internet research and media support. With its current facilities, SFUSD schools are well positioned to meet the Common Core standards and maintain digital fluency with all of its students.

Each school in SFUSD determines its own curriculum and students may receive differing amounts of exposure to computers depending on their school site. For instance, the use of SFUSD's School Loop, an online interface to increase communication between students' families and school officials, varies between schools. Some high schools may actively use School Loop to post homework and generate discussion boards while others might not use School Loop much at all.

San Francisco Public Library System

The San Francisco Public Library (SFPL) system also plays an important role in helping connect residents to the Internet. As noted above, the library is a common resource for the digitally disconnected to access the Internet. National statistics show that 32 percent of Americans without home access use the library as their primary means to go online.[64] Further, a 2013 survey by Pew Research Center's Internet & American Life Project found that African Americans and Hispanics also were more likely to state that libraries are important to them and their families to access the Internet.[65]

To address this need, SFPL has developed its facilities to provide comprehensive service. Figure 16 below displays the current broadband connection at each library. As can be seen, though there is great variance in Internet access speeds, ranging from 10 Mbps at seven branch libraries to a high of 1 Gbps at three libraries, most SFPL facilities do not currently meet the FCC standard for broadband, defined as of January 2015 as 25 Mbps download and 4 Mbps upload. As also can be seen, branch libraries using the City fiber network have significantly higher speeds compared to those using AT&T. SFPL representatives have explained the amount of bandwidth allotted to each library was determined by the needs of members but can be increased through AT&T if necessary.

Many of the SFPL branch libraries are scheduled to connect to the City fiber network in FY 2014-15. Figure 16 below shows, as a result of converting to the City fiber network more SFPL branches are expected to achieve broadband speeds after the transition.

[64] National Telecommunication and Information Administration and Economics and Statistics Administration, U.S. Department of Commerce, "Exploring the Digital Nation: America's Emerging Online Experience." Washington, D.C. June 2013. Accessed online October 22, 2014. In addition, the Institute of Museum and Library Services found that 44% of people living in households below the federal poverty line of $22,000 a year for a family four used public library computers and the Internet. Institute of Museum and Library Services, "Opportunity for All: How the American Public Benefits from Internet Access at U.S. Libraries." Washington, D.C. March 2010. Accessed online October 22, 2014.

[65] Pew Internet & American Life Project, "Library Services in the Digital Age." January 22, 2013. Accessed online October 22, 2014.

While the 27 branch libraries and the Main Library are all connected to the Internet through a fiber connection, currently only the Main Library and three branches are connected to City fiber. The remaining 24 branches are connected through AT&T's fiber network. However, according to Mr. Michael Liang, Chief Information Officer of SFPL, the department plans on connecting all branch libraries to the City fiber network by the end of FY 2019-20. Mr. Liang explains that although AT&T provides SFPL with sufficient bandwidth to meet each library's needs, the City fiber network would allow SFPL to provide additional bandwidth critical for the future growth of library computing.

A 2013 survey of public libraries across the country found an overall median download speed of 11.1 Mbps. However, libraries in cities (vs. suburban municipalities, towns and rural areas) typically have a median subscribed download speed of 29.7 Mbps.[66] Compared to these metrics, San Francisco is slightly under the national median with its 20 Mbps median rate. However, the median future speed of 50 Mbps planned for FY 2014-15 at SFPL will exceed the 2013 national rate.

[66] Information Policy & Access Center, "2013 Digital Inclusion Survey: Survey Findings and Results." July 21, 2014. Accessed online October 22, 2014.

