PUBLIC WI-FI SUPERCLUSTER BLUEPRINT

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CHAPTER 1 – EXECUTIVE SUMMARY

Purpose

The purpose of this blueprint is to provide readers with a practical "how-to" guide for deploying a Public Wi-Fi system within their jurisdiction or agency. The goals of the Global City Teams Challenge program are to bring together thought leaders and experts on a wide variety of topics relating to modern "Smart City" technologies and to have them share their knowledge and create best practices to assist those who are coming after them. The authors and contributors of this blueprint have designed, built, and managed Public Wi-Fi systems all over the United States and it is this spirit of collaboration and knowledge sharing that drives this effort forward.

This is intended for readers who are interested in building Public Wi-Fi systems – particularly in outdoor and large spaces – and who would like practical and real-world advice and/or have already done so and would like to continue looking for best practices. It is intended for readers at all levels of organizational decision making and influence from technologists (e.g., engineers, security experts, and IT analysts), to finance and procurement specialists, to marketing and community development specialists, to executive staff and elected officials.

Blueprint Structure

The blueprint has been structured with a practical, modular approach in mind. That is, each chapter focuses on a specific element in the Public Wi-Fi deployment process. While each element is required to properly deploy a Public Wi-Fi system, the chapters are broad enough that readers may only need bits and pieces from each, depending on the size and scope of their projects. The chapters break down like this:

- Introduction to Public Wi-Fi Use Cases
- History of Public Wi-Fi
- Funding and Business Models
- Legal Issues
- Marketing & Outreach
- Procurement
- Technology Strategy & Policy
- Project Management
- Real-World Case Studies
- Appendices

Throughout the blueprint there are "Key Takeaways," "Important Questions to Ask," and "Helpful Hints" that are meant to provide readers with the most salient and relevant points and practical, real world advice. These can be used as a quick reference guide for this interested in getting to the heart of the matter. The Appendixes feature templates, worksheets and additional resources that agencies can readily use for their own needs. The next section will discuss the highlights of the blueprint.

Highlights

There are many use-cases for modern Public Wi-Fi systems. Municipalities surveyed[1] during the research of this project overwhelming indicated that social and public benefits, such as digital inclusion,[2] economic development, and providing services for students were their primary objectives for Wi-Fi. However, a growing use-case includes backhaul connectivity for Internet of Things (IoT) networks. There are dozens of potential use cases for Public Wi-Fi and this paper explores many of them in depth.

From a funding perspective, in many examples, we found that Wi-Fi was funded as public infrastructure, in the same manner as other public infrastructure like roads and sidewalks. When agencies fund Public Wi-Fi systems directly, we term it: "The General Fund Model." At the same time, many successful Public-Private Partnerships exist where cities have partnered with private sector firms to exchange assets for the deployment of Public Wi-Fi service. When this occurs, we term it: "The PPP Model." Finally, cities both on their own and with private sector partners are starting to realize the benefits of Public Wi-Fi as a legitimate revenue source. We call this: "The Revenue Model." **It must be understood that no funding model is inherently better or worse** – the decision depends on many factors specific to each agency.

Legal Issues come from the regulatory landscape as well as the organizational responsibilities and that come with deploying a Public Wi-Fi system. **Marketing & Outreach** benefits from coordination with external partners, such as: schools, businesses, and other public sector partners. Agencies should prepare a robust social media strategy along with promoting strong word of mouth.

Procurement is part of any project and this blueprint identifies four main areas to focus on: researching the industry; creating an advisory board; the approach; and the contract (pricing, vendor evaluation, and contract execution). **Wi-Fi Technology** has significantly improved over the years, and there are only three architectural pieces required: access points; management; and backhaul. Access points, particularly in outdoor networks, significantly benefit from mesh networking while management comes with the platform. Backhaul can be harder, but wireless technologies are emerging that are cost-effective compared to fiber construction. Meanwhile, agencies must think about policies around: security, access, maintenance and support, and management and build up a firm understanding of the evolving wireless technology landscape, which is discussed in depth.

The Project Management chapter is highly modular and practical. It provides many templates, worksheets, samples, and lists that can be readily adopted by an agency for a Public Wi-Fi project. This can be found in the Chapter Appendix.

Conclusion

It is our hope that readers find this blueprint to be a useful tool for understanding and advancing Public Wi-Fi projects. As smart city technologies continue to evolve, Wi-Fi will remain a key part of the solution both as a backhaul technology and as a connectivity solution for the public and municipal staff. We hope that the blueprint offers useful, practical advice and that our case studies inspire you. Good luck in your future Public Wi-Fi endeavors!

[1] The survey was conducted online. 75% of responses were from California and 70% were from IT functions.

[2] https://www.benton.org/blog/what-do-we-mean-when-we-say-digital-equity-and-digital-inclusion

CHAPTER 2 – INTRODUCTION TO PUBLIC WI-FI USE CASES

Overview

Public Wi-Fi has a large number of use cases. This section seeks to provide guidance and information related to the most prominent types and will provide a general overview of the most frequently cited use cases for implementing Public Wi-Fi. What it does not seek to do is provide explicit guidance in terms of implementation. Each city/municipality will have their own strategy and execution plan as there are several additional elements associated with developing and deploying a public solution (many of which are discussed in other areas of this document).

The following use cases and outcomes will vary by city, but nearly all represent possibilities to improve overall city efficiency, citizen engagement, quality of life, economic develop, digital inclusion, and enhance city services and performance. These use cases represent the core reasons and goals for executing a Public Wi-Fi network deployment and are therefore critical to consider in advance. Outlined below are a few of the most frequently cited use cases and their drivers for consideration.

Digital Inclusion

This is often identified as one of the most important reasons for implementing a Public Wi-Fi solution. Digital inclusion - or reducing the digital divide - is also viewed as “Creating a more digitally connected community” and includes:

- Underserved communities/areas
    - Economically disadvantaged
- Rural and remote areas with limited telecommunications infrastructure
- Schools, primarily K-12
- Programs within the community
    - eHealth services
    - Community Centers (youth, senior, cultural, etc.)

Where cities/municipalities have incorporated a strategy for deploying a Public Wi-Fi solution to address this use case, the elements of consideration and planning are significant in terms of:

- **Funding** - Where are there opportunity for funding vehicles
- **Best Practice** - What is the best way to deploy and what model should be adopted
- **Service level delivery** - What service level and performance should be expected
- **Security** - What is the security model and what level of responsibility does the city/municipality hold and what is the policy
- **Governance, accountability, overall policy and cost**
- **O&M (Operation and Management)** - Who is responsible for operating, managing and maintaining the network and services

Under the use case of Digital Inclusion there are several service level offerings that any city/municipality could consider, including:

- **Unified School District:**
  - Ensuring that the schools and libraries have connected access to the internet for the purpose of education, students doing their homework etc.
- **Underserved communities and programs:**
  - Includes issuing devices (PCs, laptops, etc.) as the rollout takes place.
  - Includes getting individuals that are connected, but have no data plan.
  - Donations from Private/Public partnerships.
  - Training and Adoption.
    - Improve digital literacy
    - Cybersecurity and risk mitigation

There should also be metrics in place to determine the measure of success. Some metrics that could be considered are:

- Cost to deliver services to the schools and communities.
- Improved educational outcomes - Test score improvements.
- Economic mobility - (Growth in jobs or individuals employed due to the connected access).
- Improved citizen experience due to the city delivered services - Improved community involvement and citizen satisfaction.

