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# Franklin Township Municipal Broadband and Wireless Network

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# Table of Contents

**Abstract**

Franklin Township is a municipality in Somerset County, New Jersey covering an area of approximately 46.15 square miles and a population of 62,300 as of the 2010 Census. The town relies on a cellular provider to provide data connections for computers in municipal vehicles such as police cars, public works vehicles, fire inspection trucks, building inspectors and other departments. Additionally, the municipality pays for connections for security cameras at remote facilities and for smart garbage can monitoring throughout the town. These services are costly for the municipality and create a dependency on service providers for access to information needed by municipal employees.

This paper explores the current solution in place for data connections and a proposed solution of implementing a municipal broadband network. It lists disadvantages and advantages of each solution. It also explores the failures and successes of similar projects. The paper covers the implementation process that would need to be followed. Finally, it examines two potential wireless technologies which could be implemented for the wireless connection. The goal is to show the potential benefits of Franklin Township implementing its own network and the potential benefits through long term cost savings and gathering or access to data.

**Introduction**

Municipal governments are tasked with providing services to residents in the most cost-effective way. This includes but is not limited to providing emergency services, social services, utilities such as water and sewerage treatment, recreation, and road maintenance. While the geographical size of each municipality is not changing, the types of services and the number of residents continue to increase. Each of the services requires access to information, which in most cases relies upon cellular connections from wireless providers.

Franklin Township is a municipality which is facing the challenge of finding the most cost-effective way to connect wireless devices. The municipality relies on cellular SIM cards to connect devices throughout the town. This poses a challenge as new technology becomes available for the municipality to use. The cost of the immediate purchase and long-term connection fees need to be considered. The purpose of this paper is to explore network options available to the municipality which balances both cost and the needs of local government to provide services to the residents.

**About Franklin Township**

Franklin Township is a municipality within Somerset County, New Jersey covering an area of 46.15 miles (United States Census Bureau, 2018). It has a combination of population areas with a densely populated area closest to the New Brunswick border, less densely populated residential areas, farmland, commercial and industrial zones. Approximately 34% or roughly 15.7 square miles of Franklin Township is preserved open space which is undeveloped land, farmland, or parks. The municipality owns 55 parks or designated open space areas with several more being built within the next few years. These areas range in size from small neighborhood parks to large complexes including athletic fields. Two areas of the town have been identified as economic redevelopment zones. One area is the Hamilton Street area which borders the city of New Brunswick and the other is the Davidson Avenue area, which is comprised of hotels and office buildings. There are over 245 miles of roads within the municipality of which the town is responsible for 237 miles.

The town has an estimated population of 66,344 residents as of 2018, up from 62,300 in the 2010 census (Census.gov)(See Appendix A). It has a diverse population with approximately 45% identifying as Caucasian, 27% identifying as African American or Black, 22.5% identifying as

Asian, and 13.6% identifying as Hispanic or Latino. Approximately 24.5% of the population was under the age of 18 and 16.7% was over 65.

Franklin Township is governed under the Faulkner Act Council-Manager form of government. This form of government is an elected council and an appointed township manager. The council is comprised of an elected mayor who presides over council and is elected at-large. The council also has three additional at-large council members and five ward council members. The township manager is the chief executive and administrative official who handles day to day operations, attends council meetings but has no vote, and is responsible for preparing the annual budget (New Jersey League of Municipalities). Council members serve on committees responsible for different areas of the town operations such as Administration, Public Safety, Department of Public Works (DPW), Land Use, and Financial Oversight. Any new initiatives by council members are brought to the manager to be assigned to staff members for evaluation. The committees evaluate the plans to make recommendations to the entire council and then decisions are made whether or not to include in the upcoming budget.

The town is served by a police department with 108 officers and civilian employees. Fire protection service is provided by 10 volunteer fire companies which are broken into four districts, each with its own governing body of commissioners. The municipal government includes a water department which is responsible for the transmission of water that is purchased from American Water Company. The town also has an independent sewerage authority (FTSA) who is responsible for the collection of waste and transmission to a treatment facility. The authority is governed by an independent board of commissioners appointed by council and day to day operations are overseen by an executive director. The primary telecommunication providers in town are Comcast and Verizon.

The Franklin Township budget approved for 2019 is $61,931,338.00 (Franklin Township Municipal Government) which accounts for day to day operations, salaries, debt service, and capital expenditure projects. Since 2016, the budget has increased less than $2.5 million despite an increase in benefits' costs and continued investment in infrastructure improvements.

**How Data is Being Used**

The municipal government uses cellular connections for wireless devices throughout the entire fleet of vehicles. Law enforcement vehicles rely on the cellular connections for a range of information needed. The Department of Public Works and Water Department rely on data connections to review information in the Geographic Information System (GIS) to know where critical infrastructure elements are located. Water pump station monitoring is done via a cellular data connection. Additionally, the municipality relies on cellular connected cameras to protect remote buildings, historic landmarks throughout the town, and monitoring of infrastructure stations around town. The town has embarked on procuring and installing Bigbelly waste receptacles in parks. Bigbelly is a smart waste and recycling solution which uses a data connection to monitor capacity and inform public works when the receptacle needs to be emptied (Bigbelly, 2018). The goal of installing these trash and recycling bins is to efficiently deploy crews to parks as needed rather than having them follow a daily routine and going to a park with empty bins.

The FTSA relies on data connections to the GIS as they perform routine maintenance, inspections, and mark outs. Inspections can include routine monitoring of existing pipes and manholes, assisting customers who call about slow drains and blockages, or visiting construction areas as new connections are being made. The authority has recently undertaken a project of updating the GIS and adding asset management tracking for better monitoring of equipment and

planning for capital expenditures. As new connections are installed, or maintenance is being performed, the authority has been using GPS and recording the location for accurate documentation. As required by regulatory bodies, the authority documents daily monitoring of pump stations and routine maintenance performed. Given the amount of information and limited connection availability in areas of the town, much of this information is recorded offline and then updated once the crews return to the authority at the end of the shift. Each of the pump stations has a monitoring system which alerts staff if there is an issue with equipment. The remote monitoring systems rely on a cellular connection.