Figure 16: San Francisco Public Library Connection Speeds*

Location	Type of Connection	Current Speed (Mbps)	Type of Connection FY 2014-15 Plan	FY 2014-15 Plan (Mbps)
Main Library	Both AT&T & City	500	Both AT&T & City	1 to 10 GB/s
Anza	City Fiber	20	City Fiber	50
Bayview	AT&T	20	City Fiber	1 GB/s
Bernal Heights	City Fiber	1 GB/s	City Fiber	-
Chinatown	AT&T	50	City Fiber	1 GB/s
Eureka Valley	AT&T	10	City Fiber	1 GB/s
Excelsior	AT&T	50	City Fiber	1 GB/s
Glen Park	AT&T	10	AT&T	50
Golden Gate Valley	AT&T	10	AT&T	20
Ingleside	AT&T	50	AT&T	50
Marina	AT&T	10	AT&T	20
Merced	AT&T	20	AT&T	50
Mission	AT&T	20	City Fiber	1 GB/s
Mission Bay	AT&T	20	AT&T	-
Noe Valley	AT&T	10	AT&T	50
North Beach	City Fiber	1 GB/s	City Fiber	-
Ocean View	AT&T	20	AT&T	-
Ortega	AT&T	50	City Fiber	1 GB/s
Park	AT&T	20	AT&T	-
Parkside	AT&T	20	AT&T	50
Portola	AT&T	50	City Fiber	1 GB/s
Potrero	AT&T	10	AT&T	20
Presidio	AT&T	10	AT&T	20
Richmond	AT&T	50	City Fiber	1 GB/s
Sunset	AT&T	50	AT&T	-
Visitacion Valley	City Fiber	1 GB/s	City Fiber	-
West Portal	AT&T	50	AT&T	-
Western Addition	AT&T	20	AT&T	-

* All SFPL libraries have symmetrical Internet connections.

Source: San Francisco Public Library

To access the Internet, SFPL offers 697 desktop computers, 302 laptops, and 18 tablets for a total of 1,017 connected devices available for use by the public. SFPL also offers free Wi-Fi for the public to use in its facilities.[67] To use a library computer, a patron must

[67] The Library provides public access to 697 desktop computers, 302 laptops, and 18 tablets for a total of 1,017 computers.

log-in with their library ID and is free to use the Internet for two one-hour increments. SFPL does not restrict any web sites so users are allowed to freely roam the Internet as they wish. Mr. Liang advises that, currently, every single computer available for use is less than four years old, reflecting SFPL's policy to provide and maintain modern hardware for its members. However, as with SFUSD facilities, unlimited Internet access is not possible at SFPL libraries in order to provide Internet access to all members.

In SFPL's performance measures presented in the Controller's City Services Performance Measure Report for FY 2012-13, the Library reported that SFPL's free Wi-Fi service was being heavily used. In FY 2012-13, the Main Library alone had an average of 1,004 people use the Library's Wi-Fi each day. At the 27 branch libraries, an average of 2,785 people used the Library's Wi-Fi per day.[68] The heavy use of computers in the libraries is similarly reflected in the growth of e-services and e-resources including e-books, audio, and movies.

In addition to SFPL's well-equipped facilities, the Library also hosts several programs designed to help build digital literacy. SFPL creates programs by surveying its librarians and members on what programs should be offered. Currently, SFPL offers a range of basic literacy courses which can help members learn fundamentals on how to use a computer. More advanced courses are also offered such as helping members build their resumes and learning how to write programming code. SFPL also allows outside non-profits and interested groups to use their computer facilities to teach. For instance, Girls Who Code, a non-profit organization that helps encourage young girls to learn to program, uses SFPL facilities. Through FY 2013-14, SFPL hosted 979 technology related courses using library computer facilities, instructing 9,464 people over the course of the year.

SFPL also offers several resources online for people who want to learn on their own. Online courses help build digital and other skills. For example, SFPL promotes the use of Learning Express Library which allows users to learn skills such as math, reading, and writing at their own pace.[69] Another service, Gale Courses, offers 6 weeks of guided instruction on topics ranging from computer fundamentals to accounting and finance.[70]

Further, SFPL uses its website to advertise its facilities and to provide more services. On their website, members can search the library's catalog and reserve books and can download e-resources from home. All of SFPL's courses are available to view through

[68] Office of the Controller, San Francisco, "City Services Performance Measure Report Fiscal Year 2012-13." December 11, 2013. Accessed online October 22, 2014.