Funding
Funding vehicles will predominantly be covered under the Finance section of the blueprint document. However, for consideration:

- e-Rate programs have been used by other cities and municipalities as a means of satisfying this use case.
- Private/Public partnerships via donation programs for hardware and services.
- Leveraging existing city Wi-Fi networks and fiber as a means of offsetting cost.
- HUD and or FCC Universal Service Funds may be available to fund deployments in lower income, under-served communities.

Economic Development

High on the list for many municipalities is using Public Wi-Fi to promote and economic development. Building Wi-Fi networks in high-density public indoor and outdoor spaces provides an additional attraction to draw people to these locations. Here are some examples of how Public Wi-Fi can contribute to economic development efforts:

- **Downtown areas** – Many Public Wi-Fi projects start with downtown cores given their proximity to nearby businesses (e.g., coffee shops, restaurants, cafes, etc.) and their high density of foot traffic. Surrounding businesses can promote the Wi-Fi networks as a benefit for patrons.
- **Plazas** – Like downtown spaces, outdoor plazas are a prime location for Public Wi-Fi systems
- **Tourist Attractions** – In many cases, Public Wi-Fi can enhance tourist destinations by providing tourists with an amenity to use while visiting. These efforts can be combined with business groups, such as the Chamber of Commerce, etc. to promote these locations.

- **Business Parks –** Wi-Fi in business parks can be an attraction for new businesses as the outdoor spaces around the offices can be used by employees for leisure making the location a desirable work site.

Public Safety

Cities could elect to deploy Public Safety services over a Public Wi-Fi network reserving bandwidth and specific frequency and channel allocations such that they are not "publicly accessible" (i.e., only authorized devices can access the network). The services on these secure public safety networks can include, but are not limited to:

- **Connected lighting** - In several areas of the city there are safety issues related to poor lighting conditions and leveraging the Public Wi-Fi network to connect the lights improves safety in these areas e.g.:
    - Parking lots
    - Parking garages
    - On and off-street parking locations
- **Reduced crime and or crime prevention**
- **Improved citizen satisfaction** - Citizens feel less vulnerable to crimes.
- **Image sensors** - Connecting image sensors to the Public Wi-Fi network for the city provides benefits of public safety by way of "Security". Image sensors are becoming more and more commodity items that can serve to deter crime, afford the city an opportunity to view crimes and other issues in near real-time as opposed to forensically.
    - Likewise, could be used to inform first responders as to where emergency situations are located, and allow a more effective and efficient response.
    - Image sensors could also be leveraged to provide insight to other neighborhood crimes such as:
        - Loitering
        - Graffiti
        - Vehicle intrusion

In addition, public safety Wi-Fi systems can be used as alternative communication systems for public safety professionals, such as police and fire fighters. In these cases, devices can connect to these networks and send secured transmissions to City Hall and other locations.

Public Notifications

An emerging use case for Public Wi-Fi infrastructure is public notifications and other helpful services. These are best exemplified by the LinkNYC system, which uses kiosks as both digital way-finding devices and Wi-Fi hotspots, while also providing advertising and revenue opportunities.

- **Digital Signage** - Providing various city services;
    - Wayfinding - Providing citizens city information such as;
        - Parking
        - Festival occupancy - How crowded is a venue or city location
- **Other notification types**
    - Emergency services
    - City engaged responses - Twitter feeds and other citywide notifications

- **Kiosks**
  - Interactive digital signage e.g. Sidewalk labs kiosks that provide citywide information
- **Public transportation**

Enhanced Municipal Services & Emerging Use Cases

Use cases for Wi-Fi extend beyond the common sited cases above. Here are some additional areas where Wi-Fi is being used as a communications system for municipal services.

- **Smart Grid**
  - Demand response and backhaul for other Smart Grid solutions and transport.
- **IoT Backhaul**
  - With modern Internet of Things networks, Wi-Fi is frequently becoming a cost-effective and useful technology for backhaul.
- **Traffic monitoring**
  - Vision zero initiatives - Monitoring and reducing collisions at intersections.
  - Improvements to traffic systems, car counting down city corridors to aid in congestion management.
- **Tracking - Pedestrian, Bicycle, Vehicle**
  - Counting for the purpose of crowd detection and management.
  - Various location based services e.g. Bike programs and where the bikes are or have been.
- **Layered services** - Pub/Gov/Others

Key Takeaways

There are many use-cases for Public Wi-Fi. It is important to consider the goals and desired outcomes while still in the planning phase. Here are some key points to consider.

- Always consider the additional applications that can be placed a Wi-Fi network.
- Digital Inclusion is often cited as a reason for Public Wi-Fi; to be successful look to partner with schools and other institutions in your community who will benefit from the system.
- Just because its's called "Public Wi-Fi," does not mean that there cannot be "Private" elements that serve city or municipal initiatives (i.e., secured public safety networks, etc.)
- There are many emerging use-cases that can be explored, such as public notifications, way-finding, advertising (i.e., revenue), smart grid, traffic monitoring, and more. Find out what is the most important for your community and start researching there.
- Having a vision, strategy and an execution plan will be critical in the success of your program.
- Make sure that you have a roadmap for future applications and proper maintenance.

CHAPTER 3 – HISTORY OF PUBLIC WI-FI

The Early Days

The dreams and aspirations of a municipal Wi-Fi system aren't new: provide free, high-speed internet to your community, close the digital divide, shrink the homework gap, and give consumers a free, public option for internet service. It's not hard to see why the concept has remained so popular over the years. Municipal Wi-Fi projects date back nearly two decades. As early as 1999 Metricom was offering a 28.8 kbps commercial service in most of the San Francisco Bay Area, and a few years later they launched a blisteringly-fast (for the time) service with 128 kbps – comparable to the copper-pair ISDN data service which many startup companies used for what was then considered broadband. In parallel, there was a growing desire to provide Wi-Fi data as a public service.

One of the first high-profile public projects came in 2005, when the City and County of San Francisco, CA issued a Request for Information for the deployment of a city-wide wireless broadband network.[3] In 2006, EarthLink & Google, by proposing a unique, strategic partnership, were awarded the contract. Using the same wireless network, Google would offer free, 300 kilobits-per-second service, while EarthLink, an internet service provider transitioning from the dial-up modem to broadband era, would offer a faster, premium service of 1 megabit per second for US$20/month.[4] The cost to the city would be zero, which was assuredly music to city officials' ears.