The fire districts oversee the volunteer fire departments throughout the municipality. The town relies on volunteer fire coverage and does not have a paid fire department. The fire apparatus and chiefs' vehicles are relying more on data connections in the vehicles for information regarding incidents they are responding to. As more blue prints are being electronically stored, access to the information helps in assessing incidents. Also, the connections help in coordinating with dispatchers.

**Current Solution**

Franklin Township Municipal Government, the Franklin Township Sewerage Authority, and the Franklin Township Fire Districts currently rely on cellular data connections with Verizon Wireless. Verizon Wireless has a contract with the State of New Jersey, setting a fixed price for each device connected to the network. The current state contract has a set price of $37.99 a month per connected device.

There are advantages to using Verizon under the state contract. The monthly service charged is a set price for the duration of the state contract and will be negotiated to the best possible rate given the number of municipalities and state agencies who use the services provided. The

infrastructure and network are maintained by Verizon and they have the crews readily available to make repairs as needed. As technology improves and advances, it is in Verizon's best interest to make improvements and capital investments in the system with the cost more widely spread-out over-all consumers, not just a small subset. Also, the general coverage area is significant since Verizon has heavily invested in the system throughout the country. Vehicles which need to leave the town for any reason can maintain a data connection.

The disadvantage is having to pay for a connection for every new vehicle, portable device, or smart technology device added. Currently, the municipality pays for approximately 100 devices per month for cellular connections which include computers for the police department, SCADA monitoring at the water pump stations, BigBelly waste receptacles at the parks, and security cameras throughout the town. Each of the four fire districts pays for cellular data connections for apparatus and vehicles at the stations. The number of connections in Fire Districts 1, 2, 3, and 4 totals approximately 71 units. Fire District 4 serves both Franklin Township and South Brunswick, therefore the monthly charges are split between the two municipalities. The sewerage authority connects each of the 21 pump stations for remote monitoring and two additional stations will be coming online within the next 24 months (See Appendix B). As a note, the numbers provided for cellular connections exclude cellular phones. Even with the state contract pricing, the amount paid by the municipality, authority, and fire districts amounts to an estimated $7,500 a month, or $90,000 annually. The municipality has an additional 115 devices scheduled to come online within the next three years (See Appendix C). This will add an additional $52,500 annually to the municipal budget once the hundred devices are online. During the procurement phase, the device cost not only has to include the one-time purchase price and any additional maintenance fees, but also the monthly connection fee. Municipal

budgets are already stretched thin across all departments and to add a new device would require either cutting from other budgets or increasing the tax burden to the residents. Given the additional cost, this limits the technology explored which could benefit the municipality to only necessary essentials and prevent technology from being used to help with sustainability initiatives. While coverage is strong throughout most of the town, there are still areas around the Delaware & Raritan River Canal and farmlands which are weak and make it difficult to get a strong cellular connection impacting data needed. Verizon and other telecommunication providers have implemented measures to ensure first responders have priority access to communication systems in the event of an emergency. However, devices are still competing for access to a single network. The plan is an unlimited data plan, but data throttling occurs once a certain threshold is reached. Data throttling is a restriction placed on a cellular connection by the wireless provider in which a connection is maintained but the data connection speed is reduced. While most devices should never reach the threshold, cameras require adjustments to ensure a continuous connection is maintained monthly.

**Proposed Solution**

The current solution meets the current needs of the municipality, but any expansion must be balanced with the restriction of monthly service costs. An alternative solution would be for Franklin Township to build its wireless network for municipal devices. This would allow the municipality to expand the usage of wireless devices without having to factor in a monthly connection fee. It would provide the opportunity to look at alternative solutions for monitoring systems. The municipality would also be able to look at new technologies rather than being forced to evaluate solutions which must work with Verizon’s network.

The ideal solution would be to implement a hybrid broadband and wireless network throughout the municipality. As part of the cable franchise agreement in 1999 RCN, the cable provider to the municipality prior to Comcast, rebuilt the system. Dark fiber was installed from the municipal building to any remote offices and to each of the volunteer fire departments and rescue squads. At the time of the agreement, the fire departments were using local emergency dispatch prior to transitioning to central county 911 dispatch. Since its installation, much of the fiber has remained dark and sitting unused at the fire houses. One fire house connection was used to assist the Board of Education in connecting a newly built school which otherwise would have required a costly new connection to be built. Fire houses are strategically spread throughout the municipality and would provide an initial point of access for evaluation and further development of the network.

Franklin Township has focused on creating economic redevelopment zones. One example is the Hamilton Street Economic Redevelopment Zone which has attracted mixed use buildings, utilizing the space for retail, office space and housing. Community Volunteer Fire Company is perfectly situated within this zone and would be an ideal starting location to pilot the network.

**Implementation**

The process for implementing a network would take time. The project would need to be proposed and an engineering firm would need to be hired to design the network. While the municipality retains several firms, if none have the expertise in the network design and implementation, a request for proposal would need to be publicized and firms would need to bid on the project. Once a bid is accepted the contract would be awarded and the firm would work to study the municipality, evaluate the technology already in place, and design the system as well as create a list of equipment which would be needed. The proposal would give an estimated cost.

Once the initial proposal is completed it would have to be presented to the appropriate council committees for evaluation. At minimum this would go to the IT Steering Committee, Public Works Committee, Financial Oversight, and possibly the Public Safety Committee. Once it is vetted by the committees, the plan would come before council for discussion at a meeting. Based upon public feedback and council discussion, the council would decide if it should go to the next steps or be shelved. If council proceeds with the project, staff would then need to establish a plan and begin to budget accordingly. Budget planning sessions start in the late fall of each year and projects are listed.

Budget hearings for the fiscal year are held in February. The project would have to be presented as a capital improvement project along with how much of the project would be completed for the year. There would have to be a determination of how to pay for the project, out of the budget or bond for the project.