[69] San Francisco Public Library, "LearningExpress Library 3.0." Accessed online October 22, 2014.

[70] San Francisco Public Library, "Welcome to Gale Courses!" Accessed online October 22, 2014.

their calendar posted on their website.[71] To accommodate residents who do not speak English, SFPL has translated its website to Spanish and Chinese as well.

Non-Profit Organization Strategies to Close the Digital Divide

Throughout San Francisco, a number of organizations are also actively working to address closing the digital divide. The following are a sample of some of the groups currently helping connect every San Francisco resident to the Internet. A number of other organizations not listed below are also providing such services.

Community Technology Network

Community Technology Network (CTN) is a local 501(c)3 non-profit whose mission is to help build digital literacy among non-adopters in San Francisco. To achieve this goal, CTN works with over 60 volunteers to teach digital skills in various computing centers in San Francisco. CTN provides training for new volunteers, coordination, and recruiting for digital literacy efforts. A majority of CTN's work is through the City's Department of Aging and Adult Services (DAAS) which has provided funding to CTN through June 2015. CTN provides technology training to seniors in 24 of DAAS's computer centers. CTN works through computing centers that are hosted in senior centers or housing authorities throughout San Francisco.

CTN offers a range of digital literacy courses but focuses on building fundamental computing skills, e-health literacy, and workforce development. CTN's teaching model is to help seniors understand how using the Internet is relevant. Many of the lessons first revolve around teaching seniors how to communicate to their families, especially through social media. 80 percent of CTN's tutoring is through one-on-one instruction.

Mission Economic Development Agency (MEDA)

The Mission Economic Development Agency (MEDA) is a non-profit organization dedicated to improving the lives of households living in San Francisco's Mission District through their Mission Promise Neighborhood program. A major component of their community-based approach is building digital awareness and technology skills for the entire neighborhood.

In order to most effectively target digital divide issues in the Mission, MEDA regularly surveys Mission District residents to learn how many families have Internet at home or if a household's only access to the Internet is a smartphone. Through door-to-door and phone interviews, MEDA collects specific data on the Mission District. Using this information, MEDA's goal is to target the specific problems facing the community.

[71] San Francisco Public Library, "Calendar." Accessed online October 22, 2014.

Currently, MEDA is engaged in a range of efforts to help connect more Mission District households to the Internet. Many of MEDA's programs serve as a complement to programming at four local schools: Cesar Chavez Elementary School, Bryant Elementary School, Everett Middle School, and John O'Connell High School. For instance, a focus of many of the courses is to help students' families learn how to use a computer and the Internet. By helping parents build basic digital literacy skills, they can better understand their child's curriculum and communicate more easily with teachers through email or SFUSD's School Loop.

In terms of digital literacy, MEDA also helps build awareness and the skills necessary to take advantage of the Internet. MEDA has over 60 computers available to host computer classes and digital literacy training. Courses range from basic computer literacy courses to more digital life areas like how to do keyword searches or how to upload pictures.

To help families subscribe to broadband Internet at home to, MEDA also helps students' families navigate subscribing to Comcast's Internet Essentials program, a discount Internet service intended to help low-income students and their families obtain access at home, discussed above.

5. Efforts in Other Cities to Close the Digital Divide

Like San Francisco, other cities in the United States also have ongoing digital inclusion programs. In particular, Seattle, Chicago, and Boston are heavily engaged in helping provide Internet access to all of the residents.

City of Seattle: Digital Inclusion Program

Much like San Francisco, most Seattle residents have home Internet access. In their latest Information Technology and Adoption survey in 2013, the city of Seattle reported 85 percent of its residents have at least some access to the Internet at home. Similarly, 88 percent of Seattle residents were reported to own a computer at home. However, that leaves approximately 15 percent of Seattle residents without home Internet access, or 97,860 people out of a total 2013 population of 652,405 in Seattle.

