Millennium Strategies

Broadband Assessment & Feasibility Study

City of Albany

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July 7, 2017

Broadband Team
C\O Mark Dorry
Chief Information Technology Officer
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Mr. Broadband Team,

We respectfully submit the attached report pursuant to the contract between Millennium Strategies and the City of Albany. We would like to thank the Broadband Team for their direction and insight during the course of this Study. It has been a pleasure working with you. Your interest in bringing Albany to into the ranks of communities such as Chattanooga, TN, Lafayette, LA and Bridgeport, Stamford & Norwalk CT where greater than 50% of their populations have access to gigabit broadband services is commendable.

As you will see in the enclosed study document there exists a demonstrable and compelling need for a high-speed broadband network to bridge the digital divide experienced by the residents of the City of Albany. It is estimated that many residents of the City Albany do not have access to high-speed broadband internet and that percentage is likely significantly higher in low income neighborhoods. The study cites research that has been conducted that shows the lack of internet access may exacerbate the urban problems of low educational achievement, unemployment and chronic poverty.

There are several technical platforms identified within, as well as the costs associated with each, upon which a city-wide broadband network could be deployed. These include a fiber-to-the-home (FTTH) network; TV White space network; fiber fed wireless (Wi-Fi) network and a LTE (4G/5G) powered hybrid Wi-Fi network. Also identified are potential resources and models for funding such networks utilizing Federal, State and local government program dollars as well as private partner matching monies to design, build and operate the network. In particular we would direct your attention to the high level of interest expressed by private sector partners in deploying "smart city" applications for parking, public safety, lighting and meter reading as a means to fund a community broadband network. This interest combined with access by the City to public rights of way, particularly if this were to include the street lights within the City, could be the basis for highly effective public/private partnerships.

In short, it is the findings of this study that there exists:

1) A compelling need for and interest in an alternative broadband network,

2) Enabling technologies upon which a network could be deployed,
3) Potential sources of public and private funding with which to fund its construction and operation and
4) Interested public and private partners with the motivation to undertake the task.

However, given the critical importance of community engagement, the practical realities of the costs of building a network, the absence of any broadband policy and the uncertainty of securing public funding it is the recommendation of this study that the city convene a working group comprised of public, private and community stakeholders to evaluate the options presented in the study and determine the set of options that best suits the City's needs. It is further recommended that the working group would undertake to launch a citizen engagement campaign, issuance of request for interest/proposals (RFI/RFP) to identify private partners and the development of final network design and engineering.

Best Regards,

James McGuinness
President
Millennium Strategies

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EXECUTIVE SUMMARY

The market penetration of high speed broadband access to the home is increasing worldwide driven not only by convenience but by absolute necessity. Consumers are looking to keep pace with high bandwidth Internet applications and home entertainment options such as high definition video on demand. What's more, this ongoing transformation to high speed broadband networks is now a matter of strategic national importance, particularly as other countries in Asia and Europe proceed toward wiring up their communities with high-bandwidth fiber. Few people understand this better than civic leaders in many of America's outlying cities and towns, where access to the information highway can mean the difference between a future of robust economic development and one of community decline.

Accordingly, Albany Mayor Kathy Sheehan along with other elected officials have taken it upon themselves to call for the building of high-speed broadband networks – much in the way that they have previously built maritime ports, roads, bridges, parking garages and water/sewer systems – as a means of ensuring that the City of Albany residents have access to necessary services, in this case, Internet connectivity for the 21st Century. As is the case in Albany, municipal deployments are usually undertaken after private service providers have declined to upgrade their networks or build such systems[1]. Municipal broadband networks represent an important aspect of national high-speed broadband deployment, namely, the option and opportunity for local elected officials and civic leaders to upgrade local connectivity - when private enterprise will not take on the job. It is in local as well as national interest that higher-speed networks proliferate quickly and to the greatest extent possible and that special measures be taken to ensure that these networks can be accessed by people who live beyond the major metropolitan areas.

Realizing that high-speed broadband is a powerful economic development tool that supports education, healthcare, government and bridges the digital divide among low income residents of the City, Mayor Sheehan called for a study to determine concept feasibility and to provide the information and recommendations upon which the citizens, businesses and elected officials can reach a consensus on how to proceed in a responsible and prudent manner to provide this essential service in the City of Albany. In doing this the Mayor first assembled a partnership comprised of the Albany Community Development Agency, the Central Avenue and Downtown Business Improvement Districts, and the Capitalize Albany Corporation to underwrite the cost of this study at no cost to the taxpayers. A broadband committee was then empaneled comprised of representatives of city government, The City of Albany School District, the business community, the Albany Housing Authority, University at Albany and the Albany Public Library and various at-large subject matter experts – collectively referred to herein as the Broadband Team. The Broadband Team initially developed an RFP to competitively select a consultant to undertake the study. Millennium Strategies was ultimately selected to conduct the study.

[1] Please see Exhibit 1 of this document which is a letter from Verizon to the City stating unequivocally that Verizon will not be building or delivering FiOS to the City of Albany.

Key Findings

In conducting this study Millennium did extensive research, interviewed related government and industry experts, surveyed the public and reported to and sought input from the City's Broadband Team throughout the study period. Some of the key findings of the study include:

1. It is estimated that as there may be as many as 35% of the City's population that does not have access to high-speed broadband (25 – 100 mbps) and that number is likely higher in low income neighborhoods. This estimate is supported by both statewide and national research studies.
2. Cost and affordability is the major reason why many residents do not have high-speed broadband in their homes. Even with discounts for low income subscribers it is estimated that only 6% of those eligible for discounted bandwidth programs ever access them.
3. The incumbent carrier, Verizon has decided not to offer FIOS, their high-speed broadband service, to the residents of the City despite the Mayor's and other elected officials' request for Verizon's consideration to do so.
4. Significant initial public support exists for the development of an alternative high-speed broadband network in the City.
5. Proven technology platforms exist with which to deliver high-speed broadband to the residents of the City, most notably fiber-to-the-home (FTTH), fixed wireless (Wi-Fi 802.11 spectrum) and the emergent cellular 4G/5G LTE network as well as other wireless and satellite technologies.
6. Several potential funding sources exist at the federal, state and local government levels as well as private monies that could be used to build and operate a high-speed broadband network.

Recommendations

In reviewing the key findings of the study with the Broadband Team several recommendations emerged as a path for the City to pursue in order to realize an alternative high-speed broadband network for the City of Albany. The recommendations include:

1. Create a Broadband Working Group to build key stakeholder and community consensus on the specifics of an alternative high-speed broadband network for the City and make recommendations based on community input.
2. Review city policies to determine ways to make easier or incent private industry to build broadband facilities in the City. These could include policies to make it easier to access City owned rights-of-way, joint street trenching agreements and streamlined permitting in an attempt to lower network construction costs. Particular consideration should be given to providing private sector partners access to street lights in the City as this could prove to be a significant inducement to leverage private sector funding of a community broadband network.
3. Charge the Broadband Working Group with reviewing the business models, technologies and associate costs identified in this study and recommend a specific direction around which to coalesce community support.

4. Issue a Request for Proposals (RFP) or a Request for Interest (RFI) to private sector bandwidth providers to identify a private sector partner with whom the City would enter into negotiations with on the construction, operation and maintenance of a high-speed broadband network.

WHAT IS BROADBAND?

Broadband refers to high-speed Internet access and advanced telecommunications services for homes, commercial establishments, government, schools, and community anchor institutions. In the City of Albany, broadband service is primarily delivered via cable modem, fiber-optic cable, digital subscriber line (DSL), or through mobile wireless (3G/4G LTE). In fact, many service providers use a combination of wireline and wireless technologies to provide hybrid broadband service to their customers.

Different governing authorities have developed inconsistent definitions of what constitutes broadband service based on access speed. In January 2015, the Federal Communications Commission (FCC) voted to define broadband as at least 25 Mbps (megabits per second) download and 3 Mbps upload. Their definition affects policy decisions and the FCC's annual assessment of whether broadband is being deployed to all Americans quickly enough.

In New York State, the New York Broadband Program Office currently defines effective broadband network capacity as 100 Mbps. Broadband providers must make internet speeds of at least 100 Mbps available, with funding priority given to those delivering the highest speeds at the lowest cost. In limited cases, providers may offer 25 Mbps speeds to the most remote unserved and underserved areas of the state.

- **Fiber to the Premise (FTTP)** is the “Gold Standard” in broadband technology. FTTP is the most expensive to deploy, but can deliver consistently high speeds reaching 1 Gigabit (1,000 Mbps) and higher.
- **Cable Modem** uses coaxial cable connection to deliver broadband with download speeds ranging from 6 Megabits (Mbps) to over 50 Mbps. Bandwidth is managed through shared connections. Therefore, although broadband is widely available throughout New York State, advertised speeds may not always be maintained during peak usage times.
- **Digital Subscriber Line (DSL)** uses copper telephone lines to deliver broadband with download speeds generally under 10 Mbps. Aging networks can degrade service over time, which can decrease speeds delivered to the home.
- **Broadband Over Power Lines (BPL)** uses existing electric wiring along with fiber to deliver broadband through electric outlets. Requires special equipment installed at the home. Limited availability in New York State.
- **Fixed Wireless / WiMAX** uses a combination of a fiber backbone and wireless towers to deliver broadband at speeds comparable to DSL. Can be quickly deployed at lower costs with a wide reach. Many plans have data usage caps.
- **Mobile Broadband** is a combination of cellular and data service generally for use on mobile devices. Typically complements wireline connections, but some companies provide home broadband service delivered over mobile broadband networks. Many plans have caps that limit usage but new developments in the technology such as 5G LTE hold promise for higher speeds and different business models.