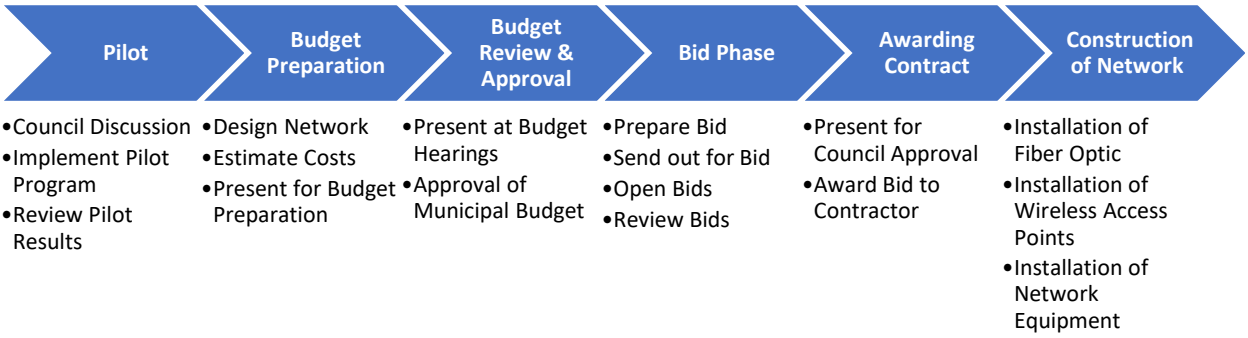


*Figure 1.* Implementation Process and Key Milestones. A brief overview of the process the project would follow and key milestones for project progression.

The Franklin Township municipal budget for the 2019 fiscal year as noted is just over $61 million with $34.3 million appropriated for capital projects. Capital projects include water system improvements, road resurfacing, park improvements, building improvements, current technology upgrades, and vehicle replacement. Also, any other information technology projects would have to be included in the budget. The budget is approved in April. The phased area of

focus for the project would need to be designed and put out for bid if a contractor is needed to do work. If only parts are needed, a bid package would have to be put together for a vendor to provide the materials needed (See Appendix D for Project Timelines).

Under the cable franchise agreement signed between the municipality and Comcast, the fiber optic cable originally installed by RCN/Patriot Media is to be maintained by the municipality. Franklin Township can use the fiber for government related needs. The municipality is not unique in having fiber optic cable that was installed as part of an infrastructure rebuild and left dark. In 2018, Germaine Halegoua and Jessa Lingel investigated LinkNYC to determine how much fiber was installed by telecommunication providers but never turned on. Their research found it was difficult to get the exact figure on how much fiber had been installed to date, where the fiber was run, and the percentage of fiber which remained dark after installation. Some of this information is protected for security reasons and some of the information, as noted in their research, was because multiple entities own the cable systems installed and it would be almost impossible to identify all of them. The LinkNYC project was a project to bring wireless access throughout all of New York City.

One policy which Halegoua and Lingel do highlight is the "recent federal policies such as 'dig once' and high-profile smart city initiatives and grant competitions which have generated attention to city streets and sidewalks as spaces where digital connections happen" (Halegoua & Lingel, 2018). The "Dig Once" federal policy "would call for crews to lay fiber optic cabling, or a conduit to hold such cabling later, whenever the ground was dug up for another purpose." (Fisher, 2018). While this was not created as a mandate, the policy in and of itself is important. Many neighborhoods within Franklin Township are starting to come to the age where infrastructure improvements are needed. These improvements include replacement gas lines

from PSEG, replacement water lines and sewer lines, installation or replacement of storm water systems, or even rebuilding the road bed rather than simply resurfacing the road. The municipality is already taking this approach in coordinating between the water department and sewerage authority to repair or replace lines at one time. This minimizes the disruption to the neighborhood, prevents wasting money and time on resurfacing a road multiple times, and calls for a complete assessment of a street. A high percentage of power and telecommunication lines throughout the municipality are above ground but expanding the dig once policy to include cable or conduit would assist in preparing the town for future needs. Given the implementation would take multiple years, a pilot area could be created, and then future expansion could potentially follow other construction projects based upon need.

**Failures and Successes**

The installation of a municipal network is an expensive project that can take a significant amount of time. Cities have set out with intentions of creating networks, either for government use only or with the intention of providing access to residents. Notable projects over the past two decades include Philadelphia, Pennsylvania, Amsterdam, Netherlands and Chattanooga, Tennessee. As the cities began to implement the projects, multiple hurdles were encountered. Some of the hurdles could not be overcome and resulted in a failure of the project. Others were able to overcome the challenges and result in cost savings initiatives and economic growth.

Philadelphia set out on an ambitious initiative in the early 2000s with the goal of deploying WiFi to the entire city and giving affordable internet connection to all residents. The city partnered with a non-profit organization called Wireless Philadelphia and Earthlink, who was the provider selected to build and operate the network (Jassem, 2010). The system faced challenges as it was being built, both technologically and politically. Politically, companies such as Verizon and

Comcast petitioned Pennsylvania to ban local governments from building the networks. Philadelphia was exempt from legislation banning municipal networks from being built throughout the state. The technology selected originally was not producing usable signals. Also, only 6000 residents had signed up for the service, resulting in Earthlink losing money on the project (Jassem, 2010). Earthlink eventually discontinued work and sold the network to Network Acquisition Company (NAC) who modified the scope of the project and limited it to only outdoors. Philadelphia's attempt to create a network was ultimately a failure and never reached the original goal of the project.