To help connect more people to the Internet, the City of Seattle developed a comprehensive digital inclusion strategy and developed several different programs to close the digital divide.

- Access: Seattle conducts surveys every four years to measure how many households are connected to the Internet and how many are disconnected. Since 2000, Seattle has conducted four separate surveys to get precise measures of the

status of the digital divide.[72] Results are collected through telephone and online surveys and targeted focus groups. With more information on Internet access rates, barriers to adoption, and residents' preferences for City services, Seattle is able to tailor their digital inclusion efforts towards residents' needs.

- Availability: Seattle offers free public access to computers and free Wi-Fi at all libraries, City Hall, and downtown city conference rooms. Residents can also go to six different Neighborhood Service Centers and 15 Recreation Community Centers to use public Internet kiosks.

Through partnerships and franchise agreements with Comcast and Wave Broadband, Seattle also offers free cable broadband service to local non-profits that provide access and digital literacy assistance. City officials helped broker the agreement to provide extra assistance to select non-profit organizations.[73]

- Affordability: To help more low-income Seattle residents obtain home Internet access, assistance is provided by the city to both help purchase a computer and obtain discounted Internet service. Working with five different organizations, Seattle helps residents find low-cost options for home broadband and/or affordable computers. For instance, Interconnection.org offers $10 a month Internet service allowing use of Clear's 4G cellular network. Interconnection.org also offers laptops from $99 for low-income households.

The City of Seattle offers its refurbished computers for free to local schools and non-profit organizations. Since 1999, over 10,000 computers have been distributed for re-use in Seattle.[74]

- Adoption: To address the hurdle of digital literacy, the City of Seattle offers various courses to help educate residents. Six of Seattle's Recreation Community Centers offer computer learning centers where residents can learn how to use office software, multimedia and web design skills, and conduct homework.[75] Seattle's Office for Senior Citizens also helps bring in volunteers to teach basic computing skills. Since 2003, over 3,500 seniors have reportedly been trained.[76] Residents also have access to online education resources for those interested in learning on their own.

[72] City of Seattle, "Technology Access and Adoption in Seattle." Accessed online October 22, 2014.

[73] City of Seattle, "Access for All: High-Speed Cable Broadband Program." Accessed online October 22, 2014.

[74] City of Seattle, "Free City Surplus Computers." Accessed online October 22, 2014.

[75] City of Seattle, "RecTech." Accessed online October 22, 2014.

[76] City of Seattle, "Mayor's Office for Senior Citizens." Accessed online October 22, 2014.

The City of Seattle's budget includes a Technology Matching Fund that offers grants up to $20,000 to Seattle organizations that help build community-driven technology projects. Organizations that help build digital literacy, access rates, or e-civic engagement projects are eligible. Matching funds by community organizations are then provided by volunteer labor or in cash. Since 1998, Seattle has provided $2.79 million for 223 projects.[77]

The City of Seattle entered in to an agreement with Gigabit Squared with the idea that the company would lease the city's 550 miles of fiber-optic cable to provide broadband Internet access to end user premises. That plan was not successful and the city ending up suing the company. The city is now conducting a feasibility study of a city-run fiber network for high-speed Internet service and to be executed through a public-private partnership.

City of Chicago: Smart Communities Program

In 2010, the City of Chicago received a $6.6 million grant from the National Telecommunications and Information Administration (NTIA) to implement a Smart Communities program in nine neighborhoods. The goal of the program was to help build a "culture of technology use and digital excellence" by increasing broadband subscription rates in select neighborhoods.[78] At the beginning of the project, approximately a third of households in the nine neighborhoods had home Internet access and only a small majority had used the Internet before.

To improve access rates, the Smart Communities program laid out a multiple component strategy.