- **White Space** is a new and emerging technology that uses the empty fragments of TV spectrum scattered between frequencies. Less expensive to deploy in areas without a lot of existing infrastructure, with the ability to travel through physical obstacles, such as trees and mountains, without diminished signal. The FCC requires networks to follow strict requirements not to interfere with existing broadcasts.
- **Satellite** is a two-way transmission of Internet data passed between satellite and a dish placed at the home. Because data traverses long distances, latency delays can occur. Most plans have data caps, but satellite broadband is 100% available in New York State.

1. OVERVIEW

The City of Albany commissioned this study to assess the feasibility of alternative methods for the delivery of high-speed internet access to all residents of the City of Albany. The City has empaneled a "Broadband Team" comprised of concerned individuals who are knowledgeable, subject matter experts. It is their intent and belief that such a network could very likely address the digital divide that exists within the City of Albany (as well as most urban centers throughout the country) whereby up to 35% of households do not have high-speed internet access because of physical network limitations or due to affordability issues. Many of these households consist of low income residents in economically distressed neighborhoods and have children in City schools. The lack of access to high-speed broadband is a limiting factor in the lives of these residents in educational achievement, employment and economic opportunities and their general participation in a civil and just society. The Pew Research Group recently found, two-thirds of Americans believe that "not having a home high-speed internet connection would be a major disadvantage to finding a job, getting health information or accessing other key information."[2]

ABOUT ALBANY

The City of Albany, the New York State capital, is located approximately 140 miles north of New York City on the west bank of the Hudson River. Settled by Europeans in 1624, Albany was first chartered as a city in 1686 and became the permanent State capital in 1797.

Today, Albany is the sixth–largest city in the State, with a population of 97,856. It sits at the crossroads of two major interstate highways in close proximity to rail service and an international airport facility. It is also home to the Port of Albany on the Hudson River, which handled 7.5 million tons of cargo in 2012, making it the 60th-busiest port in the nation.2 In addition to its position as the center of State government; the City has three hospitals and several college and university campuses that provide a stable employment base. However, higher-than average poverty rates in the City drive demand for social services, while the large proportion of tax-exempt property reduces the tax base used to support them.

OPPORTUNITY

It is the finding of this study that there currently exists a unique window in time to support such a development in the City Albany's digital infrastructure. By leveraging a unique confluence of funding sources that already exist or will become available in the near future, the City along with its strategic partners have an opportunity to encourage the development of a City wide, high-speed internet broadband network which is affordable and sustainable. These funding sources include but are not limited to:

- **Smart Schools Bond Act Funding**; The Smart Schools Bond Act was passed in the 2014-15 Enacted NYS Budget and approved by the voters in a statewide referendum held during the 2014 General Election on Tuesday, November 4, 2014. The Smart Schools Bond Act (SSBA) authorized the issuance of $2 billion

[2] FCC 2016 Broadband Progress Report, Adopted January 28, 2016, Released January 29, 2016. This figure is up from 56 percent in 2010

of general obligation bonds to finance improved educational technology and infrastructure to improve learning and opportunity for students throughout the State. The SSBA requires that a Review Board review and approve districts' Smart Schools Investment Plans before any funds may be made available for the program. The City School District of Albany has not allocated any SSBA funds for an Albany Community Broadband Network.

- **Universal Service Administrative Company's E-Rate Program;** The E-Rate program was established by the telecommunications act of 1996 in which the costs to connect to the internet for school districts is subsidized at a rate of between 20% and 90%. The Albany Public Library qualifies for discounts on connectivity services at 90% and qualifies for discounts on equipment costs at 85%. Portions of expanding broadband connectivity within the city may qualify for E-rate discounts.

- **New York State's "New NY Broadband Program";** Governor Cuomo created this $500 million program utilizing funds recaptured from bank settlements to incentivize the expansion of high-speed broadband access in unserved and underserved areas. Specifically, the program calls for applications for funding to provide access to broadband at speeds of at least 100 megabits per second (Mbps) (download) in most places, and 25 Mbps (download) in the most remote Unserved parts of the State, with priority given to applications that will provide broadband to unserved/underserved communities, libraries, and Educational Opportunity Centers. As defined by the U.S. Census Bureau. An Unserved area is defined as an area where broadband service is not available from a wireline or wireless facilities-based provider at advertised speeds equal to or higher than 25 Mbps download. Since no urban areas of the state are considered unserved/underserved, the City of Albany would need a waiver from the ESDC Commissioner to apply for the Program. The Program will achieve its goals through public-private sector partnerships, and will require a private-sector co-investment. The Program will be implemented by 2018.

- **Private Sector Matching Funds**; In interviews with the various private sector stakeholders there was expressed an interest in participating in the Albany Community Broadband project as a potential capex offset for their network builds in the City of Albany. This was most strongly expressed by a national cellular company in return for accessing city rights of way (particularly on City street lights) on which they want to deploy high density small cells for the emerging 5G LTE technology platform. It appears that providing a private equity match to qualify for matching funding from one or more of the public funding sources is a significant inducement to potential private sector partners.

Additionally, this study finds that there currently exists proven, state-of-the-art technology with which to build a high-speed broadband network delivering speeds to meet the FCC's goal of 25Mbps[3] as well as the New York Broadband Program Office's goal of 100Mbps[4] of internet access to the users of such a network. Similar networks have already been deployed in other locations throughout the country. These networks can also be utilized for the so-called "Smart City" applications whereby the network is used to better manage other municipal infrastructure and programs such as street

[3] FCC 2016 Broadband Progress Report, Adopted January 28, 2016, Released January 29, 2016.
[4] New NY Broadband Request for Proposal Guidelines

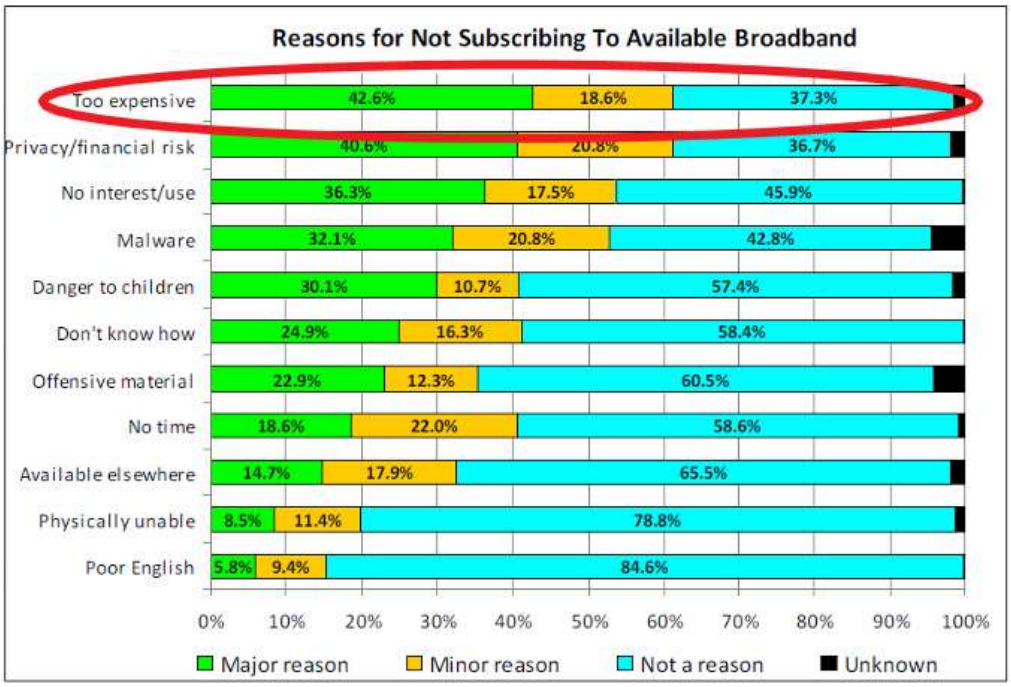
lighting, water metering, traffic control, public safety and many others with the potential for cost savings and better service levels to the tax payer. In the course of the study several different service delivery technology platforms were evaluated including various fiber technologies, satellite, TV white space, mobile broadband, as well as Wi-Fi.

STATEMENT OF NEED

In 2015 the State of New York, under the leadership of Governor Cuomo, committed $500 million in capital to expand high-speed broadband service to unserved or underserved areas of the state[5]. The goal of the program is to ensure that all residents of the State have access to broadband download speeds of at least 100Mbps, or in some limited cases download speeds of 25Mbps[6].

We believe the definition of unserved areas should be broadened to include those areas in which although infrastructure may exist for high speed internet access, the affordability to that access is limited. In other words, although an existing provider may be in a given neighborhood, a large percentage of that neighborhood doesn't have internet access because they cannot afford the monthly recurring costs charged by the existing provider. In other words, in addition to unserved and underserved areas, unserved and underserved "*populations*" should be deemed eligible.

The Center for Technology in Government at the University at Albany surveyed over 3000 New York households and determined that 42.6% of households that do not subscribe to Broadband Services site the affordability of said service as a major reason for abstaining from subscribing. An additional 18.6% of respondents expressed afforadibility as a minor reason, meaning that affordability is a factor for over 60% of New York State residents who do not subscribe to high speed internet service.[7]



The culmination of the aforementioned report concluded with a list of recommendations,

[5] NYS Broadband Mapping Project
[6] New NY Broadband Request for Proposal Guidelines
[7] Broadband Internet Service Adoption and Use in New York State Households. Prepared by the Center for Technology in Government University at Albany-SUNY.

of which the following was listed as the first priority:

"Make broadband more affordable for the lower income households in the state. This can be accomplished by policies to increase competition among providers, ***public provision of service in low income or isolated areas****, subsidies for low income households or for providers serving those areas."*[8]

A more recent national study of low and moderate income parents of children ages 6 to 13 supported the Center's findings and concluded that:

> *Our study makes clear that the primary obstacle preventing greater equity in access and digital participation—at least among families with school aged children—is financial. Most surveyed families who do not have computers or home interent access are not holding back because of a lack of confidence or interest in what the internet or new tech tools can offer.* ***For most, cost is the primary reason*** *(emphsis added). Interrupted service is also a cost-related as is having to share devices between too many people to have enough time with them. And currently, only a small proportion of families are benifiting from discounted internet services designed to get low-income families whith school-age children on line.*[9]

Some have suggested that this digitial inequity can be solved by the discounted internet service offerings of the national MSO's (Multi System Operators i.e. Cable TV Companies) and ILECs (Incumbent Local Exchange Carriers i.e. Telephone Companies). However it is questionable if discounted internet service plans are in fact having the intended consequence. It is estimated that only 6% of low income families nation-wide actually ever use these discounted programs.[10] Leaving the majority of those who cannot afford internet access without any solution for inclusion in the digital world.