Amsterdam is a city who worked towards a successful implementation of a municipal network in order to improve services throughout the city. Michael Fitzgerald wrote a case study entitled "Data-Driven City Management" in 2016 which highlighted the successes and challenges Amsterdam faced to use data. Fitzgerald highlights how Amsterdam realized data was key to improving the flood protection system, controlling energy waste, and working to improve traffic management. Amsterdam faced the problem of companies thinking they knew how cities ran and creating solutions that did not necessarily address the issues the city needed to address. Companies also offer promises of solutions without accounting for the full use of the technology. "Modern LED lights can be programmed at the factory to dim at certain hours, based on traffic patterns. But what if those patterns change? In Amsterdam, city workers would have to change the streetlights, light by light, potentially all 150,000 of them" (Fitzgerald, 2016). For Amsterdam to take advantage of the cost savings and benefit from the LED conversion a wireless network had to be created. Through data collection throughout the city, Amsterdam was able to achieve a savings of approximately 8 billion Euros in flood protection alone (Fitzgerald, 2016). Amsterdam has continued to look for additional ways to expand its network. A new

network they are exploring is Long Range Wide Area Network (LoRaWAN). "A LoRaWAN network is based on a star-of-stars topology composed of three basic elements: end-devices, gateways and a central network server" (Casals & Bernat Mir & Gomez, 2017). This allows for even more IoT devices to be connected and provide information without using a significant amount of energy and installing expensive equipment.

Another successful implementation of a municipal wireless network is Chattanooga, Tennessee. Hugo Martin Koch researched the driving factors behind creating municipal broadband networks. Chattanooga was highlighted in the research and listed the original intent as "an effort to connect 'smart meters' used by the city's electric utility" (Koch, 2018). Koch notes that it helped reduce the duration of power outages. Koch further noted that Chattanooga was able to attract high tech firms to set up headquarters, creating more jobs for the residents and attracting other businesses. The Chattanooga municipal network was opened to all residents and the network was paid for using the fees collected from users. The Chattanooga project was also brought about to bring connections into the town where telecommunication providers were not ready to expand. Chattanooga also faced hurdles in expanding its network due to Tennessee laws restricting Municipal Broadband. The project proved that even though the implementation process faced difficulties, the end result has provided significant improvements and gains for the city.

**Disadvantages/Challenges**

There are multiple disadvantages to the municipality building its own network. First, the town would need to run fiber optic cable throughout the municipality which is expensive. The Department of Transportation has tracked the cost of fiber optic cable installation in cities throughout the United States since the early 2000s to assist in providing guidance for project

planning. As noted by USDOT, reporting data is often delayed due to the length of projects and the completion of funding and financing. The most recent data for the New York area was from 2004-2005 and had a price tag ranging from $16,100 to $67,000 per mile depending on the type of cable installed, the method of cable installation, and additional equipment needed (United States Department of Transportation). Running the cable throughout the municipality would require coordination with Public Service Enterprise Group (PSEG) and other utility providers for space on utility poles, monthly rent for pole usage to PSEG, and metering to be installed for any power consumption from devices installed on the pole. The fiber optic backbone and last mile wireless network would require additional equipment to be purchased and installed. The Chattanooga, Tennessee municipal broadband project cost approximately $281 million, "receiving $111 million federal grant and issuing $170 million worth of municipal bonds" (Koch, 2018). In comparison, Chattanooga is also significantly larger covering 137.15 square miles (Census.gov) versus Franklin Township's 46.15 miles. The population is also almost triple Franklin Township's with a revised estimate of 180,557 (Census.gov). This still highlights implementing a network is a significant cost to a municipality and is an investment.

Another disadvantage is the municipality having to take on the operations and maintenance of a wireless network designed to cover over 46 square miles. This would require either hiring staff or retaining the services of a contractor to perform routine maintenance, perform updates and perform repairs on the network.

Communications equipment would be required to be treated like other equipment throughout the town and be added to an asset management system. Installation of the equipment is not a one-time item but would require a projected lifespan and planned replacement at the end of the lifespan. Also, technology standards are changing rapidly, and decisions would have to be made

as to the frequency of updates of equipment. Corning is one of the major manufacturers of fiber optic cable and in 2016 published a white paper regarding the life span. Fiber optic cable is projected to have a lifespan of 20 to 25 years, but Corning also noted there is currently no actual known lifespan. Without an approximation for end of useful life, it is difficult to determine when additional expenses will arise to replace the currently unused fiber.

There are several options for the type of wireless network which can be installed. The municipality already has several hundred wireless devices which utilize wireless connections. The current equipment would have to be assessed to see if it is compatible with the system chosen. Any incompatible equipment would either have to be replaced or adapted to work with the network, both of which would add additional costs to the project implementation and would have to be addressed early in the project creating higher costs.

An additional challenge which needs to be explored and considered is how to handle data connections for emergency vehicles. Larger cities that have implemented wireless networks, such as New York City, typically do not have vehicles leave the city. Franklin Township emergency vehicles must leave municipal boundaries to go to area hospitals, transport people to the county seat of Somerville for the jail, and for mutual aid with surrounding municipalities. While fire apparatus may be able to grab a mobile hotspot from a station before heading to a call outside municipal boundaries, the same may not be true for police vehicles who are already on patrol and being dispatched to a neighboring town. This may require police vehicles to be excluded from the project, which would reduce the potential cost savings.

Another disadvantage is the network can only be used for non-commercial government usage. As part of an amendment to the cable television franchise agreement, Ordinance Number 4275-19 added Exhibit A which states “The Township may use the I-Net for non-commercial

government purposes and shall not lease out any portion of the I-Net to any third party, allow the I-Net to be used by a third party for commercial purposes or itself use the I-Net for the provision of services to non-governmental entities" (Franklin Township, 2019). The success cases seen in municipalities that invested in fiber optic cable installation and wireless networks has allowed for a mixed use by residents, businesses, government agencies, and allowed excess capacity to be leased by providers. Any further investment in a municipal network would be for several hundred devices for the near future.

There are also regulatory hurdles which must be overcome in the creation of a municipal broadband network. J.T. Cobb explored the hurdles Chattanooga, Tennessee and Wilson, North Carolina faced in implementing their networks. While the Federal Communications Commission (FCC) has jurisdiction under the 1996 Telecommunications Act to ensure broadband is being deployed, the argument of States Rights versus the Federal Government surfaced. New Jersey currently is not one of the 26 states that bans the installation or operation of municipal networks, however, this is an issue which would need to be monitored and could lead to restrictions on network expansion.