- Build awareness of the power of digital technologies.
- Expand digital education and training for individuals, families, and businesses.
- Improve access to technology and the Internet at home and in the community.
- Generate local content and improve access to neighborhood news and resources.
- Help existing businesses grow and attract new businesses through technology use.

The Smart Communities' programs were primarily intended to address the problem of digital literacy and home adoption rather than the issue of affordability.[79] For instance, the Smart Communities program created "FamilyNet Centers" which offered drop-in assistance and training for computers. Smart Communities also helped start youth training programs in neighborhood libraries and after-school programs in community

[77] City of Seattle, "Technology Matching Fund." Accessed online October 22, 2014.

[78] Smart Chicago, "Smart Communities Formative Evaluation Report." Accessed online October 22, 2014.

[79] Mossberger, Dr. Karen, Arizona State University, "Measuring Change in Internet Use and Broadband Adoption: Comparing BTOP Smart Communities and Other Chicago Neighborhoods." April 2013. Accessed online October 22, 2014.

areas. Although financial advice was provided, the Smart Communities program largely was not able to directly address the cost of home Internet service. However, the creation of Comcast's Internet Essentials program in 2011 did provide an alternative for households to connect and program officers helped families enroll.

Five years after the Smart Communities program began, each of the nine participating neighborhoods showed increased Internet access rates. According to research conducted by Dr. Karen Mossberger from Arizona State University, broadband adoption in Smart Community neighborhoods increased by 15 percent from 2008-2013 and only 6 percent in other similar Chicago neighborhoods, a difference of 9 percent. Internet use in Smart Community neighborhoods also increased by 13 percent compared to only 4.5 percent in similar Chicago neighborhoods.

City of Boston Non-Profit: Tech Goes Home

The City of Boston currently has many ongoing efforts but Tech Goes Home is an example of a Boston non-profit organization addressing the problem of affordability. The mission of Tech Goes Home, primarily funded by the City of Boston, is to help low-income households learn digital skills and obtain a home computer.[80] Initially, Tech Goes Home helped low-income households obtain refurbished computers once participants completed a 15-hour digital literacy training session. In 2010 however, Tech Goes Home shifted its strategy to provide new netbooks instead. In 2013, Tech Goes Home shifted again to provide Google Chromebooks to students who complete its program, at a cost to the students of only $50.

According to Co-Director Mr. Daniel Noyes, Tech Goes Home found that the cost to warehouse, refurbish, deliver, and repair old machines actually was greater than the cost of a new netbook. With Chromebooks, Tech Goes Home can purchase a brand new computer with a warranty and local tech support for only $200. The Tech Goes Home program teaches approximately 3,500 low-income households each year, 90 percent of whom continue to stay engaged and use the Internet a year after completion.[81]

Municipal Broadband Network Options: Chatanooga and Other Cities

The U.S. ranks between 11th and 27th in average Internet speeds internationally, depending on which survey is used[82]. Some of this difference is due to most U.S. providers continuing to rely on DSL and cable connections for their network connections

[80] Outside Boston, Tech Goes Home also operates in New York City and Las Cruces in New Mexico.

[81] Tech Goes Home, "Our Story." Accessed online October 22, 2014.

[82] *State of the Internet 2014:* Akami reports the U.S. as 11th in average Internet connection speed. Net Index from Ookla accessed online reports the U.S. as 27th in self-tests conducted within 30 days of April 2015.

to end user premises. Communities with higher access speeds have generally made public investments in more extensive fiber networks, or "fiber to the premises".

Chatanooga, Tennessee is one of more than 150 communities throughout the U.S. that has created their own municipally-owned broadband network that is available not only to municipal agencies but to residents and businesses in the city as an alternative to private sector telecommunications companies and Internet Service Providers. The city's initiative started in the late 1990s when its municipal electric utility began investing in fiber optics.