It is clear that urban centers such as the City of Albany, are in a precarious situation with regards to broadband access within the community due to the lack of afforadbility. Which in turn contributes to a downward spiral of a lack of subscriptions to broadband service preventing cost-justifiable upgrade investments by the incumbents. This resulting lack of 8investment by the private sector forbodes a future with internet access speeds not improving over the next several years in our urben centers. In addition there is an glaring inequity between students who may have sufficient home access to internet resources compared to those students that have no access to the internet.

In the Spring, we included questions in the annual survey that the Albany Public Library released. There were 930 total respondants to the online release of this survey. Some of the salient points of this survey include:

- 13.3% of respondents stated that they do not have access to high speed broadband from their home[11].
- 10.3% of respondents stated theat they were not sure if they had access to high speed internet access from their home.

[8] Ibid

[9] Rideout, V.J. & Katz, V.S. (2016) Opportunity for all? Technology and learning in lower-income families. A report of the Families and Media Project. New York: The Joan Ganz Cooney Center at Sesame Workshop

[10] Ibid

[11] It should be noted that because this particular set of survey data is from the online survey, it is Millenniums contention that a disproportionate number of respondents have access to the internet from their home and therefore we believe that the actual percentage of households that lack internet access from their residence is much higher.

- Upwards of 23% of repsondents may not have access to high speed internet access at home.
- 70% of the respondents who stated they did not have internet access at home stated the reason for this lack of access was the AFFORABILITY of internet access.
- Nearly 10% of all respondents stated that their primary source for accessing the internet was through their mobile devices such as cell phone or tablet.

2. APPROACH

In the course of conducting the study, stakeholder groups of interest were interviewed to determine what network and related assets might exist, what potential public and private sector partners might have interest, what technologies might be used, what funding sources might be applicable and what business models would be most efficient and cost effective. Stakeholder interviews were conducted with:

Public Stakeholders:

- City School District of Albany
- City of Albany Mayor's Office
- Albany Public Library
- Albany Housing Authority
- NYS Broadband Program Office

Private Sector Stakeholders:

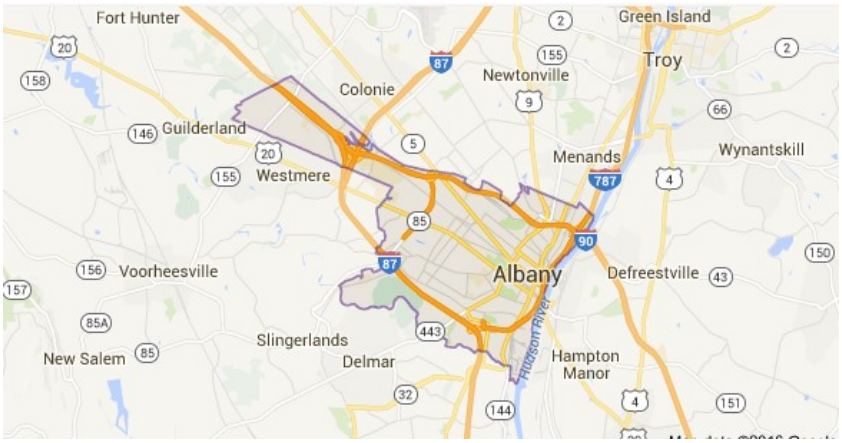
- American Tower
- CCI Systems
- Cisco
- FirstLight Fiber
- LightTower (acquired FiberTech)
- Time Warner Cable
- Verizon Enterprise Solutions
- WildFire 5G
- Windstream
- Carlson Wireless

Albany's Chief of Information Technology Services and/or The Albany Broadband Team representatives were present at the meetings or were briefed on the content following the meetings to provide feedback and practical perspective on the input from each stakeholder. Most meetings were held at City Hall with only a limited number of meetings held elsewhere or telephonically. In general, there was a high degree of interest in the Feasibility Study by the various stakeholders and in actively participating in the planning, constructing, operating and funding the initiative. There was no stated opposition to the concept of a community broadband initiative voiced by any of the stakeholders interviewed and in general all meetings were constructive and cooperative.

3. DEMOGRAPHICS

General

The City of Albany is the seat of New York State government, as well as being a regional medical center and the location of several universities and colleges. Due in large measure to State owned properties, nearly 60 percent of the City's full value is tax exempt, the sixth-highest proportion among New York cities. Between 1950 and 2000, Albany's population fell by 29 percent, from nearly 135,000 to 95,658. Between 2000 and 2010, the population grew by 2.3 percent. Albany's 2013 unemployment rate of 7.2 percent is slightly lower than the statewide rate of 7.7 percent. Albany's child poverty rate is 34.2 percent—higher than both the median for all cities (28.4 percent) and the statewide rate (21.0 percent). The closure of the City's landfill, expected in six or seven years, will result in a drop in general fund revenues and significant post closure costs.



Population and Economic Factors

The City's population increased from 94,151 to nearly 135,000 during the first half of the twentieth century before falling back to 95,658 by 2000. Between 2000 and 2010, the population grew by 2.3 percent, to 97,856. In 2013, Albany's unemployment rate was 7.2 percent, compared to a statewide rate of 7.7 percent. Albany is wealthier than most other New York cities when measured by household income. Albany's median household income in 2012 was $40,145, higher than the median for all cities of $38,913, although lower than the $57,683 statewide median.4 However, the City also has relatively high levels of poverty. Approximately one in three children in Albany lived in poverty in 2012 (34.2 percent), compared to a city median of 28.4 percent and a statewide rate of 21.0 percent.

Poverty Levels

Residents with income below the poverty level:
Albany: 21.7%
Whole state: 14.6%

Residents with income below 50% of the poverty level:
Albany: 11.3%
Whole state: 7.4%

Poverty rate among disabled males:
Albany: 25.7%
New York: 18.1%

Disability rate in this city among poor males (it is 19.5% among residents who are not classified as poor):
Albany: 28.2%
New York: 18.1%

Poverty rate among disabled females:
Albany: 28.2%
New York: 23.0%

Disability rate in this city among poor females (it is 22.1% among residents who are not classified as poor):
Albany: 30.2%
New York: 23.0%

Renting rate in this city among poor and not poor residents:
Residents below poverty level: 91.6%
Residents above poverty level: 54.9%

Children below poverty level:
Albany, New York: 24.8%
State: 22.5%

Poverty rate among high school graduates not in families:
Albany: 27.1%
New York: 18.3%

Poverty rate among people who did not graduate high school not in families:
Albany: 41.5%
New York: 44.0

4. BACKGROUND

The City of Albany has multiple public anchor institutions that can be leveraged to expand broadband service within and to the community. The anchor institutions we reviewed include:

- City Libraries
- City Police and Fire Stations
- School District

City Libraries:

There are a total of 7 Libraries located throughout the city. These libraries include: the Arbor Hill/West Hill Branch, Bach Branch, Delaware Branch, Howe Branch, North Albany Branch, Pine Hills Branch and the Washington Avenue Branch. The main branch of the Library has a 70mbps internet connection and the branches are connected to the main library via a 30Mbps WAN link[12] through a contract with FirstLight at $5,000 per month for a total of $60,000 annually (for which they do not get E-rate reimbursement). This backbone is not robust enough to utilize for the delivery of the broadband services. However, the libraries could benefit from the implementation of the Albany Wi-Fi Network initiative by utilizing the City/Library Wide network for network service. This could reduce annual connectivity fees after E-rate subsidies by as much as $10,000.

City Facilities:

The City of Albany operates multiple facilities including police stations, fire stations, and other city facilities. In reviewing the geographical locations of these sites and the existing networks to interconnect these facilities, we noted the following:

1. There is a partial geographical overlap of City facilities and School District facilities that do not necessarily garner better reach or distribution of community broadband by utilizing school facilities.
2. The city has multiple police cars with Verizon air cards for connectivity to data resources. If connectivity to police vehicles were shifted to the proposed Albany Wi-Fi Network the police department could realize a cost savings of nearly $10,000 per year through the attrition of just 25 air cards at $40 per month. Of course the network would need to be reliable and accessible City wide in order to justify any transition from existing resources to new resources.

School District:

The school district has a robust Wide Area Network connecting each remote school and/or facility back to the district headend over a 10Gbps fiber ring. This service is provided by leased dedicated fiber circuits from Windstream Communications on fiber leased from LightTower. If these anchor institutions could be utilized, the Albany Wi-Fi Network could extend the services available within the school campus to the community as a whole. However, the district had some reservations and concerns regarding network security and E-rate funding, so we opted to build and utilize a separate network for the backhaul.

[12] Scheduled to be upgraded to 50mbps in the Fall of 2016

E-Rate: The Wide Area Network of the school district is funded through the Federal E-rate program and subsidized at 90%. The Library could also fund their Wide Area Network through the E-rate program. Any use of the WAN as the backhaul will need to be reviewed with the Schools and Libraries Division (SLD) of the Universal Service Administrative Corporation (USAC) to determine how much, if any, of the leased service would need to be cost allocated.