By this time, Google was already offering free Wi-Fi service in its hometown of Mountain View, CA and EarthLink had struck agreements with Philadelphia and other cities.[5] Many others quickly followed suit as Chicago; Portland, Oregon; Minneapolis and signed similar deals with EarthLink, Metricom, Metro-Fi, and other providers. In fact, by one count, over 200 municipalities had announced projects by the middle of 2006.[6]

Yet by 2007, the San Francisco project was dead along with many more. EarthLink's model proved to be a failure. Metro-Fi and Metricom devices were left stranded on city poles, leaving municipal public works crews to clean them up and foot the bill for the removal cost. Meanwhile, Google's free Wi-Fi in Mountain View, according to one insider we spoke with, was by then foundering.

Analysis of What Went Wrong

Much has been written on the death of municipal Wi-Fi. Eric M. Fraser, a legal scholar, pointed to Wi-Fi technology itself as the problem, citing three factors: "imperfect frequency, congestion within the frequency bands, and limited signal strength" as the main causes. These factors, he argued, resulted in signal degradation over short distances and when passing through "trees, cars, walls, windows, and household furniture"; thus, connections were unreliable and the cost to build out a network that would overcome this (which would require tremendous access point density in the architectural design of the network) was thus cost-prohibitive.[7]

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[3] http://www.irma-international.org/viewtitle/33276/

[4] https://www.cnet.com/news/earthlink-and-google-win-san-francisco-wi-fi-bid/

[5] https://www.cnet.com/news/earthlink-wins-philly-wi-fi-contract/

[6] http://www.economist.com/node/5571560

[7] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1682088

Wi-Fi also lacks an intrinsic authentication method, and does not have a handoff mechanism to allow users to move between access points without disruption to the connection.[8]

Tim Wu – famous for coining the phrase "net neutrality" – blamed cities for turning over muni Wi-Fi networks to private partners that needed to generate profits in order to be sustainable. In 2007, he argued with "typical configurations…municipal wireless connections are slower, not dramatically cheaper, and by their nature less reliable than existing internet services," thus no one would pay for it.[9]

Another factor is simply market readiness. In 2005-2007, end users were much less likely to know how to associate to a public Wi-Fi network, much less even think it might be doable or have a reason to connect.

Public Wi-Fi Renaissance

While things looked bleak in 2007, municipal Wi-Fi never truly died. In cases where the city itself became the "anchor tenant" on the system (i.e., the city uses the network for cost reductions and to increase operational efficiency), municipal Wi-Fi networks were able to sustain and do quite well.[10]

Meanwhile, the dreams of achieving ubiquitous, free connectivity have not only survived intact, but today are thriving all over the world. This is because the situation is dramatically different now and much more favorable for Public Wi-Fi deployments. This has occurred for several reasons.

For one, Wi-Fi has become a mature, recognizable, and reliable technology with many companies building powerful and affordable enterprise-grade solutions and systems. Wi-Fi technology itself has greatly improved, particularly with the release of 802.11AC.[11] This is the fifth generation of Wi-Fi technology and provides gigabit speeds and excellent range. Mesh networking has made outdoor buildouts cost-effective and achievable.

At the same time, with mobile devices flourishing since the release of the first iPhone in 2007, people all over the world have become familiar with Wi-Fi and are confident in its basic ability to effectively deliver wireless internet connectivity. In fact, Wi-Fi plays a critical role in internet connectivity. One study forecasts that more than 49% of the world's internet traffic will be transmitted on Wi-Fi technology by 2020.[12] And it's not just for humans. As the Internet of Things (IoT) advances, Wi-Fi will play in also key role in connectivity and backhaul for machine-to-machine (M2M) systems.[13]

Lastly, municipalities have learned from the lessons of the past. Some are exploring breakthrough business models and public-private partnerships, while others are successfully justifying expenditures from the general fund to build and maintain Wi-Fi systems. In this way, Public Wi-Fi has emerged from the ashes of Muni Wi-Fi and there is no better time than today to consider building public Wi-Fi.

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[8] http://bit.ly/jvsv-telecom-hbook

[9] http://www.slate.com/articles/technology/technology/2007/09/wheres_my_free_wifi.html

[10] https://www.csmonitor.com/2007/0913/p13s01-stct.html

[11] http://standards.ieee.org/news/2014/ieee_802_11ac_ballot.html

[12] https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.html

[13] http://www.networkworld.com/article/2917793/internet-of-things/is-wi-fi-going-to-be-the-technology-of-choice-for-iot.html

CHAPTER 4 – FUNDING MODELS

Business Model

The Fundamental Question

Three primary business models clearly emerge for today's Public Wi-Fi projects. The direction a municipality takes depends on a multitude of factors, many specific to the municipality itself, such as: the local economy, physical location, density and size of the municipality, private partners available, organizational structure, fiscal and financial situation, economic forecast, political landscape and, of course, the underlying philosophy and values of the community itself. These all play a critical role in the decision of how to fund a Public Wi-Fi project.

Thus, consider this the fundamental question: will the Wi-Fi system be a part of a public-private partnership (where the private firm absorbs some or all of the costs), a revenue generator (where some mechanism generates revenue to offset the cost to the agency), or, simply, a general fund initiative (i.e., a "public service")? Questions to ask, include will the municipality use the network for human or machine connectivity and/or to create efficiencies or reduce expenses? This direction will answer the all-important question of sustainability (i.e., how will the Wi-Fi system be paid for and maintained over time?) It will also inform subsequent decisions down the line, such as whom to partner with and what types of investments will need to be made.

The Public-Private Partnership (PPP) Model

"PPP Model" is used here as a blanket umbrella for any model where a public agency partners with a private entity to deploy a Public Wi-Fi system. In many cases, agencies trade access to their assets (e.g., street poles, infrastructure in the public right-of-way, etc.) in exchange for having a Public Wi-Fi system deployed by the private firm.

PPP models have been around for a long time and there are myriad strategies that have been proposed over the years. In fact, the roots can be traced back to the Muni Wi-Fi 1.0 days and projects such as San Francisco's EarthLink deal. While today's models have had much more success, the underlying tenets remain the same: cities can benefit from having Public Wi-Fi deployed throughout their community, while avoiding, ether partially or, the up-front capital cost of construction and ongoing cost of maintenance. The cost comes in the form of an opportunity cost of the asset exchanged in the PPP structure.

Some recent projects that have been announced that fall under this model include:

1. A recent partnership between the City of Sacramento, CA and Verizon. Sacramento exchanged access to over 100 city-owned poles and miles of its fiber conduit in exchange for free, Public Wi-Fi kiosks in 25+ public parks in the city. Verizon is expected to invest over US$100 million in the city over the next several years.[14]

[14] http://www.sacbee.com/news/local/news-columns-blogs/city-beat/article154728374.html

2. Kansas City, MO launched Public Wi-Fi in 2016 through a strategic public-private partnership between the city, Cisco Systems, and Sprint. The city paid for US$3.7 million of the total US$16 million cost with Sprint and Cisco picking up the rest.