Though it had been discussed for years, it was not until 2007 that Chatanooga's public utility committed to becoming a "fiber to the premises" (FTTP) retail telecommunications and Internet Service Provider. The city constructed a fiber-optic network based on its municipal electric utility grid and, in 2009, began providing higher-speed Internet access than private sector ISPs at competitive or lower prices. As of 2012, the City reported having over 60,000 customers who were offered a minimum 30 Mbps symmetrical speed and 1 Gbps at the upper end.[83] The higher speeds are designed to attract and retain businesses though they are available to residential customers too.

It helped that the City operated its own electric utility that was used as the backbone for the system and that the existing utility was able to borrow from its electric utility revenue to cover some of the initial investment costs. The utility also received a grant from the Department of Energy to more rapidly roll out its grid. A report by the Institute for Local Self-Reliance on the establishment of Chatanooga's and two other cities' public broadband networks depicts the extensive time and resources required for these undertakings, including fighting lawsuits filed by private sector ISPs.

Other cities that have created their own high-speed fiber-optic public broadband networks include Lafayette, Louisiana, Wilson, North Carolina, Mont Vernon, Washington, Cedar Falls, Iowa, and Bristol, Virginia. These networks all offer upload and download speeds significantly faster than those offered by most private sector Internet Service Providers and, generally, at lower cost.

Most cities with public broadband networks are relatively smaller and have their own electric utilities and infrastructures which they control and can modify to accommodate fiber networks. However, larger cities that may not have their own electric utilities are exploring other means of incenting private sector telecommunications companies to invest in more fiber-optic capabilities. As mentioned above, the City of Seattle is exploring creation of municipal broadband and/or public-private partnerships to make high-speed Internet access available and affordable.

[83] "Chatanooga's super-fast publicly owned Internet", Money.cnn.com. March 20, 2014. Accessed online.

A number of private sector companies are developing, and beginning to offer fiber, or fiber-hybrid systems where data is provided by a high-speed fiber-optic network to hubs within a city, with the "last mile" or final leg of their networks provided through existing or new wires to individual residences or business facilities. This allows for much higher speed access than most traditional Internet provider networks offer. Google, AT&T and Verizon are examples of companies developing or offering fiber-hybrid Internet access services. In the case of Google, the company is not a traditional telecommunications Internet Service Provider but it has established a new venture building fiber-optic networks in a limited number of jurisdictions, including Kansas City and Austin, which may serve as an alternative business model for providing higher speed access to more customers.

POLICY OPTIONS

In 2010, the Board of Supervisors passed Resolution 554-10, which set a goal of 90 percent home broadband Internet access by 2015, with a focus on connecting seniors and low income households. Should the Board of Supervisors wish to renew efforts to connect more households and address the issues of availability, affordability, and non-adoption, the following policy options are provided for consideration:

1) Institute a Regular Digital Divide Survey and Measure Progress: The Board of Supervisors could advocate for a dedicated survey to analyze what neighborhoods and groups are most affected by the digital divide, what barriers keep them from connecting and what progress has been made in reducing or eliminating the digital divide. This could be an expanded version of the Controller's existing bi-annual survey or separately conducted with a focus on digital divide issues only.

2) Initiate a Computer Hardware Subsidy Program: The Board of Supervisors should consider advocating for creation of a computer refurbishment program from City surplus hardware or supporting non-profit organization efforts to make affordable computers available to low-income households.

3) Create Third-Party Partnerships to Provide Affordable Internet: The Board of Supervisors should consider requesting that Internet Service Providers in San Francisco create reduced cost Internet access programs for low-income households and other targeted groups in addition to Comcast's current Internet Essentials program for families of students at schools with 70 percent of the students eligible for the National School Lunch Program.

4) Advocate for More Outreach regarding Comcast Internet Essentials at SFUSD: The Board of Supervisors should consider advocating that SFUSD administration consider a waiver to its current policy restricting advertising and outreach efforts at school sites to allow Comcast to better publicize their reduced cost Internet access program to qualified District families.