In the sixth report and order, the FCC authorized schools to allow for community access of network resources during hours in which schools are not in session. Therefore, the argument we will make is that community access should be allowed regardless of the end-user's geographic location within the city. Making use of the WAN from 3:30 PM to 7:30 AM should subsequently not have to be discounted. The only portion of the WAN circuit that would have to be cost-allocated would be that portion of the WAN circuit utilized during school hours. School hours also do not occur during the weekends, summer breaks, holidays, etc., yet the circuits are available regardless of whether or not school is in session. The State of NY requires that there be 180 school days in a given year, and as such the total cost allocation should include this factor in the equation and multiply the result by 180 school days divided by 365 calendar days. In addition, the community access, will not utilize the full WAN circuit, but rather a fraction of the 10GBps circuit. Utilizing the formula above, with a circuit cost of $1,400 per month and assuming 2GBps bandwidth utilization per circuit, the worst case scenario for cost allocation would be $45.57 per month per circuit. However, our goal is to convince the SLD and the FCC that no cost allocation would be deemed necessary.[13]

$$\left\{\left(A * \left(\frac{X}{Y} * Z\right)\right) * \frac{180}{365}\right\} = Cost\ Allocation\ by\ Circuit$$

A = Cost of Single Circuit
X = Total School Hours per Day
Y = Total hours of the Day
Z = Percentage of 10GBps utilized by Community

NETWORK PRIORITIZATION: Although the library is eager to expand services within the community, it cannot come at the expense of ensuring adequate access to the library population. In other words, measures and technologies need to be implemented to guarantee quality of service, bandwidth allocation priorities, security and ensure Erate guidelines are met.

NETWORK ACCESS: The WAN circuits would need to be terminated in equipment that reside within building's Main Distribution Frame (MDF.) The extension of Fiber from these locations to the surrounding neighborhoods near each facility would also need connectivity to the building core switch. Although the first phase of implementation will be a "Best effort" implementation in which the SLA to end users will be met as soon as possible, subsequent phases will require quality response times. These quality response times may necessitate off hour access to city and library facilities, specifically data closets, as well as access to some network electronics. One design consideration would be to have outdoor cabinets mounted to the exterior of the school facilities for the distribution of fiber and electronics so that maintenance and support would not be hindered by lack of access to school buildings.

[13] Our goal is to convince the SLD that the same allocation that has been approved in the past for School Systems should be allowed and set as the standard for Library Systems. One of the projects that both Millennium Strategies and the Albany Consulting Group is currently engaged in is to lobby the SLD on this point as well as other issues such as subsidizing other costs for community access.

5. TECHNOLOGY PLATFORMS & ASSETS

During the course of the study several internet access delivery platforms were evaluated for high speed broadband networks, which are explained below, to meet the Broadband Team's goals. In addition the existing network assets connecting anchor institutions in the City were identified and are also outlined in this section.

Fixed Satellite Broadband

This delivery platform is not an ideal solution because of the limiting factor of not being able to provide the minimum speeds of between 25 Mbps to 100 Mbps. The FCC recently reported that their "Form 477 data show that no fixed satellite broadband service reaches the 25 Mbps/3 Mbps speed benchmark as of the reporting period" and cannot therefore be considered an advanced telecommunications service.

Mobile (Cellular) Broadband

Next generation 4G and the inevitable migration to 5G LTE presents significant opportunities to use the LTE network as a means to provide high-speed community broadband services particularly when coupled with other "smart city" application as has been done in New York City, Boston and Kansas City. While mobile phone use seems to have reached near ubiquity in adoption levels even among low income users, there are currently several limiting factors in its use as substitution for a fixed internet connection.

The Pew Research Group found that the size of cell phones and other mobile devices "limits the computational abilities of mobile devices and makes their interfaces smaller, especially screens. It follows that data-intensive activities such as telecommuting or the highest-quality multimedia experiences are generally inappropriate for mobile devices."[14]

The FCC stated the limitation of mobile broadband access succinctly in their recently released 2016 Broadband Progress Report:

> *Access to broadband has become essential for students in all levels of education. Fixed broadband access, combined with cutting edge educational tools and content, are transforming the educational landscape in America. Mobile broadband access does not currently provide the speeds or capacity that schools and libraries need. Particularly given ongoing disparities in broadband deployment and adoption, it is critical that our Nation's students have access to high-speed broadband to effectively participate in the digital world.*

Pew Research Group also found that when compared with other smartphone owners, "smartphone-dependent consumers"[15] are less likely to own a computer or tablet, less likely to have a bank account or health insurance, and less likely to own their current residence.[16] That report also found that although some 13 percent of Americans with a household income of less than $30,000 per year are smartphone dependent, only one percent of Americans with an annual income of $75,000 or more rely solely on mobile broadband.[17] These data suggest that the decision to rely exclusively on mobile broadband service is frequently driven by financial necessity, rather than the view that

[14] As reflected in our benchmarks, schools and libraries have large capacity needs and almost exclusively receive service over fixed broadband. We therefore do not consider mobile broadband access or deployment as part of our evaluation at this time.
[15] Pew Smartphones April 2015 Report at 3-4.
[16] Pew Smartphones April 2015 at 18.
[17] *Id.* At 17.

fixed and mobile broadband are adequate substitutes for one another.[18]

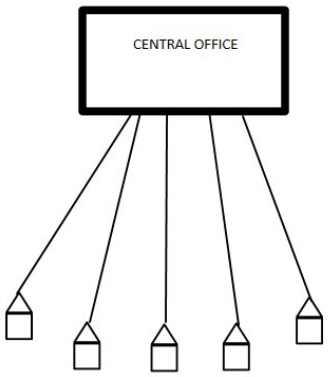
However, there are very promising new developments in the mobility/cellular field with the advent of 5G LTE which promises deeper coverage with much higher bandwidth (100 Mbps+) and quality of service (QoS). This coupled with the industry's interest in so called smart city applications may provide an opportunity to leverage the private sector to assist in building out a community broadband network. One of the national mobility companies explained the benefits of smart city applications in the follow way:

> *All of this happens through six important community elements:*
>
> *1) Gaining insight from sensors, autonomous and connected vehicles and other sources throughout the city.*
> *2) Moving that real-time awareness seamlessly through state-of-the-art cellular, fiber optic, Wi-Fi or mesh networks.*
> *3) Integrating and presenting city status as services through a scalable, highly available software platform.*
> *4) Fostering further understanding through new applications and analytics.*
> *5) Relaying back status or other content to citizens and city officials.*
> *6) Establishing formal offices/programs/labs to drive innovation, economic development and community engagement based on this transformative environment.*

Since the development of 5G LTE requires the deployment of densely populated small cells in an area and each or most of which require fiber and all require individual power feeds the City's street light network would be an ideal location upon which to mount small cells. I the City were to provide the mobility companies access to the street light network in the City it could be a significant inducement for the private mobility companies to participate in a community broadband network.

Fiber to the Home (FTTH): There are three primary types of architecture for Fiber to the Home Deployments. The first is referred to as Home Run Fiber, the second is Active Star and the last is Passive Star.

- **Home Run Fiber:** Home Run Fiber is exactly how it sounds. Every house would have dedicated fiber strands from a central office to the end user. The benefit of such architecture is that the end-user's bandwidth is only limited by the network electronics on either end. The second benefit is that there is no need to power any equipment on the poles. However, there is a major drawback, in that such a design is extremely expensive.



- **Active Star:** This type of architecture places a node in between the central office and the end user. There is a feeder fiber from the central office to the node and a switch at the node to light up the distributed fiber to the homes. In our scenario the node could be each of the schools. The benefit of this type of architecture is it reduces the amount of fiber required for a

[18] *Id.* At 18.

FTTH deployment. The drawback is each node would require power. A single node typically serves up to 1000 customers.

- **Passive Star:** This architecture is also know as a Passive Optical Network (PON) and utillizes optical splitters at the pole in between the fiber feed and multiple homes. This design reduces costs by minimizing fiber run's and the need for active equipment on the pole.

The ideal FTTH architecture for the city Albany would be a combination of both the Active and Passive Star solutions in which anchor institutions within the neighboorhoods would act as the node in the Active Star and from this node we would utilize a PON to distribute services to the homes. However, this deployment in and by itself is not economically feasible.

In 2010, Google started deploying "Fiberhoods" in Kansas City. The cost to have a fiber pass a home is estimated at $616 per home. The cost to connect a home is $250 per home for a total cost of $868. The service fee is $36 per month. In the western part of the state , a company by the name of GreenLight is also building fiber to the homes in specific Fiberhoods. Although we do not know the exact costs for the GreenLight buildouts, we know that the charge is a onetime non-recurring fee of $100 and a monthly recurring fee of $50 per month. Both companies utilize a pre-subscription model in which the fiberhood is not built until a certain level of committed subscriptions are made by future customers. The cost to deploy fiber to the home for all households is estimated at $44,414,796. It should be noted however, that these costs assume the typical design of creating a separate backhaul to a central office. The $30,506,196 allocated as the Cost to Pass could be drastically reduced if a provider was willing to utilize the City's WAN.