Considerations for Public-Private Partnerships

Public-private partnerships are attractive because they can deliver tremendous value for communities with little cost to municipalities themselves. However, there are still important considerations for those exploring a private-sector partnership. G.W.E.B. van Herpen, in an essay for the Dutch Ministry of Transport[15], outlined some:

- **Insecurity**: Whenever two or more parties enter into a contract, there is a risk that the administrative efforts on each side will be frustrated by a lack of cooperation on the part of the other party(s).
- **Inefficiencies**: Due to a lack of contestability and competition.
- **Culture gap**: The private sector's motive to take part in a public private partnership is generally profit-making or image-building; the public sector's motive is merely social attractiveness …To overcome the gap in culture, trust is one of the most important aspects in a partnership; without trust, real success is hard to realize.

In sum, private partners have much different incentives, goals, timelines, operations, and cultures than public sector organizations. As such, not all public-private partnerships are created equal and public sector organizations should think carefully about the partners they select.

Some have called this the "*Let Google Do It*" approach arguing that private partners have developed deep skills-sets in Wi-Fi solutions and management and so municipalities should partner and not try to compete with them. It's a persuasive point. However, one important piece in a public-private partnership is the **contingency plan**. What happens if the partnership or the private entity fails? The answer is not always clear, but it's a question that needs to be answered in the beginning.

MINI CASE STUDY: LINKNYC

The project that has received the most attention is arguably New York City's "LinkNYC." LinkNYC spawned from a competition New York City held in 2014 to replace its existing payphones with Wi-Fi hotspots. The innovation is to deliver large kiosk towers that display advertisements, way-finding, and act as Wi-Fi hotspots. Many partners, including Alphabet (Google), Intersection, CIVIA, Qualcomm, Antenna, and others came together under a consortium called "CityBridge" (see Figure 1). This team promises to deliver over 7,000 kiosks in New York City over the next 12 years, delivering free, gigabit speed Wi-Fi throughout all five boroughs. The system will return US$500 million in advertising revenue to the city over 10 years. It will cost US$200 million to build, with no cost to New York City.[1]

The model is now operational in New York City and CIVIQ, one of the consortium partners who are responsible for building and installing the physical kiosk towers (a/k/a "Links") has since announced similar deals with Miami-Dade County and Chicago to deploy Public Wi-Fi with zero cost to the municipalities.

See Chapter Appendix for a graphic

[15] https://finmin.lrv.lt/en/competence-areas/public-and-private-partnership-ppp/ppp-advantages-and-disadvantages

The Revenue Model

This Revenue Model is one where the agency deploying Public Wi-Fi uses some form of revenue generation to offset the cost of the building and maintaining the system. The revenue could be direct, such as charging users for on-demand or premium levels of service (i.e., faster speeds), or could be indirect, such as selling advertisements and/or usage data and statistics to advertising partners, while providing the service free of charge for the public. There are not many successful examples of publicly funded Wi-Fi systems (i.e., paid for with tax monies) that employ the Revenue Model. In many cases, it seems end-users are unwilling to pay for premium service if free service is available.

Meanwhile, there are emerging examples of successful advertising revenue from Public Wi-Fi systems, but in the cases where this is working these are actually PPP models where the private sector firm is responsible for building, managing and delivering the advertising platform, securing the relationships with the advertisers, and developing privacy policies for user data. In these cases, the private sector firms simply agree to cut the public-sector partner a check with some percentage of the revenue generated.

The General Fund Model

On the other side of the coin is what, for this blueprint, we call the "General Fund" model. This is an umbrella term for any model for which the municipality itself pays for Wi-Fi through a funding source such as the general fund. In projects like this, the procurement is much more traditional with a selected vendor and negotiated contract vehicle.

Most often, there is no expectation of generating revenue with these types of deployments. In addition, they are often installed and/or operated with the involvement of city staff. Sometimes, private-sector partnerships arise in this model, usually in the form of integrators or private partners who trade some for on services, such as assistance with the design, installation, operation, and/or maintenance of Wi-Fi systems for city assets of some form. However, at the end of the day, the municipality generally still writes a check for such services, so these forms of partnerships tend to resemble much more of a traditional vendor/customer paradigm.

When municipalities self-fund Public Wi-Fi initiatives, especially when the source is from existing monies, such as general fund or reserves, the projects tend to be on a smaller scale. This is simply a matter of cost: because the funding is much more limited, the projects cover a smaller area and require lower construction costs. Many cities start with their downtowns and other core areas, such as tourist attractions and retail/restaurant districts where Wi-Fi will provide the most "bang for the buck."

MINI CASE STUDY: SMCPUBLIC

SMC PUBLIC WiFi
www.smcgov.org/wifi

In 2012, voters in the County of San Mateo passed a half cent sales tax measure. Revenues from this tax increase have gone to fund Wi-Fi projects throughout the county, which ranges from dense, urban city to rural, forested and coastal areas. As of June, 2017, over 30 sites have been brought online to "SMC Public Wi-Fi" with more sites planned in the future.[1]

However, municipalities are not limited to existing funds. They can raise new revenues through taxes, bonds, municipal loans, and the like.

Considerations for General Fund Model

When municipalities procure their own Wi-Fi systems, there are several things to consider. The first is the funding source itself, which can be from existing funds, future revenues (bonds, loans, etc.), or grants. Grants are a one-time source and thus future years will need to come from other sources. Presuming a funding source is identified, there are hidden costs associated with wireless systems. The two major hidden costs are **support** and **hardware refresh**.

> **Support** is defined as the need to provide ongoing maintenance and service to keep the system running optimally. When Wi-Fi in a public space goes down, it will eventually be reported in some fashion to city officials and will require servicing to restore. That cost, therefore, need to be accounted for upfront. Who will provide the support? How will requests for service be addresses? What is the service level agreement (SLA) the city provides? Planning for this ahead of time will avoid costly outages down the line. Oftentimes, municipalities will contract with external partners to provide ongoing maintenance, but this comes at a recurring cost.
>
> **Hardware Refresh** is defined as the lifecycle of the network equipment. Five years after deployment, the Wi-Fi technology of the time will likely have been replaced with a newer generation. Municipalities must consider that future years will need to be budgeted for, otherwise the system could become stale and obsolete. With the General Fund model, municipalities should be clear-eyed about the ongoing refreshment costs and the commitment to upgrade equipment, as needed.

Lastly, when agencies self-fund Wi-Fi projects one of the largest future challenges they will face will be quantifying the benefits of the system over time. Just as it is hard to quantify the benefit of a new road or sidewalk, so it is with a Public Wi-Fi system. However, in order to continue justifying the expenditures, agencies should be prepared to analyze the real-world value their Public Wi-Fi system creates. Is it closing the homework gap and increasing students' test scores? Is it providing a measurable uptick is measures of the local economy? Is tourism increasing? These are all questions that can be asked, and the answers could make-or-break a Public Wi-Fi system in the General Fund Model.