5) Digital Training for Youth: The City no longer supports digital training programs for youth in San Francisco. The Board of Supervisors should consider providing direct financial support or encouraging City staff to seek grants as were awarded in the past to help train youth in a range of courses such as digital media, workforce development, and computer programming.

6) Mobile Device Training for Seniors and People with Disabilities: As mobile devices become increasingly ubiquitous, more support is needed to train seniors and people with disabilities. Current DAAS training focuses primarily on computers or laptops. Increased support should be provided to seniors for digital training.

7) Make Public Computer Centers Available to Outside Groups: The Housing Authority has computer labs at its facilities that reportedly are largely unused. Computer labs that have excess capacity could be made available to local non-profit organizations for digital literacy training.

8) Expand #SFWiFi and Consider Municipal Broadband Network Alternatives: The Board of Supervisors should consult with the Department of Technology and examine how the City fiber network can be used and expanded to address digital inequality, increase provider competition, and advance the City's digital infrastructure. Alternatives considered should include creation of a Citywide municipal broadband network, with the City either operating or leasing the network to private companies. Public-private partnerships with existing Internet providers and new companies entering the high-speed fiber-optic market should also be considered.

Appendix A: San Francisco Housing Authority, Department of Aging & Adult Services, and Non-Profits on the Community Broadband Network

Organization	CBN Locations	Address	Fiber/Wireless Connection
Dept of Aging & Adult Services	Eastern Park Apartments	711 Eddy Street	Wireless
Dept of Aging & Adult Services	30th Street Senior Center	225 - 30th Street	Wireless
Dept of Aging & Adult Services	Canon Kip Senior Center	705 Natoma Street	Wireless
Dept of Aging & Adult Services	Capp Street Senior Center	362 Capp Street	Wireless
Dept of Aging & Adult Services	IT Bookman Community Center	446 Randolph Street	Wireless
Dept of Aging & Adult Services	Bernal Heights Neighborhood Center	515 Cortland Avenue	Wireless
Dept of Aging & Adult Services	Centro Latino	1656 – 15th Street	Wireless
Dept of Aging & Adult Services	Lighthouse for the blind	214 Van Ness Avenue	Wireless
Dept of Aging & Adult Services	Lady Shaw Residence	1483 Mason Street	Wireless
Dept of Aging & Adult Services	Lady Shaw Senior Center	1483 Mason Street	Wireless
Dept of Aging & Adult Services	Bayview Hunters Point Dr George Davis	1706 Yosemite Avenue	Wireless
Dept of Aging & Adult Services	Jackie Chan ADHC	5757 Geary Blvd.	Wireless
Dept of Aging & Adult Services	Jackie Chan SC	5757 Geary Blvd.	Wireless
Dept of Aging & Adult Services	Richmond Senior Center	6221 Geary Boulevard, 3rd Floor	Wireless
Dept of Aging & Adult Services	Stepping Stone Health Presentation	301 Ellis Street Street	Wireless
Dept of Aging & Adult Services	Downtown Sr Ctr	481 O'Farrell Street	Wireless
Dept of Aging & Adult Services	Western Addition Senior Center Citizens Service Center	1390 1/2 Turk Street	Wireless
Dept of Aging & Adult Services	Excelsior Community Center	4468 Mission Street	Wireless
Dept of Aging & Adult Services	Castro Senior Center	117 Diamond St,	Wireless
Dept of Aging & Adult Services	Bayview ADHC	1250 La Salle Avenue.	Wireless
Dept of Aging & Adult Services	JFCS L'Chaim ADS	2534 Judah Street	Wireless
Dept of Aging & Adult Services	Curry Senior Center	315 Turk Street	Wireless
Non-profit	MEDA (19th & Mission)	19th & Mission	Fiber
Non-profit	Warfield Theater	982 Market St	Fiber