**Advantages**

There are many advantages to installing a municipal wide broadband and wireless network. One advantage would be increasing wireless coverage throughout the municipality. There are areas of town which have poor signal quality and maintaining a signal is difficult. Telecommunication companies require numerous approvals to add equipment to increase service coverage and must weigh return on investment when installing additional equipment. The municipality would not require as many approvals that utilities and telecommunication providers need to obtain. Large antennae would not be required as well depending on the technology selected. Also, it is in the

town's best interest to have coverage as it would assist in connecting monitoring devices and vehicles throughout the town.

Building a municipal network would assist in providing quicker access to information and secure the information better. Rather than having to expose information outside of the municipal network, it would allow for all connections to be made internally. Also, camera connections to parks and facilities could be configured without frame restrictions. Municipal employees could have better access to information and not be required to go back to offices for information. Building monitoring and management could be handled differently. Facilities at parks could be converted to access cards, which municipal employees use at certain facilities already rather than key entries. The Supervisory Control and Data Acquisition (SCADA) systems used at pump stations can now be connected via an internal connection rather than paying for a cellular provider. Parks can have moisture sensors installed rather than relying on rain sensors for more efficient watering of fields. This can save money and prevent fields from being damaged. Public safety initiatives can be increased allowing for additional cameras to be used. This also opens the potential for systems such as ShotSpotter if necessary, which helps to improve public safety and helped to reduce crime rates in Camden, New Jersey. Providing resources for public safety initiatives assists the men and women of the police department perform their jobs more efficiently.

Installing a municipal network would take connection costs out of any decision in expanding Smart City Technology investment. Franklin Township has worked to be an environmentally friendly municipality. The installation of LED light fixtures could significantly reduce annual lighting costs the municipality pays. Currently, the municipality budgets $1.2 million annually for street lighting. LED conversion with smart city integration has an estimated savings of 65 to

80 percent, which would be an approximate $1 million savings annually. Installing the municipal network would provide the opportunity to take full advantage of smart lighting features as well as connect additional sensors to fixtures. Sensors expected to be available soon from various manufacturers include road surface monitoring for ice and snow and motion sensors for pedestrian and animal movement detection. The municipality is already investing in road brining equipment which will significantly reduce the amount of salt spread on roads prior to storms. Adding road surface monitoring could assist in sending equipment to roads in need of additional treatment faster and ensure no roads are missed after storm clean ups. Motion sensors can be used to brighten lighting if a human or animal is in an area to alert drivers. A concept being explored with motion sensors is also tracking traffic speeds. Using historical information, if a sudden slowdown is noticed on a road, police dispatchers could receive alerts and begin to move an available unit over to the area. This has the potential to reduce emergency response times for accidents and minimize the disruption on the road, especially during rush hour.

One of the disadvantages is the initial installation of fiber optic cable throughout the municipality. As was previously mentioned, during the rebuild of the cable network throughout the network, dark fiber optic cable was installed connecting the municipal building to remote buildings and fire houses. Having a portion of cable already installed can significantly save time and allow for pilot areas to be implemented. The pilot areas would provide an opportunity to evaluate if the network build out should continue. Building a municipal network would assist in providing quicker access to information and utilize already installed resources.

The fire districts would be able to potentially reduce costs and utilize funds for equipment. They also would be able to access more information and take advantage of technology as needed. New equipment is being added to the fire departments which have the potential of requiring data

connections. Recently, several of the departments have added unmanned aerial systems (UAS) to be able to see incidents from above and be used in search and rescue operations. There is also a movement to have digital blueprints for buildings stored with municipalities. Rather than having to wait for someone to provide a paper copy to first responders, information would be readily available on scene to the incident commander.

**Technology**

There are multiple types of wireless networks which can be implemented. The most common wireless network which comes to people's minds is WiFi. WiFi is a common wireless network standard which can readily connect to portable devices. However, WiFi has significant disadvantages. The number of wireless radios to cover the entire town would be significant. Wireless radios typically have a radius of approximately 300 feet when utilizing the 2.4GHz frequency or less on the 5GHz frequency. WiFi channels would be competing with networks set up by businesses and residents, which could potentially impact the strength of the signal and cause interference requiring even more access points. WiFi security has been proven to have vulnerabilities. Given the vital information and systems that would be attached to the network, this would pose a strong security risk.

The preferred option to explore would be Citizens Broadband Radio Service (CBRS). This is a limited spectrum which would require bidding on a frequency and obtaining a license. CBRS is the equivalent of 5G but within the 3.55GHZ to 3.7GHz range. Rather than utilizing WiFi frequencies, the signal is the equivalent of a cellular connection and has speeds equivalent to Long-term Evolution (LTE). Each device would require the utilization of a SIM card to connect to the network. This could be simpler to set up given most wireless device are already utilizing a cellular connection to Verizon's network. CBRS signals have a theoretical range of

approximately half a mile to several miles from the access point, which would significantly reduce the amount of equipment which needs to be installed. The exact range is dependent upon signal loss calculations, density of obstructions, and number of devices connecting to the access point. CBRS specifications do have antenna height restrictions dependent upon the licensing with the General Authorized Access (GAA) having a maximum installation of 20 feet height above average terrain (HAAT). The maximum height and interference impacts the number of access points which need to be installed. CBRS and cellular connections have been proven to be more secure connection than WiFi. The connection would provide sustained faster speeds. Given the frequency would be dedicated to the municipality, there is less interference. The network can also be designed to handle the current number of devices and be improved to accept future devices. CBRS radio antennas do not have to be as high as current cellular antennas, which can make installation significantly easier and not stand out. As noted in the disadvantages, devices currently being utilized would have to be evaluated to see if it would be as simple as swapping the SIM card to work with the CBRS network or if modifications would be needed to connect to the network.