Wi-Fi as an Add-On to Another Project

Often, Wi-Fi is not an end-game, but a complimentary service that can be added to another, funded project. For example, a low-income housing project that has large political support may also provide an opportunity to include fiber-optics and Wi-Fi service in the immediate public spaces around it. Likewise, a transportation project such as a light-rail system could be the catalyst to deploy Wi-Fi along the service route. Many of these projects fall under the umbrella of "Smart City" technologies.

The following list is by no means exhaustive, but in our research, we found General Fund model Wi-Fi projects that tied into such projects as:

- Smart lighting
- Cameras/surveillance/CCTV
- Fiber-optics, broadband build-outs
- Traffic signal build-outs
- Public safety technology projects

- Low income housing
- Internet of Things (aka "IoT", where Wi-Fi can be an effective backhaul technology)
- Transportation projects like Light Rail or Bus Rapid Transit (BRT)
- Street beautification/improvement projects
- 4G cellular densification and small cell HetNet[16] systems

Thus, municipal leaders interested in deploying Wi-Fi must observe projects going on throughout the municipality and effectively spot and present such "tie-on" opportunities. This requires inter-department/inter-agency cooperation and communication and even spread beyond a single municipality to a regionalized approach that explores opportunities with adjacent cities, mass transportation agencies, school districts, public utilities, parks districts, and more.

An important takeaway we have found is that Wi-Fi champions are often in the Information Technology departments and when these people are involved in decision-making (i.e., "at the table") these "tie-on" opportunities are more likely to be capitalized on.

Conclusion

Public Wi-Fi is now in a renaissance where new models and innovations have been implemented, such as LinkNYC, which are changing the perception of public-private Wi-Fi projects. Meanwhile, municipalities all over the country are taking Wi-Fi into their own hands and deploying systems that complement and even connect to other public-infrastructure, particularly in the smart city age.

Yet, while these funding and sustaining models may seem appear to be philosophically different – one approaches Wi-Fi as a revenue source to be installed and managed by for-profit enterprises while the other approaches Wi-Fi as a public service in the same vein as roads, streets, and public works infrastructure, the desires and intentions of the municipalities and officials behind them are nearly universal: to provide the public with free- high-speed wireless internet service. **As such, there is no right or wrong answer to the funding model puzzle** and neither model should be viewed as fundamentally superior to the other.

Which direction a municipality takes depends largely on local factors, such as the regional ecosystem, the size of the municipality, the location and density (rural/suburban/urban), the economics, and the public-private partnership (PPP) opportunities that are available. As a result, each Muni Wi-Fi project will look slightly different and no two will be identical.

Public Wi-Fi is now in a renaissance where new PPP models have been implemented, such as LinkNYC, while other agencies are successfully justifying expenditures from their general fund.

[16] HetNet is short for "heterogeneous networks" in cellular mobile telecommunications networks. Refer to "Bridging the Gap" (Joint Venture Silicon Valley, 2016, http://bit.ly/jvsv-telecom-hbook) for details.

Key Takeaways

- New “Revenue Fund” model projects in the form of public-private partnerships are yielding significant benefits to municipalities. There are many examples, such as: Sacramento’s exchanging city-owned assets like street lights in poles in exchange for Verizon putting Wi-Fi in city parks; and advertising-based systems like LinkNYC with no cost to the city that combine way-finding, Wi-Fi, charging stations and other services together.
- Yet, risk still must be managed in a PPP and answering the question, “What happens if it fails?” should be done in the beginning, not later. In addition, municipalities should take the time to find the right “fit” in a private partner.
- Meanwhile, “General Fund” model using public funds are flourishing, such as in San Leandro, CA and San Mateo County, CA. These projects tend to start on a smaller scale, targeting dense areas such as downtowns, tourist areas, and transit hubs. This keeps costs lower and allows expansions to happen over time.
- However, these projects must answer future funding challenges such as ongoing maintenance, support, hardware refreshment costs, while establishing data and metrics that continue accurately measure the benefits of publicly funded Wi-Fi systems.
- Wi-Fi can often be deployed successfully as a “tie-on” to other public projects, such as IoT; transportation; broadband/fiber; security and surveillance cameras; and more.
- City leaders who take up the mantle as “Wi-Fi Champions” must actively look for such opportunities both inter-agency, cross-departmentally and with regional public partners.

Chapter Appendix

CHAPTER 5 – LEGAL ISSUES

Municipalities should be prepared to investigate legal issues that could impact their Public Wi-Fi project. This document is not intended as a substitute for legal advice. Issues from our perspective will be classified below in terms of 1) the Regulatory Landscape and 2) Organizational Responsibilities[17].

Regulatory Landscape

Broadband technologies are regulated by several bodies. In the United States, at the national level, the Federal Communications Commission (FCC) has oversight of broadband systems and companies and has the authority to create and enforce regulations that may impact Public Wi-Fi deployments. While commercially available enterprise Wi-Fi systems use unlicensed spectrum (e.g., 2.4 GHz and 5.0 GHz) many wireless technologies use licensed spectrum, which is regulated by the FCC. Certain public safety systems can be exempted from license fees, which may be important in a municipal project.[18]

Regulations also occur at the state level. For example, half the states in the nation have some form of broadband law that applies to municipalities.[19] Agencies operating in these states should take the time to review these laws prior to deploying Public Wi-Fi.

Finally, cities have their own local laws and policies that may apply to Public Wi-Fi projects, especially those that are located outdoor, in the public right-of-way. These typically require permits, such as encroachment and/or building permits. Depending on the level of construction required, there may also be labor laws associated with the project. Each municipality is different, but those Public Wi-Fi projects will be best served by conferring with their Building, Planning, and Engineering Division and Public Works teams *before* breaking ground.

Agency Liability

While there are many laws and regulations at all levels of government that can impact Public Wi-Fi deployments, there are also several important topics, which, regardless of whether they are legal or now, agencies should be aware of. Some of these topics involve the potential for liability. These include[20]:

1. Use of the network to exchange copyrighted material.
2. Illegal activity on the network.
3. Privacy concerns and use of end-user data.

Exchange of Copyrighted Material
Unfortunately, it is common for end-users to download and access illegal content while using Public Wi-Fi networks. While there are technical systems that can be installed to eliminate and/or limit this ability (e.g., firewalls with traffic inspection software or content filtering software), there is not an easy way to completely block end-users from accessing programs like BitTorrent to download content illegally. This

[17] *Disclaimer: This section is for informational use only and does not constitute legal counsel*.

[18] https://www.fcc.gov/general/license-exempt-wireless-applications-public-safety

[19] https://broadbandnow.com/report/municipal-broadband-roadblocks-by-state/

[20] http://www.wireless-social.com/how-it-works/legal-compliance/

becomes a complex issue, because BitTorrent has legitimate uses. A 100% reliable method to block a torrent site requires complicated and expensive hardware and complex software configuration.[21]

When an end-user downloads content illegally, the ISP will often receive a notice of copyright infringement from the content owner and/or their legal counsel with corresponding public IP addresses. The ISPs will then, in turn, forward these notices to the customers identified by the public IP address (i.e., the agency). At this point, the agency must choose whether to respond to the inquiry or not. Such notices can range from small fines (US$200-US$300) to threats of large penalties in the thousands.