Provider	Cost to Pass	Cost to Connect	Total Cost
Google	$616.00	$250.00	$866.00
Greenlight	700.00	350.00	1,050.00
Avg	658.00	300.00	958.00
Households	46,362		
Households		46,362	
Estimate for Albany	$30,506,196	$13,908,600	**$44,414,796**

Fiber Fed Fixed Wireless: WiFi is ubiquitous. Utilizing the same models described earlier, the city could deploy wireless and utilize the City/Library Wide area Network as the backhaul. Hardened outdoor WAPs would be strategically placed within the neighboorhood of the nearest anchor institution fed by fiber and powered at the end via a coaxial power supply. The benefit of this deployment is that part of the Active and Passive Fiber network would be built so that if another service provider desires to utilize this network it would minimize the costs to connect each house and would require a significantly less commitment for subscriptions. The figure to the right depicts the neighborhood around the Delaware Library Branch. Each blue circle denotes a

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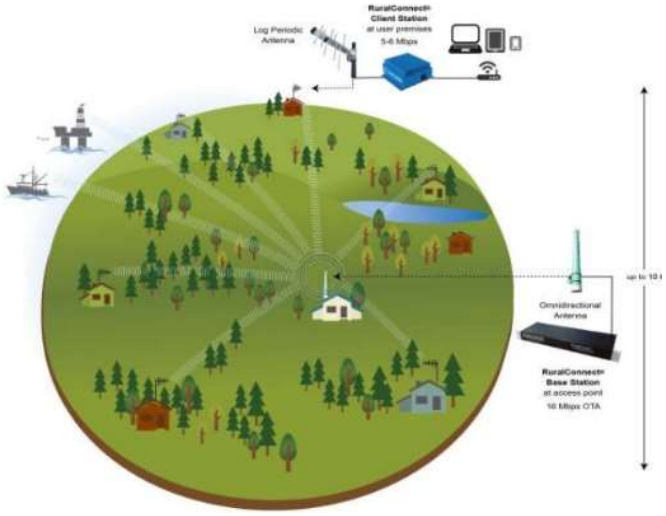
WAP that has a coverage radius of 250 feet. Each WAP would serve between 10 and 20 households connected back to the network at 1Gbps. Throughput could meet the New New York Broadband goal of 100Mbps and would exceed the FCC goal of 25Mbps.

TV "White Space" Wireless:

TV "White Space" utilizes the available unlicensed wireless spectrum of between 470 MHz to 790 MHz This spectrum was made available in 2010 by the FCC and is currently underutilized. The technology enables a single radio to broadcast nearly a 100 times further than a traditional Wireless Access Point. This spectrum was part of the old broadcast television network that functioned for years and its greatest benefit is that the higher frequency enables extremely reliable penetration around and through both natural and manmade terrain.

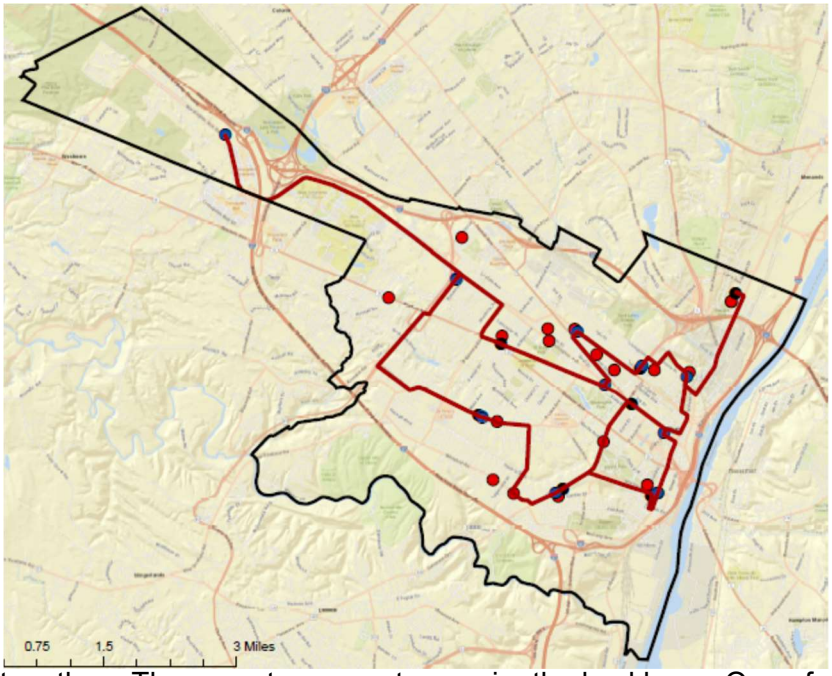


Solutions utilizing TV "White Space" would require 1 to 2 base stations at the anchor[19] institution which would be connected to the City/Library WAN and broadcast up to 384Mbps per base station. In order to receive the broadcast, each housing unit would require a terminal which would translate the TV "White Space" to 802.11 n or ac so that end user devices within the housing unit could access the internet resources. Preliminary pricing estimates that the 16 Zone anchor institutions would require an estimated 2 base stations for a cost per anchor institution of $12,500 to $15,000. Each Housing unit would require a terminal at $100 per unit for a cost of $4,632,000. Total cost of housing unit terminals and base stations for a fully deployed solution is estimated at $4,872,000. The solution is viable in that it would enable connectivity, but that connectivity back to the city backhaul might be as low as 1.5mbps. In addition, with the high density of housing units within the City of Albany, a full deployment may only be able to connect between 6,000 and 8,000 housing units based on the fact that the generation of equipment under development is capped at 250 users per base station. This would mean that this solution may only give access to less than 20% of the households in the City of Albany and may not allow for adequate bandwidth or access to the internet.

[19] Graphic utilized from Carlson Wireless presentation.

CITY'S FIBER BACKBONE:

During the investigative process we reviewed the facilities and connectivity of the anchor institutions. The goal was to utilize the robust Wide Area Network that the school district has as the backhaul and backbone of the proposed network. The district had reservations and concerns related to network security and E-rate funding, and therefore the approach was changed to assess how and what would be needed to utilize just library and city owned facilities as the backhaul to the internet. By mapping the libraries, police stations and fire houses it was clear that connecting these sites together would offer an improved geographical presence and would not require access to the school districts WAN (See Drawing WB-003.) The first step will be to build a dark fiber network consisting of 3 major rings connecting each of the libraries, police, fire and city hall together. There are two ways to acquire the backbone. One of those ways is to issue an RFP for a Dark Fiber Build and the other way is to issue an RFP for 10Gbps service on fiber infrastructure that already exists from incumbent providers. The estimated cost for this portion of the project is estimated at $791,520. However, a large portion of this project is eligible for E-rate subsidies and may cost as little as $100,000. The positive externality of building this WAN and obtaining subsidies through the Erate program is that the City may realize a reduction in operating costs by eliminating any connectivity expenses that are contracted for and paid to outside providers.



The dark fiber rings should be capable of multiple 10Gbps connections with diverse routes to ensure reliability, resiliency and optimum scalability

6. FUNDING

It is recommended that funding for capital expenditures to build the network are requested from the New NY Broadband Grant Program. In addition, some of the equipment is eligible for E-rate discounts, but that is not included because the district has already determined how it will allocate its allotment of $150 per student of E-Rate subsidies on eligible network equipment. However, we will be making an argument to the Schools and Libraries Division that some of the operational costs should be made eligible for community access.

. **New NY Broadband Grant**

The New NY Broadband grant requires a match for funding eligibility. The program was designed to help subsidize capital expenditures for private companies to upgrade their systems to meet the bandwidth demands of the future. However, the program was not designed to completely pay for private institutions to upgrade their networks and as such requires a match from applicants. The goal of the match is 50% but not less than 20% with some projects being funded at a higher rate and some being funded at a lower rate.

In addition, other items can be calculated into the match because they are contributing factors and the foundation for connectivity. These items are already installed and paid for on an ongoing basis by the library system but are utilized for connectivity and as such should be counted towards the match. In other words, although the implementation of the broadband solution requires these services, and these services are being provided to the program at no additional cost, then these services should be monetized and included in the States interpretation for match.

The first item to monetize is the connectivity to the internet. Although we are suggesting that we add an additional internet circuit to the design, the existing internet circuit will also be utilized and therefore should be monetized. At $30,000 per year for 6 years, them monetization of the internet circuit is estimated at $180,000

7. Capital Expenditures

There are a total of Three Options to consider for the deployment of a City Wide Network. The first option is a Fiber to the Home (FTTH) network where all housing units are connected to a providers Point-of-Presence and which does not utilize newly constructed or an existing backbone. The total cost for this solution is estimated at $44,414,796. The private partner could realize their Return on Investment (ROI) if 20% of the households within the City sign up for unrestricted 100Mbps internet service at $48.50 per month within 8 years and 3 months. Although this is the optimal solution for the City, it may not be viable for a provider to blanket the area with such a long ROI, and as such would require offsets or funding from the New NY Broadband Program or other public programs.

Albany FTTH All households - NEW PROVIDER BACKBONE

ROI with Subscription Offset

Option 1

	Total Capital Expenditure				
	Units		**Unit Cost**		**Total**
Fiber to the Home (Cost to Pass)	46,362	$	658.00	**$**	**30,506,196**
Fiber to the Home (Cost to Connect)	46,362	$	300.00	**$**	**13,908,600**
Total Cost		$	958	**$**	**44,414,796**
	Funding Sources				
Provider Capital Contribution				$	44,414,796
SmartBond Funding				$	-
New NY Broadband Grant				$	-
Provider Match Percentage					**100.00%**
	ROI for Provider assuming $48.50/month Rate				
Subscription Revenue for Free Service (5Mbps)	$ -	$	-	$	-
20% of Housholds that may subscribe	$ 9,272	$	582	$	5,396,537
ROI in years for Provider after Capital Contribution					**8.23**

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The second option is also a Fiber to the Home (FTTH) network where all the housing units within the city are connected to a provider's Point-of-Presence but that the major variant is that the provider would utilize the newly built Wide Area Network as the Backhaul and the distribution point for all connecting fiber. This approach would drastically reduce the "Cost to Pass" to an estimated $2 million. The total Option is estimated at $15,908,600. The private partner could realize their return on investment if 20% of the households within the City sign up for unrestricted 100Mbps internet service at $48.50 per month within 3 years.