Non-profit	Exploratorium	Pier 15	Fiber
Non-profit	Boys and Girls Club	195 Kiska Rd	Fiber
Non-profit	Literacy for Environmental Justice Heron Point Eco Center	Herron Point	Wireless
Non-profit	Invineo	--	Wireless
Non-profit	Farralon Island (Academy of Sciences)	Farralon Islands	Wireless
San Francisco Housing Authority	Woodside SFHA	255 Woodside	Fiber
San Francisco Housing Authority	Alemany SFHA	938 Ellsworth St	Fiber
San Francisco Housing Authority	Valencia Gardents SFHA	390 Valencia St.	Fiber
San Francisco Housing Authority	Bernal Dwellings	3138 Kamille Court	Fiber
San Francisco Housing Authority	Robert Pitts SFHA	1150 Scott St.	Fiber
San Francisco Housing Authority	Westside Court SFHA	2501 Sutter St.	Fiber
San Francisco Housing Authority	Rosa Parks SFHA	1251 Turk St.	Fiber
San Francisco Housing Authority	31/32 Fillmore/Eddy SFHA	939/951 Eddy	Fiber
San Francisco Housing Authority	Ping Yuen SFHA	795 Pacific	Fiber
San Francisco Housing Authority	North Beach SFHA	455 Bay St.	Fiber
San Francisco Housing Authority	Hunter's View (SFHA)	125 West Point	Fiber
San Francisco Housing Authority	JFK Towers	2451 Sacramento	Wireless
San Francisco Housing Authority	2698 California	2698 California	Wireless
San Francisco Housing Authority	1750 McAllister	1750 McAllister	Wireless
San Francisco Housing Authority	1880 Pine	1880 Pine	Wireless
San Francisco Housing Authority	1760 Bush	1760 Bush	Wireless
San Francisco Housing Authority	Mission Dolores	1855 15th St.	Wireless
San Francisco Housing Authority	350 Ellis	350 Ellis St.	Wireless
San Francisco Housing Authority	666 Ellis	666 Ellis St.	Wireless
San Francisco Housing Authority	430 Turk	430 Turk St.	Wireless
San Francisco Housing Authority	Alice Griffith	207 Cameron Way	Wireless
San Francisco Housing Authority	Westbrook	90 Kiska Rd.	Wireless
San Francisco Housing Authority	Hunters Point east/West (Oakdale)	1105 Oakdale Rd	Wireless
San Francisco Housing Authority	Bay Street	227 Bay St.	Wireless

San Francisco Housing Authority	990 Pacific	990 Pacific	Wireless
San Francisco Housing Authority	363 Noe	363 Noe St.	Wireless
San Francisco Housing Authority	25 Sanchez	25 Sanchez	Wireless
San Francisco Housing Authority	462 Duboce	462 Duboce St.	Wireless
San Francisco Housing Authority	320 Clementina	320 Clementina St.	Wireless
San Francisco Housing Authority	330 Clementina	330 Clementina St.	Wireless
San Francisco Housing Authority	4101 Noriega St	4101 Noriega St	Wireless
San Francisco Housing Authority	200 Randolph/409 Head	209 Randolph St.	Wireless
San Francisco Housing Authority	Great Highway	Great Highway	Wireless
San Francisco Housing Authority	345 Arguello	345 Arguello	Wireless
San Francisco Housing Authority	491-31st Avenue	491-31st Avenue	Wireless
San Francisco Housing Authority	Holly Court	100 Appleton	Wireless
San Francisco Housing Authority	Sunnydale	1654 Sunnydale	Wireless
San Francisco Housing Authority	18th Street/Dorland	3850 18th St.	Wireless
San Francisco Housing Authority	Potrero Hill Annex	911 Missouri	Wireless
San Francisco Housing Authority	Potrero Hill Terrace	1095 Connecticut St.	Wireless
San Francisco Housing Authority	Hayes Valley North & South	401 Rose St.	Wireless
San Francisco Housing Authority	Plaza East	1300 Buchannan St.	Wireless