Illegal Activity

Along with downloading copyrighted content, another potential problem is the use of the network for more serious illegal activities. These perhaps occur less often, but can be even more problematic. For example, if a person utilizes a public network to launch a cyberattack, the agency operating the public network could be held responsible. Likewise, an end-user on an unsecured, open public network may be "hacked" by a sophisticated user on the network using snooping and spoofing techniques to gain illegally gain access to data and files on the network. In this case, agencies might be liable for the damages to affected users, although in many cases the courts have not established definitive precedent to these liability questions.[22]

Mitigation includes having an end user agreement or terms of service and/or using system logging to detect the system used to perform the illegal activity, in order to aid with criminal investigations.

End User Data (Data Privacy)

Along with the question of whether the Public Wi-Fi provider is responsible for *protecting* end-user data, comes the question of what agencies *collecting* end-user data should do with it. Wi-Fi usage on public networks may be used to target advertising, which allows monetizing anonymized end-user information. While this anonymized data might be valuable enough to generate revenue for the agency or municipality, which would help offset costs of building and maintaining a Public Wi-Fi network, end-users may rightfully be concerned that they're being tracked. In reality any user of a smartphone or other device is already being tracked and their data is monetized by the device vendor and their network provider, but agencies and municipalities are often held to different standards. If a decision is made to monetize end-user data, this should be openly disclosed in council meetings and other means to ensure transparency and avoid public opinion backlash.

Likewise, a municipality that collects end-user data on the Public Wi-Fi system may be asked to cooperate with law enforcement agency requests to hand over end-user data. Disclosure could create privacy concerns and resident backlash. These are questions about privacy that each agency must determine on their own, in conjunction with sound legal advice based on constitutional principles. In a best practices deployment these policies will be made clear to the public up-front so that end-users connect to the network with explicit knowledge of how their data may or may not be used.

[21] BitTorrent uses randomized ports to connect to the Internet and is nearly impossible to block without using packet inspection software at the firewall level. And again, there are legal uses for BitTorrent.

[22] http://www.mbm-law.net/newsletter-articles/wi-fi-hotspots-and-liability-concerns/1229/

CHAPTER 6 – MARKETING & OUTREACH

Municipalities tend to have standard channels of communicating news and project information to their constituents. Most often this includes public announcements, meetings, and eventually a press release. For some public works and development projects, a ceremony might be planned, which could include a ribbon-cutting and speeches by elected officials. This is certainly an important part of launching a new service, such as a Public Wi-Fi system. However, we have found that these activities alone are not sufficient to ensure a Public Wi-Fi system is successful in terms of the number of users it serves. **The problem is obvious: many people will simply not realize the system exists, and therefore will not use it**.

Thus, widespread awareness is critical to a successful Public Wi-Fi project. To achieve this level of public awareness city leaders must think beyond traditional outreach efforts and treat the Public Wi-Fi system as a brand. In effect, they must become brand managers and devise an appropriate brand strategy to ensure that the Public Wi-Fi system – what it is, how it works, how to connect to it, what locations it serves, etc. – is widely known and communicated.

Wi-Fi Brand Strategy

Building a brand requires, first and foremost, a name that encompasses the project and spirit of it. For example, San Leandro calls its Public Wi-Fi system "Wi-Fiber," which combines the words "fiber" and "Wi-Fi" to reflect that it uses the Lit San Leandro fiber loop as its internet connection. Once a name brand is determined, marketing materials such as logos, flyers, posters, and graphics should be developed.

Beyond the name, a strategy requires defining demographic targets and then using certain channels to reach them. For example, high school students and teenagers, who would presumably be heavy users of a Public Wi-Fi system, will not follow standard municipal outreach like press releases and public announcements. They will need to be reached through targeted campaigns on channels where they are active.

Thus, a marketing strategy should be based on different profiles. These can include: students, parents, young adults, business owners, tourists, seniors, and more. To reach these groups, campaigns should be devised to reach them.

Digital Channels

Municipalities have several digital channels available on which they can promote services like Public Wi-Fi. An official website is the most logical place to being. The Public Wi-Fi system should be setup with an online web presence. This could be as simple as an announcement on the city home page or as complex as a website devoted specifically to the Public Wi-Fi project with status updates, news, reviews, and more.

At minimum, an online Public Wi-Fi presence should include:

- A description of the project
- The city leaders, elected officials, and partners involved
- Locations where the service is available (which can include online GIS maps)

- Official logos
- Contact information to inquire about the service
- News and updates

However, while a dedicated website can be a powerful branding tool for a Public Wi-Fi system, social media is a major source of online traffic. While specific social media strategies are outside the scope of this blueprint, it is crucial to note that social networking sites like Twitter, Instagram, and Facebook should be used to promote the Public Wi-Fi system. These activities should fit into a municipalities overall social media strategy.

In addition, most cities have public access television stations and can control the content that airs on these. So, a short video could be aired on public access (PEG) television, as well as more modern media channels, such as YouTube and the city's website.

Other digital channels include mobile apps, blogs, community sites like Nextdoor.com, and anywhere else that a municipality posts news updates for the public.

Physical Channels

In addition to online channels, municipalities typically have several physical promotional channels at their disposal, as well. For example, city officials can setup booths at their local festivals and events to promote the Wi-Fi service with giveaways, like branded shopping bags and accessories.

A brief list includes:

- Local businesses within the Wi-Fi range
- Events and Festivals
- Council and Board meetings & Town Hall events
- Public Safety meetings
- Neighborhood Association meetings
- Influencer Marketing
- Guerilla Marketing/Hackathons

"GUERILLA" MARKETING STICKER

The last line, Guerilla Marketing, deserves a little more discussion. Here, we are referring to efforts by municipal staff and/or volunteers to canvas an area with promotional material such as flyers, stickers, posters, artwork, and similar items. This can be combined with traditional municipal signage which can be displayed on in the public right of way of street poles and the external walls of facility buildings. Think of typical, blue "Free Parking" signs only with Wi-Fi logos that say "Free Wi-Fi."

Along with these examples, some municipalities have organized hackathons and similar events with their Wi-Fi systems as ways to engage the local tech community. If your mayor or council members have strong followings on social media, their endorsement of the Public Wi-Fi network will have a huge impact on adoption.[23]

[23] https://ncbroadband.gov/spreading-word-downtown-wifi-program/

External Partners

Municipalities should avoid approaching marketing strategies on their own. Our research uncovered several potential partners that can help promote services, such as Public Wi-Fi. The list below is not exhaustive and can be tailored to fit a certain target. For instance, if the Public Wi-Fi system covers a heavily-trafficked tourist site, a great marketing partner would be the tourism board or the like. It's useful to make a list of all the partner agencies and pair it to demographic and marketing profiles. Such a list may include:

- Business leagues (Chamber of Commerce, etc.)
- Improvement districts and neighborhood associations
- Service organizations (Rotary, Lions, Kiwanis, etc.)
- Local school districts
- Universities & colleges
- Other special districts, such as water and electrical utilities and parks
- Tourism boards and groups
- Non-profits
- External media
- Private sector partners

Perhaps nothing is more effective than a friend saying to another, "Hey, did you know there is free Wi-Fi right here? Check it out!" That is the ultimate form of endorsement.