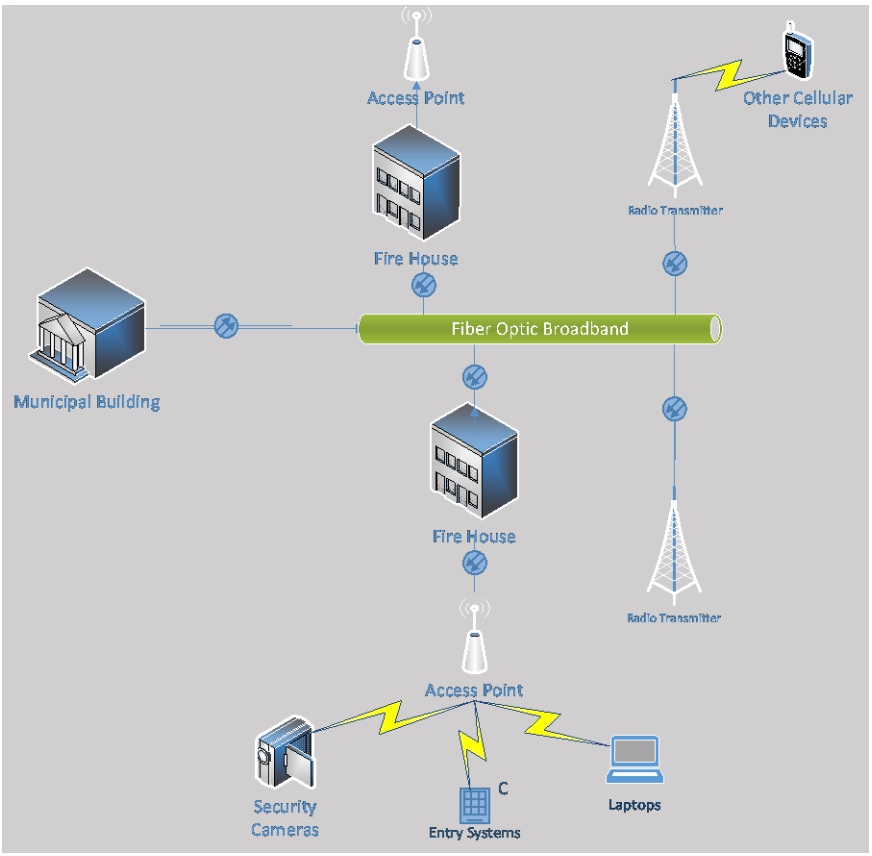


*Figure 2*. Basic Network Diagram. A basic diagram utilizing existing fiber optic wire at fire houses and antennas throughout the municipality.

**Recommendation**

The current solution Franklin Township utilizes for data connections is sufficient for current needs. However, it is already known there will be a significant increase in annual data connection costs as planned devices come online. These include the previously noted public works vehicles, additional pump stations, waste receptacles, and security cameras. Additionally, if smart city technology were to be utilized, the number of connected devices could potentially increase to ten or one hundred times the number of connected devices. The most recent estimate for the number of street lights in town is between 10,000 and 12,000 lights. If each light were to be converted to a smart light this would add an estimated annual cost of $5.5 million. This would represent a 9% increase in operating costs on the municipal budget which would not be

realistic. Any cost savings from reduction in electrical usage would be negated. The fiber optic backbone would allow for the addition of sensors throughout the municipality without adding additional cellular connections and faster transmission rates of information.

The municipal network and connection of devices could increase security as they could be isolated to an internal network rather than connecting externally. The isolation of devices helps protect vital information. It also reduces the concern around the safety of IoT devices.

Franklin Township financially is in the position to take on infrastructure projects of this magnitude. A short-term investment of this nature has the potential to return significant savings in actual dollars, in efficiency of limited municipal resources, and from a sustainability perspective.

The recommendation is not to implement all at one time, but instead create a pilot area and expand outward. The pilot area would start from one of the existing dark fiber termination points at a fire house. Within the pilot program would be stationary cellular devices including but not limited to waste receptacles and security cameras. This would be an opportunity to explore smart lighting technology as a connection would now be available. A mobile device should be tested in the region as well to ensure connectivity is maintained as the device moves further away from the access point. The pilot area could focus around the economic redevelopment zone of Hamilton Street as more devices are being added. As with other projects throughout the municipality, as neighborhood infrastructure projects are undertaken, the addition of fiber optic cable and wireless radios should be considered to prevent disrupting a neighborhood repeatedly. Also, with fiber optic cable already available throughout a portion of the municipality, less set up is needed and devices and monitoring services could be switched over faster.

As a road map is created of installation and roll out, future projects can be planned to be built onto the new network, which would potentially reduce long term operating costs. In addition to government entities within the municipality, coordination with Somerset County can be made for upgrades to systems the county utilizes throughout the town such as traffic signal control.

**Conclusion**

Franklin Township has been a municipality that welcomes technology and has a history deeply rooted with technological advances. The town was home to the Marconi Wireless Antennas which was a backup to radio antennas on Long Island from the early 1900s until they were demolished in the 1950s. Companies such as AT&T once called Franklin home. Technology and lighting companies such as Signify Philips still have a corporate office in town. The municipality maintains its own Trunked Radio System for first responders which connects into the Somerset County communications system. The town also installed its own emergency radio station in two sections of town to add another way to communicate with residents in the event of an emergency. While there is a cost associated with installing and operating a municipal wireless network, the advantages allow for an immediate use and further future expansion of technology. An investment of this type would reaffirm the commitment to sustainable technology, improving and expanding infrastructure, and increasing efficiency of resources available.