Option 2

Albany FTTH All households - USE BFS BACKBONE

ROI with Subscription Offset

	Total Capital Expenditure		
	Units	**Unit Cost**	**Total**
Fiber to the Home (Cost to Pass)			**$ 2,000,000**
Fiber to the Home (Cost to Connect)	46,362	$ 300.00	**$ 13,908,600**
Total Cost		$ 300	**$ 15,908,600**
	Funding Sources		
Provider Capital Contribution			$ 15,908,600
SmartBond Funding			$ -
New NY Broadband Grant			$ -
Provider Match Percentage			**100.00%**
	ROI for Provider assuming $48.50/month Rate		
Subscription Revenue for Free Service (5Mbps)	$ -	$ -	$ -
20% of Housholds that may subscribe	$ 9,272	$ 582	$ 5,396,537
ROI in years for Provider after Capital Contribution			**2.95**

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The third and final option is a fiber fed wireless network in which Wireless Access Points (WAPs) would ubiquitously blanket the city at a 250 foot radius per WAP all fed via fiber back to the nearest school. The total Option is estimated at $9,240,998. The private partner could realize their return on investment if 10% of the households served sign up for unrestricted 100Mbps internet service that the provider would offer over a private fiber connection to the household at $48.50 per month in less than four years.

Option 3

Albany WiFi - USE NEW BACKBONE (See Attachment 1)

ROI with Subscription Offset

			Total Capital Expenditure	
				Total
Equipment			**$**	**4,620,499**
Fiber and Coaxial Extensions			**$**	**4,158,449**
Procurement Design and PM			**$**	**462,050**
	Total Cost	$ -	**$**	**9,240,998**
			Funding Sources	
Provider Capital Contribution			$	9,240,998
SmartBond Funding			$	-
New NY Broadband Grant			$	-
Provider Match Percentage				**100.00%**

					ROI for Provider assuming $48.5/month Rate
Subscription Revenue for Free Service (5Mbps)	$	-	$	-	$ -
10% of Housholds that may subscribe		4,636	$	582	$ 2,698,268
Cost to Connect	$	4,636	$	300	$ 1,390,860

ROI in years for Provider after Capital Contribution [1] **3.94**

[1] Calculated by Adding the Cost to Connect to the Provider Contribution and Dividing by Revenue

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8. EXPENSES AND REVENUE

EXPENSES:

There are multiple costs that will enable the operations of a City Wide Broadband initiative to be sustainable. These outlays include but are not limited to the following:

- **Internet Service** – The library does not have a significant connection to the internet at its core, this connection will not be sufficient to handle all of the potential users connected to the network. Therefore, additional internet service should be contracted for to augment and supplement this service. It should be noted that we believe the internet access would have to grow to at least a10Gbps subscription. It is our goal to have the E-rate program actually subsidize any increase in internet subscriptions so that although the cost would go up it could be offset by qualifying that service for E-rate subsidies.
- **Equipment Maintenance** – The RFP's that would be issued and the subsequent contracts that would be negotiated with vendor partners will include upgrades to the hardware for 5 year maintenance. However, it is prudent to budget for equipment replacement and allocate funds for future replacement so that the system will be functional long beyond the initial 5 years.
- **Fiber Maintenance** – For the most part, maintenance on the fiber infrastructure would be minimal. However, there will be fiber cuts, pole breaks, splicing issues, etc. that need to be accounted for and budgeted.
- **Power Consumption** – Although the WAPs will be powered via low voltage copper, the WAPs will consume significant electricity. The utility bill for each anchor institution within each zone will increase once all 1200.
- **Annual Pole Rental** – Assuming a cost per foot rental agreement of $7 per pole and an estimated 3,300 poles, the annual pole cost is estimated.
- **End User Support** –Neither the Library or the City have the personnel to address and handle any end user issues that are apt to arise. Although service will be best effort, end users will have questions, technical issues and connectivity concerns that will need to be addressed. Therefore, we need to budget for the annual cost to support the end users.
- **E-rate Cost Allocation** – As was mentioned previously, the E-rate program allows for community access to district resources during off school hours. Utilizing our proprietary allocation equation, we anticipate this annual cost to the Library for the utilization of the existing internet at $5,292 per year.

REVENUE:

There are multiple revenue streams that can be tapped once the city wide network is built. The goal of the program is to offer broadband services to the City as a whole, and to ensure that the operations of such an offering is sustainable. The true goal is not to make revenue, but to offset any costs so that the long term operations of the system will have an annual net cost to the district and the City of $0.00.

Therefore, when the RFP's are issued, they will include and look for potential vendor partners who will maintain the network and all operating costs and offset any charges with the potential revenue streams. These revenue stream include, but are limited to the following:

- **Advertising** – The network will be free for all constituents of the City. The advertisement may be a 30 second commercial per every 24 hour log in. We estimated conservatively that this would generate $60,000 in the first year and grow as high as $250,000 per year after. It would be the vendor partners job to find the advertisements and place them per login at the discretion and guidance of the City and District. Any revenues that they receive would be utilized to offset operational costs.
- **Cellular Offload** – Cellular phone companies are having a difficult time keeping up with the demand of data and the burden that such demand is having on their 4g cellular networks. Therefore, they have developed technology that automatically routes data traffic onto available WiFi networks when such networks are available. By enabling our vendor partner to open up the City Wide Wireless network for this cellular offload, they could generate additional revenue streams to offset their cost to operate the network. Assuming that 10% of cellular users would offload 1Gb of data per month, we conservatively estimated that the cellular offload could generate $60,000 per year from the cellular service companies to the vendor partner.
- **Data Analytics** – This free service for end users, other than students, will contain a wealth of data that data miners will pay for. It is the same model as Facebook in which a large revenue stream is mining the data for spending habits, interests, etc. We estimate that conservatively this data could be worth at least $24,000 per year that the vendor partner could auction to other interested parties to help offset annual operating costs. Because data will start to accumulate until many users are connected to the network, we do not show this potential revenue stream until the second year of operations.
- **Subscriptions** – Some residents may opt to pay for a subscription which would not contain advertisements and would bypass the district internet filter. Conservatively we estimate that multiple users may opt to pay $10 per month low bandwidth connectivity that is not filtered nor exposed to Advertisements.

9. SUSTAINABILITY BUDGETS – BALANCED AND PROJECTED SO THAT REVENUE WILL EXCEED EXPENSES

City of Albany Community FTTH

Total Operating Costs (CONSERVATIVE)

Description	Jan 2018 - Dec 2018	Jan 2019 - Dec 2019	Jan 2020 - Dec 2020	Jan 2021 - Dec 2021	Jan 2022 - Dec 2022	Jan 2023 - Dec 2023	6 Year Total
5Gbps Internet Service	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 144,000
Core Equip Maintenance	$ -	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 625,000
Fiber Maintenance (Break/Fix)	$ 25,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 525,000
End User Support	$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 480,000
Erate Cost Allocation	$ 5,292	$ 5,292	$ 5,292	$ 5,292	$ 5,292	$ 5,292	$ 31,753
Total Operating Costs	**$ 134,292**	**$ 334,292**	**$ 334,292**	**$ 334,292**	**$ 334,292**	**$ 334,292**	**$ 1,805,753**
Cost Avoidance							$ -
Library Connectivity	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 60,000
City Connectivity	$ 31,200	$ 31,200	$ 31,200	$ 31,200	$ 31,200	$ 31,200	$ 187,200
Police Aircards	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 60,000
Fire Station Connectivity	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Avoidance	**$ 51,200**	**$ 51,200**	**$ 51,200**	**$ 51,200**	**$ 51,200**	**$ 51,200**	$ 307,200
Total Operating Cost after Cost Avoidance	**$ 83,092**	**$ 283,092**	**$ 283,092**	**$ 283,092**	**$ 283,092**	**$ 283,092**	**$ 1,498,553**

City of Albany Community FTTH

Revenue

Description	Jan 2018 - Dec 2018	Jan 2019 - Dec 2019	Jan 2020 - Dec 2020	Jan 2021 - Dec 2021	Jan 2022 - Dec 2022	Jan 2023 - Dec 2023	6 Year Total
Advertising	$ 30,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 330,000
Cellular Offload	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Data Analytics (All but Students)	$ -	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 120,000
WAN Service to Schools		$ 108,000	$ 108,000	$ 108,000	$ 108,000	$ 108,000	$ 540,000
Subscriptions (No Filter & No Ads)	$ -	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 600,000
Total Potential Revenue	**$ 30,000**	**$ 312,000**	**$ 312,000**	**$ 312,000**	**$ 312,000**	**$ 312,000**	**$ 1,590,000**
Total Revenue minus Costs	**$ (53,092)**	**$ 28,908**	**$ 28,908**	**$ 28,908**	**$ 28,908**	**$ 28,908**	**$ 91,447**

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City of Albany Community WiFi

Total Operating Costs

Description	Jan 2018 - Dec 2018	Jan 2019 - Dec 2019	Jan 2020 - Dec 2020	Jan 2021 - Dec 2021	Jan 2022 - Dec 2022	Jan 2023 - Dec 2023	6 Year Total
1Gbps Internet Service (Grow each Year)	$ 24,000	$ 48,000	$ 72,000	$ 96,000	$ 96,000	$ 96,000	$ 432,000
Equipment Replacement	$ -	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 625,000
Fiber Maintenance (Break/Fix)	$ 25,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 525,000
WAP Power Cost	$ 16,320	$ 16,320	$ 16,320	$ 16,320	$ 16,320	$ 16,320	$ 97,920
End User Support	$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 80,000	$ 480,000
Erate Cost Allocation	$ 5,292	$ 5,292	$ 5,292	$ 5,292	$ 5,292	$ 5,292	$ 31,753
Total Operating Costs	**$ 150,612**	**$ 374,612**	**$ 398,612**	**$ 422,612**	**$ 422,612**	**$ 422,612**	**$ 2,191,673**
Cost Avoidance							$ -
Library Connectivity	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 60,000
City Connectivity	$ 31,200	$ 31,200	$ 31,200	$ 31,200	$ 31,200	$ 31,200	$ 187,200
Police Aircards	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 60,000
Fire Station Connectivity	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Cost Avoidance	**$ 51,200**	**$ 51,200**	**$ 51,200**	**$ 51,200**	**$ 51,200**	**$ 51,200**	$ 307,200
Total Operating Cost after Cost Avoidance	**$ 99,412**	**$ 323,412**	**$ 347,412**	**$ 371,412**	**$ 371,412**	**$ 371,412**	**$ 1,884,473**