While external media aren't exactly a "partner" organization, there are several media groups that follow municipal technology and often cover Public Wi-Fi and similar broadband and technology projects. When a municipality issues a press release, it should personally contact reporters, editors, and writers of these publications to share the press release with them. This can often lead to additional promotion for the new system.

Private sector partners will often coordinate their own, parallel promotional efforts if they are directly involved in the Wi-Fi system. For example, when Ruckus equipment was deployed in San Leandro, Ruckus issues its own press release and the company's Chief Operating Officer attended the groundbreaking ceremony, making a speech alongside the city's mayor.

Conclusion

These activities can lead to one of the most powerful form of promotion there is: word of mouth. Nothing is more effective than a friend saying to another, "Hey, did you know there is free Wi-Fi right here? Check it out!" That is the ultimate form of endorsement. A well-designed system that is properly promoted, and provides users with a great experience and fast, reliable, free internet service should win many supporters who will happily tell others about it.

Brand management can be as much an art as it is a science. However, municipalities are equipped to run sophisticated campaigns that target certain demographics that will benefit the most from their investments in Public Wi-Fi. A brand strategy has many components and requires thought, collaboration, and resources in the form of time and money to execute. However, the benefits are well worth it. Public Wi-Fi systems are literally invisible: if no one knows the system is there, no one will use it. The burden is on the municipality to raise awareness and promote the benefits to the public.

Key Takeaways

- Traditional municipal outreach efforts often fail to reach the very segments of the population who will utilize Public Wi-Fi the most, such as teenagers and young adults.
- However, groundbreaking ceremonies and press releases and still effective for celebrating accomplishments and attracting external media attention.
- A coordinated brand strategy will target demographic profiles using channels specific to them, such as social media, festivals, events, meetings, municipal websites, and more.
- Public Wi-Fi projects can often have their own web presence, including details of the project, online maps of the service location, contact information, news and updates, and usage statistics, such as number of connections and amount of data transmitted on the system over a given time.
- There are many partner organizations that will help spread the word, particularly when their organization benefits from the Public Wi-Fi system.
- Guerilla marketing can complement traditional municipal signage in the public right of way.
- Word of mouth is a powerful endorsement. A well-built, fast, reliable system will lead to people talking to each other about it.
- Wi-Fi is invisible: if no one knows it exists, no one will use it. Thus, the onus is on the municipality and their partners to promote it.

CHAPTER 7 - PROCUREMENT

The following sections provide a blueprint for the procurement process for Public Wi-Fi networks. It is broken into four main areas:

1. Researching the industry
2. Creating an advisory board
3. Procurement approach
4. Contract (pricing, vendor evaluation, and contract execution)

While much of what is covered applies to most standard government agency technology procurements, this can be viewed as a best practices model. It will also specifically address a proposed Public Wi-Fi system from both a "Design-Build" model and a Public Private Partnership (PPP) model.
The intention is for readers to apply pieces and/or the entirety of this approach for Public Wi-Fi projects of their own.

Researching the Industry

Researching industry is an important part of any procurement. Although it sounds simplistic, the most effective method is principally done via Google searches. The goals of this research are to:

- **Use the internet to obtain accelerated learning of the industry (i.e., become an "expert" in a short amount of time).**
- Obtain an understanding of industry terminology.
- Understand the current state of technology and the technology roadmap.
- Understand the principle vendors and their capabilities.
    - Conduct a market survey.
    - Determine the practices of firms engaged in producing, distributing and supporting the required products and services, such as type of contract, terms for warranties, buyer financing, maintenance, packaging and marking.
- Know where recent deployments of the technology have been implemented.
    - Read case studies of recent deployments. Understand what went well, and what were the issues in deployment?
- Know the industry conferences and details, such as:
    - Who are the speakers?
    - Who are the vendors?
    - What topics are discussed – these will provide insight into current industry trends.
- Know and read industry trade journals.
- Note the standards bodies relevant to the technology.
        - Note the current standards and future standards work.
        - Review available standards material.
    - Review similar procurements issued by other entities
        - Other entities in the U.S. and the world will likely have issued procurements to achieve the same or a similar goal. Review the procurement documentation, noting what questions could be used in your procurement.
        - Understand the procurement model used by other entities, for example, whether Design-Build, PPP, or another model.

Creating an Advisory Board

An advisory board is a group of people that will advise and provide input. Researching the industry (as discussed in the previous area) should reveal at least 1-2 key industry participants. The industry participants should not be from potential vendors, but should be independent and could be from:

- Universities.
- Consulting/Analyst companies.
- Non-profit organizations.
- Trade journals.

Other potential advisory board members include:

- A procurement expert from your entity.
- A person from a similar entity that has implemented a similar procurement.
- A person representing the user base.
- A person with deep knowledge of the technology (if not already covered by a person above).

The role of the advisory board is to advise, provide input based on the person's experience, and review procurement material produced. It is recommended to meet with the advisory board at least once a month and to meet one-one with people as needed as questions arise. It is important to note that **one should not expect the advisory board members to produce material.** Their purpose is to provide guidance and assistance. Things to consider include determining if the advisory board members need to sign a confidentiality statement (i.e., the members will be prohibited from discussing any of the work with potential vendors, and the board members must not have a conflicts of interest).

Procurement Approach

The agency should agree early in the process on the method of procurement. This will depend on the goals of the procurement, and what information is needed to execute the contract. An agency should understand what type of contract will result from the project (i.e., the desired outcomes) as this will affect the type of procurement method and process that is used.

There are two common approaches suitable for Public Wi-Fi that will be described below: Design-Build and Public Private Partnership (PPP) models[24].

- **Design-Build Model**. A Design-Build project typically has one or more vendors responsible for designing, building, and commissioning with the public entity responsible for operations and maintenance after acceptance.
- **Public, Private Partnership (PPP) Model.** A PPP involves a situation where the private partner takes on additional responsibilities, such as operating and maintaining the network over a long period of time or providing assets to the agency. A description of potential PPP models is described in the Finance, Legal, and Marketing chapter.

[24] Although PPP models can vary in many different ways, this section will look at them generally as one where a private partner provides something of value to the agency beyond basic design and installation services.