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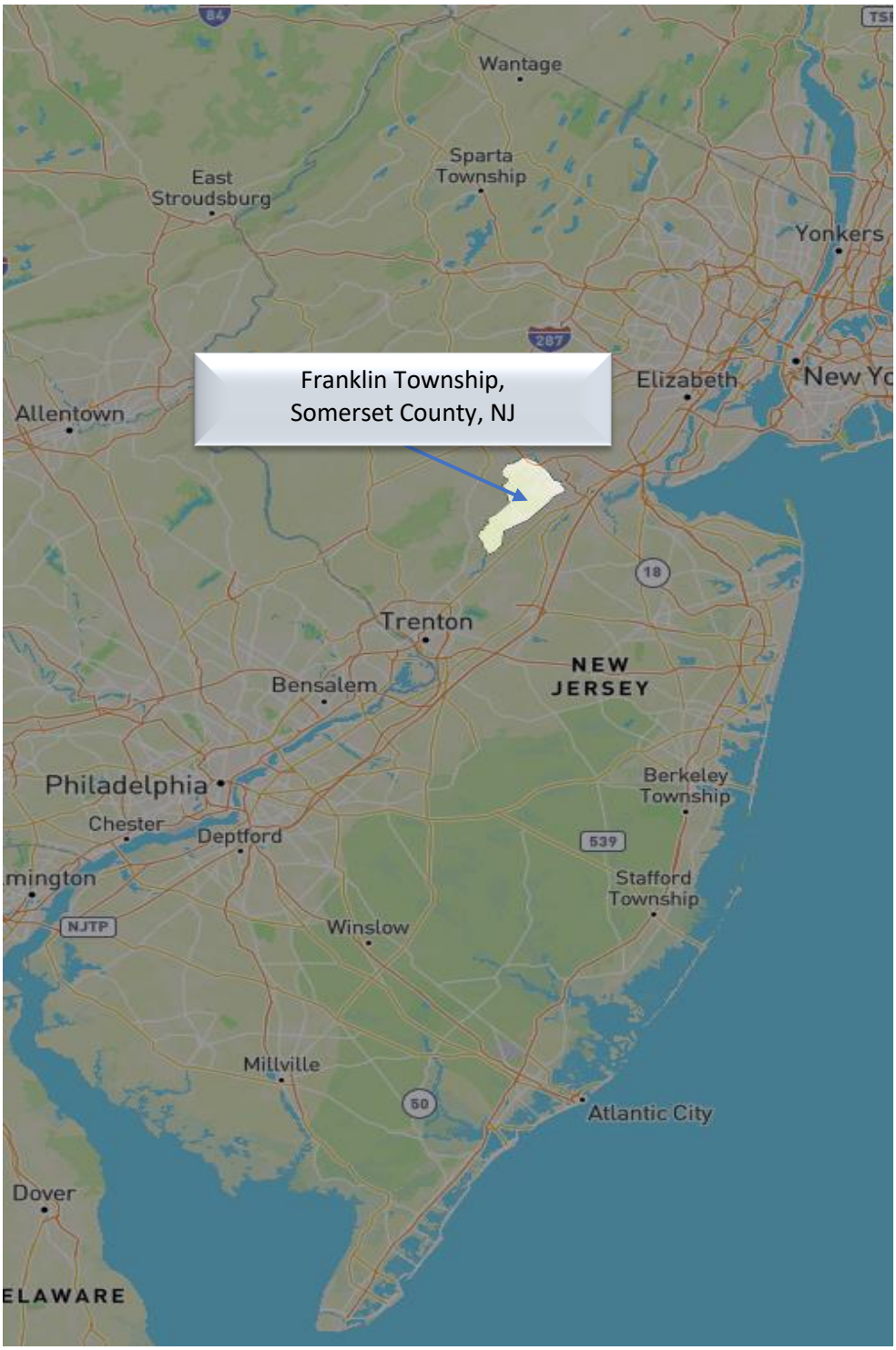
*Note – Additional information gathered from the Franklin Township Municipal Government, Franklin Township Sewerage Authority and Franklin Township Fire Districts 1, 2, 3, & 4. https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report

**Appendix A – Map of Franklin Township**



**Appendix B – Current Wireless Connected Devices**

| Franklin Township Municipal Government | | |
|---|---|---|
| Public Safety | 37 | Portable Computers |
| Public Works | 31 | BigBelly Waste Receptacles |
| Water Department | 20 | Water Pump Station SCADA |
| Information Technology | 12 | Security Cameras |

| Franklin Township Sewerage Authority | | |
|---|---|---|
| Pump Stations | 21 | Pump Station SCADA |

| Franklin Township Fire Districts | | |
|---|---|---|
| Fire District 1 | 31 | Wireless Devices in Vehicles |
| Fire District 2 | 17 | Wireless Devices in Vehicles |
| Fire District 3 | 16 | Wireless Devices in Vehicles |
| Fire District 4* | 7 | Wireless Devices in Vehicles & Station |

*Fire District 4 is shared between Franklin Township and South Brunswick

**Appendix C – Planned Wireless Connected Devices**

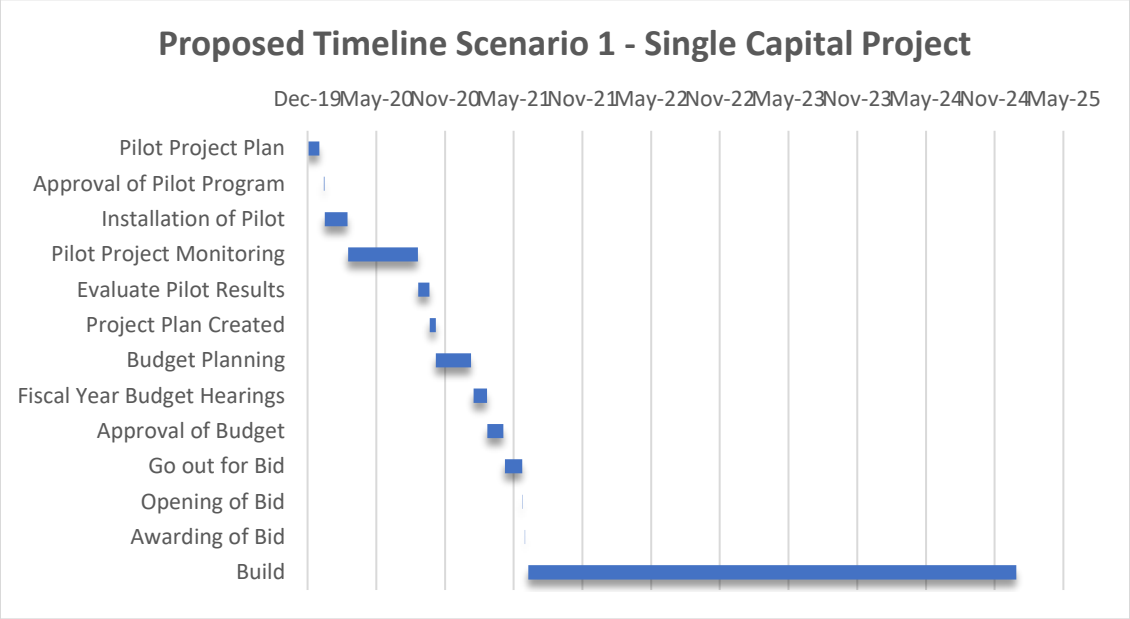
| Franklin Township Municipal Government | | |
|---|---|---|
| Public Works | 10 | BigBelly Waste Receptacles |
| | 100 | Fleet GPS Tracking* |