City of Albany Community WiFi

Revenue

Description	Jan 2018 - Dec 2018	Jan 2019 - Dec 2019	Jan 2020 - Dec 2020	Jan 2021 - Dec 2021	Jan 2022 - Dec 2022	Jan 2023 - Dec 2023	6 Year Total
Advertising	$ 30,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 330,000
Cellular Offload	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 360,000
Data Analytics (All but Students)	$ -	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 120,000
WAN Service to Schools	$ -	$ 108,000	$ 108,000	$ 108,000	$ 108,000	$ 108,000	$ 540,000
Subscriptions (No Filter & No Ads)	$ -	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 600,000
Total Potential Revenue	**$ 90,000**	**$ 372,000**	**$ 372,000**	**$ 372,000**	**$ 372,000**	**$ 372,000**	**$ 1,950,000**
Total Revenue minus Costs	**$ (9,412)**	**$ 48,588**	**$ 24,588**	**$ 588**	**$ 588**	**$ 588**	**$ 65,527**
Shortfall	$ 9,412	0	0	0	$ -	0	$ 9,412

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10. ORGANIZATION

Given the strong interests that exists among the public stakeholders including but not necessarily limited to the City of Albany Mayor's Office, the Albany Public Library, the Albany Housing Authority and the State University of Albany, it is recommended that an oversight board of the public stakeholders be constituted to oversee the deployment of the Albany Community Wi-Fi network. This group should be no more than 3 appointees appointed on a voluntary basis and reporting to the CIO for the City and an appointee of the Library System.

For reasons mentioned throughout this study, it is recommended that the Albany Public Library be the lead public operating entity but that a private sector partner be identified to construct and maintain the physical network. In effect the Library would serve as a virtual ISP with the private partner providing all network maintenance, operations and customer service functions. This public/private partnership will also enhance the possibility of obtaining capital support from NYS's New NY Broadband Program and operating support from the federal E-Rate program. The recommendations from this report include the following:

- There should be a group assigned for Oversite, herein referred to as an oversite committee. This group should be comprised of City personnel, the Library and other constituents.
- The oversite committee should review and approve all endeavors of the public/private partners contracted for installation and maintenance.
- The Oversite committee should be responsible for the approval of expenses as accrued and should be responsible for accounting for all grants, revenue, and expenditures.
- The vendor partners will be responsible for support, maintenance and ensuring customer satisfaction and the costs to guarantee that all clients and customers needs are being adequately met.
- The vendor partner will find alternative funding resources such as advertising, data mining and cellular offset to subsidize the cost for ensuring highly reliable and adequate service.
- The vendor partner will contract with and utilize revenues from cellular providers and other utilities to offset support costs.
- The oversite committee will only exist to ensure that the implementation is on time and that the needs of the customers and constituents are being met. The time commitment of said members of the committee will be less than 8 hours per quarter.

11. RECOMMENDATIONS

Based on the documented, overwhelmingly compelling need for a City wide alternative high speed broadband network and the interviews with public and private stakeholders, a pragmatic review of the existing telecommunications infrastructure in the City of Albany and the available funding sources the following approach is recommended:

1. A traditional FTTH play might prove too expensive with an estimated cost of $44Million for capital investment. However, if a provider could be convinced to utilize the new WAN for the Backhaul for a FTTH service, this cost could be reduced to roughly $16 Million.
2. Mobile/Cellular LTE technology has been evolving quickly and the advent of 5G LTE may prove to be a viable solution to deploy a high-speed community-wide broadband network using a combination of Wi-Fi, fiber fed small cells and 4G/5G in partnership with a private company.
3. The TV Whitespace may be an option for provisioning internet to some constituents only. It should be watched and maybe even piloted and could be paid for through a special grant.
4. If a private partner cannot be convinced of the business viability of Option 1 or Option 2, then a fiber fed wireless solution should be considered. With an estimated cost of $9.2 million, a ubiquitous Wi-Fi solution could be deployed. The private provider could be compelled to partner with the City while the Wi-Fi network is built and offer a FTTH solution by utilizing the infrastructure that is the foundation for the Wi-Fi Network.
5. Whereas there is an impending and critical need to address employment opportunities, economic development and issues stemming from chronic poverty and the so called digital divide it is recommended that a city wide network be deployed but not be solely constructed, operated, maintained or serviced by the City. Experiences of publicly owned and operated networks have been mostly negative and burdensome to the public entity and the tax payer. It is not the core business of the City or the Library to engage in this type of operation and to do is likely to be costly, inefficient, non-sustainable and with a high possibility for failure.
6. Issuance of a Request for Proposals (RFP) to identify public or private partners that will undertake to build a high-speed, city-wide Wi-Fi network according to all specifications and drawings. The RFP would specify that all bids must be for a turnkey network including final engineering & design, construction, operations, customer support and network maintenance. Preference will be given to the bidder that meets all technical and system performance criteria but also and equally important will be the degree to which the bidder can identify the required matching dollar requirements in new capital invested or in existing network contributed to support the construction, operation, maintenance and sustainability of the City wide Wi-Fi network.
7. Respondents to the RFP will be asked to identify models for the monetization of the network to support ongoing sustainability and include but not be limited to;
    a) Mobil backhaul. Charging national cell phone carriers to off load traffic on the City wide Wi-Fi network or to use the cellular LTE network to provide high-speed internet access City-wide.

b) Advertising. Charging local or national advertisers for a presence on the City wide Wi-Fi network.

c) Leveraging a private partner's deployment of "smart city" applications such as energy efficient street lighting, traffic & parking management, public safety video and meter reading to offset the cost of providing a City-wide high-speed broadband network for the community.

d) Location Based Services. Retailers use Wi-Fi networks to interact with customers by using location based services (LBS) with a robust Wi-Fi network, a retailer knows not only where the customer is, but can discover who they are. By acting on captured data such as age, gender, email, and frequency of visits, a retailer can increase sales and customer satisfaction

e) Paid Subscriptions. Charging users for an enhanced network experience (e.g. higher speeds, symmetrical speeds, special content, etc.)

f) Big Data Analytics. Reselling appropriate data gleaned from the network to third parties.

12. DESIGN DIAGRAMS

There are multiple diagrams that where utilized for the development of this feasibility study. These drawings are attached to this study as a separate document entitled Appendix 1. The drawings include:

Drawing Number	Drawing Description
WB-001	Zone Diagrams – South
WB-002	Zone Diagrams – North
WB-003	City Facilities – Libraries, Rec Centers Housing
WB-004	Zone 1 Fiber
WB-005	Zone 1 Fiber
WB-006	Zone 1Wireless
WB-007	Zone 2 Fiber
WB-008	Zone 2Wireless
WB-009	Zone 3 Fiber
WB-010	Zone 3 Wireless
WB-011	Zone 4 Fiber
WB-012	Zone 4 Wireless
WB-013	Zone 5 Fiber
WB-014	Zone 5 Wireless
WB-015	Zone 6 Fiber
WB-016	Zone 6 Wireless
WB-017	Zone 7 Fiber
WB-018	Zone 7 Wireless
WB-019	Zone 8 Fiber
WB-020	Zone 8 Wireless
WB-021	Zone 9 Fiber
WB-022	Zone 9 Wireless
WB-023	Zone 10 Fiber
WB-024	Zone 10 Wireless
WB-025	Zone 11 Fiber
WB-026	Zone 11 Wireless
WB-027	Zone 12 Fiber
WB-028	Zone 12 Wireless

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WB-029	Zone 13 Fiber
WB-030	Zone 13 Wireless
WB-031	Zone 14 Fiber
WB-032	Zone 14 Wireless
WB-033	Zone 15 Fiber
WB-034	Zone 15 Wireless

EXHIBIT 1 – LETTER FROM VERIZON TO MAYOR SHEEHAN

David Lamendola
Director — Government Affairs
New York & Connecticut

Verizon
158 State Street – 10th Floor
Albany, NY 12207
Phone: 518-396-1086

July 10, 2015

Honorable Kathy Sheehan, Mayor
City of Albany
24 Eagle Street
Albany, New York 12207

Dear Mayor Sheehan:

I write in response to your letter of July 7, regarding constituent outreach to your office concerning the possible expansion of FiOS into the City of Albany.

Your statement that the City of Albany is not preventing Verizon from deploying FiOS service in the City is accurate, and Verizon has not authorized anyone to represent otherwise. In an effort to eliminate any confusion that may exist with respect to this issue, I have shared your letter with our Operations team, and requested that they make sure that all of Verizon's call center personnel and repair technicians understand that the City of Albany is not preventing Verizon from expanding FiOS service into the City.

At this time, Verizon is focused on meeting its franchise obligations in the municipalities where it currently provides cable television service. The Company does not currently plan to expand FiOS in New York, but is instead focused on recovering the substantial investments that we have already made in FiOS by increasing our customer base within the areas where we have already deployed the service.

I would be happy to meet with you to discuss any issues regarding the services that Verizon currently provides in the City of Albany. If you have any questions or concerns, please feel free to contact me directly at the number above.

Sincerely yours,

David Lamendola

ATTACHMENT 1 – ITEMIZED BUDGET FOR WI-FI OPTION

The capital expenditures are calculated based on the Fiber fed Wireless Model. Total expenditures are projected to not to exceed $9,240,998. It should be noted that these estimates were based on the design drawings and a specific hardware. However, no hardware manufacturer, make or model has been selected nor is being recommended at this time. Any make model listed in this report should be read as "or equivalent" and was utilized for budget purposes only.

City of Albany - Community WiFi

Total Capital Costs

Zone	Fiber Drawing	Wireless Drawing	Fiber	Waps	Cost	
Zone 1	WB 005	WB 006	20.031	165	$	1,158,168.90
Zone 2	WB 007	WB 008	5.891	65	$	408,737.70
Zone 3	WB 009	WB 010	8.138	72	$	495,688.20
Zone 4	WB 011	WB 012	5.611	53	$	335,687.10
Zone 5	WB 013	WB 014	4.115	47	$	274,703.10
Zone 6	WB 015	WB 016	5.533	53	$	333,230.10
Zone 7	WB 017	WB 018	4.647	50	$	298,391.10
Zone 8	WB 019	WB 020	6.104	60	$	403,897.20
Zone 9	WB 021	WB 022	13.904	136	$	861,667.80
Zone 10	WB 023	WB 024	4.274	32	$	245,061.60
Zone 11	WB 025	WB 026	12.053	113	$	750,231.30
Zone 12	WB 027	WB 028	8.258	91	$	543,358.20
Zone 13	WB 029	WB 030	10.292	131	$	736,339.80
Zone 14	WB 031	WB 032	7.187	87	$	500,381.70
Zone 15	WB 033	WB 034	8.009	64	$	473,144.70
Zone 16	N/A	N/A	N/A	N/A	$	20,000.00
				Subtotal	$	7,838,688.50
				City & Library Fiber Ring	$	616,520.00
				Library Core Equipment	$	175,000.00
				Core Filter at Main Library	$	150,000
				Wireless Controller	$	200,000
				Core Equipment Maintenance Upgrade to 5 yrs	$	260,790
				Grand Total	**$**	**9,240,998.50**

City of Albany Community WiFi

Zone 1 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
4	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 84,480
4	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 14,928
4	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 3,840
4	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 3,840
4	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
4	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
4	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
160	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 32,000
4	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
20.031	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 500,775.00
20.031	Overlashing of coaxial cable for power			$ 5,000	$ 100,155.00
165	Wireless Access Points with Installation			$ 2,200	$ 363,000.00
	Procurement, Design and PM				$ 55,151
		SUBTOTAL			**$ 1,158,168.90**

City of Albany Community WiFi

Zone 2 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
2	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 42,240
2	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 7,464
2	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 1,920
2	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 1,920
2	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
2	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
2	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
80	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 16,000
2	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
5.891	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 147,275.00
5.891	Overlashing of coaxial cable for power			$ 5,000	$ 29,455.00
65	Wireless Access Points with Installation			$ 2,200	$ 143,000.00
	Procurement, Design and PM				$ 19,464
		SUBTOTAL			**$ 408,737.70**

City of Albany Community WiFi

Zone 3 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
2	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 42,240
2	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 7,464
2	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 1,920
2	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 1,920
2	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
2	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
2	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
80	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 16,000
2	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
8.138	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 203,450.00
8.138	Overlashing of coaxial cable for power			$ 5,000	$ 40,690.00
72	Wireless Access Points with Installation			$ 2,200	$ 158,400.00
	Procurement, Design and PM				$ 23,604
		SUBTOTAL			**$ 495,688.20**

City of Albany Community WiFi

Zone 4 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
1	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 21,120
1	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 3,732
1	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 960
1	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 960
1	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
1	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
1	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
40	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 8,000
1	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
5.611	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 140,275.00
5.611	Overlashing of coaxial cable for power			$ 5,000	$ 28,055.00
53	Wireless Access Points with Installation			$ 2,200	$ 116,600.00
	Procurement, Design and PM				$ 15,985
		SUBTOTAL			**$ 335,687.10**

City of Albany Community WiFi

Zone 5 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
1	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 21,120
1	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 3,732
1	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 960
1	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 960
1	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
1	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
1	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
40	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 8,000
1	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
4.115	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 102,875.00
4.115	Overlashing of coaxial cable for power			$ 5,000	$ 20,575.00
47	Wireless Access Points with Installation			$ 2,200	$ 103,400.00
	Procurement, Design and PM				$ 13,081
		SUBTOTAL			**$ 274,703.10**

City of Albany Community WiFi

Zone 6 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
1	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 21,120
1	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 3,732
1	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 960
1	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 960
1	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
1	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
1	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
40	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 8,000
1	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
5.533	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 138,325.00
5.533	Overlashing of coaxial cable for power			$ 5,000	$ 27,665.00
53	Wireless Access Points with Installation			$ 2,200	$ 116,600.00
	Procurement, Design and PM				$ 15,868
		SUBTOTAL			**$ 333,230.10**

City of Albany Community WiFi

Zone 7 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
1	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 21,120
1	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 3,732
1	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 960
1	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 960
1	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
1	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
1	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
40	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 8,000
1	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
4.647	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 116,175.00
4.647	Overlashing of coaxial cable for power			$ 5,000	$ 23,235.00
50	Wireless Access Points with Installation			$ 2,200	$ 110,000.00
	Procurement, Design and PM				$ 14,209
		SUBTOTAL			**$ 298,391.10**

City of Albany Community WiFi

Zone 8 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
2	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 42,240
2	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 7,464
2	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 1,920
2	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 1,920
2	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
2	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
2	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
80	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 16,000
2	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
6.104	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 152,600.00
6.104	Overlashing of coaxial cable for power			$ 5,000	$ 30,520.00
60	Wireless Access Points with Installation			$ 2,200	$ 132,000.00
	Procurement, Design and PM				$ 19,233
		SUBTOTAL			**$ 403,897.20**

City of Albany Community WiFi

Zone 9 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
3	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 63,360
3	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 11,196
3	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 2,880
3	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 2,880
3	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
3	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
3	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
120	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 24,000
3	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
13.904	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 347,600.00
13.904	Overlashing of coaxial cable for power			$ 5,000	$ 69,520.00
136	Wireless Access Points with Installation			$ 2,200	$ 299,200.00
	Procurement, Design and PM				$ 41,032
		SUBTOTAL			**$ 861,667.80**

City of Albany Community WiFi

Zone 10 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
1	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 21,120
1	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 3,732
1	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 960
1	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 960
1	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
1	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
1	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
40	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 8,000
1	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
4.274	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 106,850.00
4.274	Overlashing of coaxial cable for power			$ 5,000	$ 21,370.00
32	Wireless Access Points with Installation			$ 2,200	$ 70,400.00
	Procurement, Design and PM				$ 11,670
		SUBTOTAL			**$ 245,061.60**

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Zone 11 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
3	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 63,360
3	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 11,196
3	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 2,880
3	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 2,880
3	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
3	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
3	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
120	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 24,000
3	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
12.053	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 301,325.00
12.053	Overlashing of coaxial cable for power			$ 5,000	$ 60,265.00
113	Wireless Access Points with Installation			$ 2,200	$ 248,600.00
	Procurement, Design and PM				$ 35,725
		SUBTOTAL			**$ 750,231.30**

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Zone 12 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
2	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 42,240
2	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 7,464
2	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 1,920
2	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 1,920
2	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
2	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
2	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
80	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 16,000
2	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
8.258	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 206,450.00
8.258	Overlashing of coaxial cable for power			$ 5,000	$ 41,290.00
91	Wireless Access Points with Installation			$ 2,200	$ 200,200.00
	Procurement, Design and PM				$ 25,874
		SUBTOTAL			**$ 543,358.20**

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Zone 13 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
3	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 63,360
3	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 11,196
3	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 2,880
3	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 2,880
3	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
3	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
3	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
120	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 24,000
3	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
10.292	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 257,300.00
10.292	Overlashing of coaxial cable for power			$ 5,000	$ 51,460.00
131	Wireless Access Points with Installation			$ 2,200	$ 288,200.00
	Procurement, Design and PM				$ 35,064
		SUBTOTAL			**$ 736,339.80**

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Zone 14 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
2	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 42,240
2	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 7,464
2	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 1,920
2	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 1,920
2	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
2	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
2	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
80	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 16,000
2	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
7.187	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 179,675.00
7.187	Overlashing of coaxial cable for power			$ 5,000	$ 35,935.00
87	Wireless Access Points with Installation			$ 2,200	$ 191,400.00
	Procurement, Design and PM				$ 23,828
		SUBTOTAL			**$ 500,381.70**

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Zone 15 Capital Costs

Qty.	Mfg. Part #	Product Description	Unit List Price	Unit Cost	Ext. Cost
Core Switch price estimate					
2	WS-C4500X-40X-ES	Catalyst 4500-X 40 Port 10G Ent. Services, Frt-to-Bk, No P/S	$ 44,000	$ 21,120	$ 42,240
2	CON-SNTP-C45X40XE	SNTC-24X7X4 Catalyst 4500-X 40 Port 10G Ent. Service	$ 5,184	$ 3,732	$ 7,464
2	C4KX-PWR-750AC-R	Catalyst 4500X 750W AC front to back cooling power supply	$ 2,000	$ 960	$ 1,920
2	C4KX-PWR-750AC-R/2	Catalyst 4500X 750W AC front to back cooling 2nd PWR supply	$ 2,000	$ 960	$ 1,920
2	CAB-US515-C15-US	NEMA 5-15 to IEC-C15 8ft US	$ -	$ -	$ -
2	S45XUK9-38E	CAT4500-X Universal Crypto Image	$ -	$ -	$ -
2	C4500X-IP-ES	IP Base to Ent. Services license for 32 Port Catalyst 4500-X	$ -	$ -	$ -
80	GLC-SX-MMD=	1000BASE-SX SFP XCVR MOD MMF 850NM DOM	$ 500	$ 200	$ 16,000
2	C4KX-NM-8SFP+	Catalyst 4500X 8 Port 10G Network Module	$ -	$ -	$ -
8.009	Miles of Fiber from Anchor Institution to each WAP			$ 25,000	$ 200,225.00
8.009	Overlashing of coaxial cable for power			$ 5,000	$ 40,045.00
64	Wireless Access Points with Installation			$ 2,200	$ 140,800.00
	Procurement, Design and PM				$ 22,531
		SUBTOTAL			**$ 473,144.70**