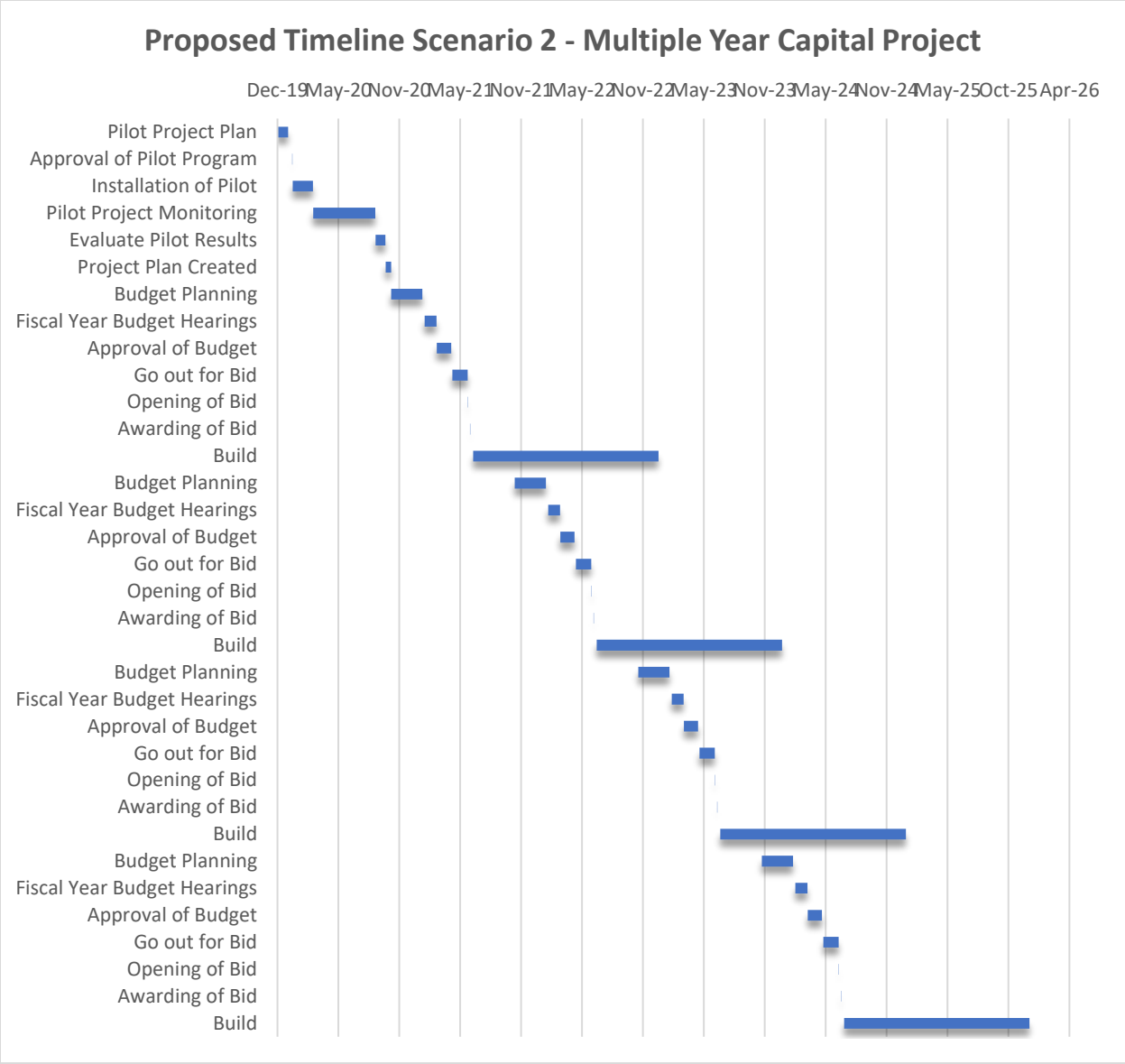
*Devices are installed and operational but part of a 5 year, no charge agreement

| Franklin Township Sewerage Authority | | |
|---|---|---|
| Pump Stations | 2 | Additional Pump Station SCADA |

**Appendix D – Proposed Implementation Timeline**

The proposed timeline is based on starting the project at the end of 2019 and approving the entire project in one budget cycle as a single capital project expense. The project could be broken into multiple phases requiring approval annually for capital expenditure, which would require repeating the budgeting process, approval, going out for bid, awarding of the contract, and building for each budget year.




Proposed Timeline Scenario 2 - Multiple Year Capital Project
Dec-19
May-20
Nov-20
May-21
Nov-21
May-22
Nov-22
May-23
Nov-23
May-24
Nov-24
May-25
Oct-25
Apr-26
Pilot Project Plan
Approval of Pilot Program
Installation of Pilot
Pilot Project Monitoring
Evaluate Pilot Results
Project Plan Created
Budget Planning
Fiscal Year Budget Hearings
Approval of Budget
Go out for Bid
Opening of Bid
Awarding of Bid
Build
Budget Planning
Fiscal Year Budget Hearings
Approval of Budget
Go out for Bid
Opening of Bid
Awarding of Bid
Build
Budget Planning
Fiscal Year Budget Hearings
Approval of Budget
Go out for Bid
Opening of Bid
Awarding of Bid
Build
Budget Planning
Fiscal Year Budget Hearings
Approval of Budget
Go out for Bid
Opening of Bid
Awarding of Bid
Build