There are many standard options available for procurement. These vehicles may vary from agency to agency, but the overall purpose and details are largely similar and easily portable. These options for the procurement include:

- **Request for Information (RFI)**
  - A request for information from industry participants. Does not request pricing, and may or may not result in a follow-on procurement
  - Provides an opportunity for the agency to have industry response to specific questions
  - An RFI is especially relevant when considering a PPP project, and there is uncertainty as to the type of PPP project to move forward with. The RFI allows an entity to receive vendor and industry input regarding PPP models and recommendations from vendors/industry regarding their preferred PPP model. An RFI can validate if the preferred PPP model is acceptable to vendors.
- **Request for Qualification (RFQ)**
  - A request to qualify vendors, for a subsequent price phase.
  - In the subsequent price phase, only the vendors qualified in this phase are permitted to respond.
- **Request for Proposal (RFP)**
  - Request for Proposal typically includes a request for both technical information and pricing information
  - Technical information divided into mandatory and desirable requirements
    - Mandatory requirements are 'must have' requirements and if the Vendor cannot meet a mandatory requirement they are disqualified
      - All mandatory requirements must be met by the Vendor to not be disqualified
    - Desirable requirements are 'desired' and points are allocated to each desirable requirement
      - A Vendor is required to have a specified minimum number of points to not be disqualified
    - A vendor meeting all mandatory requirements and having the minimum number of points for desirable requirements can have their pricing evaluated
  - A possible approach to determine Vendor price points is as follows: Vendor price points determined with the lowest priced vendor receiving all available price points. The other vendors will receive a proportionate share of the price points.
    - Request that vendors not include any pricing information in response to any desirable requirements
    - The vendor pricing response should be separate from the desirable requirement response
  - The winning vendor is the vendor that has met all mandatory requirements and has the maximum number of points (technical + price)

- **Request for Pricing/Invitation for Bid (IFB)**
  - With this procurement approach, there is no technical evaluation. The awarded vendor is selected based on price only. The vendor with the lowest price is awarded.

These approaches represent standard procurement vehicles. The next section will go into greater detail on PPP and Design-Build project projects and discuss considerations for each type.

PPP Projects

- Can be long term, for example 20 years.
- Negotiations and implementation can be complex.
- Often allows the public entity to avoid or minimize up-front investment and/or maintenance costs.
- Are subject to key performance indicators.
- Thus payments to the private partner from the public entity are dependent on the private partner meeting defined performance thresholds.
- If vendor is to operate and/or maintain the network, requirements in the procurement documentation will need to confirm Vendor ability.
- Procurement documents should specify the financing required. The procurement vehicle should help solicit from vendors financing options available. Private financing should be compared with the tax-exempt financing available directly to the public entity.
- Private partner in the PPP may share in the revenue generated. The procurement vehicle can be used to describe public entity assumptions and expectations regarding generated revenue.
- PPP agreement should include dissolution clauses:
    - Include How and When to Initiate a dissolution
    - What will be the disposition of equipment (i.e., who owns it after dissolution?)
    - What, if any, penalties would apply (early withdrawal)?
    - What is the defined buyout for the public entity if the public entity were to terminate the agreement early?
- The procurement documents should also clarify ownership during the term and at conclusion of term.
- **One key to understand is that the private partner should always share in the risk**. The level of risk is determined by the PPP model.

Design-Build Projects

- In this model, the public entity has the principal responsibility once a solution is accepted. Most vendor obligations are just until acceptance.
- Vendor is typically paid in full following acceptance.
- Design-build is typically much shorter than in a PPP project.
- Design-build models are more prevalent than PPP models.
- Understand if the resulting contract will allow joint purchasing. This is where other entities can utilize the same resulting contract. If so, are there state or local procurement rules to follow? These can sometimes be referred to as “cooperative buying” agreements. For example, the City of San Jose CA included “co-op” language in its contract with SmartWAVE Technologies for Public Wi-Fi, which has since been utilized by other cities in the San Francisco Bay Area.[25]
- Understand if the procurement is for specific material and/or services today or is to establish a master contract
- Requirements and specifications to include in the procurement could be sourced from:
    - Subject matter experts within the issuing entity; perhaps in a different department.

[25] http://www.ruckussecurity.com/newsDetail.asp?PostID=18277&n=ruckus-wireless-services-downtown

  - Published federal and/or state specification templates.
  - Similar procurements from other entities.
  - Input from the Advisory Board.
  - Review of case studies of past implementations, showing what worked and what didn't work.
  - External subject matter experts.
- Communication should not occur with potential vendors to obtain requirements and specifications. **This would be a conflict of interest and likely disqualify the vendor**.
- Agree on timeframe between publishing the procurement and deadline for response. Typically, this is between 6 and 8 weeks for RFI, RFQ and RFP procurements. May be longer for very complex procurements. Request for Pricing/Invitation for Bid procurements may be shorter.
- Within the procurement period allow vendors to ask questions.
  - State this in the RFP, and include a deadline for when no more questions are accepted, or if questions are accepted after the deadline a response is not guaranteed.
- A vendor call will be helpful to guide vendors on how to respond, and to emphasize dos and don'ts for the vendor. Goal is to minimize the vendors disqualified due to vendor errors in their procurement response.
  - For a new initiative, the vendor call can be helpful to provide background to the project, and to provide context for what is being asked.
- Once the RFP has been published, inform vendors of the existence of the procurement by:
  - Email.
    - Email as many vendors as possible that could provide a response.
    - Blind copy the vendors and only alert them to the existence of the procurement and provide a link to the procurement.
    - Do not enter into a dialogue with any vendors or provide any further information. All requests for information and any questions should be directed to the single point of contact listed in the procurement.
    - The procurement primary point of contact may need copies of all emails sent to vendors.
  - Social media.
  - Press release.
    - If the procurement is part of a larger initiative of the entity, a press release shows progress in the initiative.
  - Announcement at conferences.
  - Inform your leadership and colleagues of the existence of the procurement, and ask that they also socialize the procurement.
- Following procurement award, if the Vendor is required to sign a contract, include the contract terms in the procurement and ask the Vendor to highlight their exceptions. This will minimize/eliminate any further negotiation to get to contract signature.
- Include statement regarding Vendor exceptions to contract terms. For example, an excessive number of exceptions or certain exceptions may result in Vendor disqualification.

Helpful Tip

A procurement template likely already exists, produced by your entity. Many procurement clauses will be identical between procurements of the same type (RFI, RFQ, and RFP). Find one and use it!

The Contract

Contract Pricing

In your procurement, it is important to understand how you expect to have services and materials priced. For example, services could be priced per hour, based on the service provided. Materials could be priced with a percentage off MSRP or list price or as a set markup on the Vendor's cost to purchase. One should be prepared to ask, "If there are multiple phases of the project, how will pricing be affected?" If the master contract term is for multiple years, negotiate if a cost increase will be allowed. For example, after two years an increase in labor rates based on the Consumer Price Index (CPI) could be negotiated. Finally, PPP projects typically result in defined periodic payments to the private partner, subject to performance indicators being met. The private partner may also share in generated revenue. It is critical to define these terms up front.

Procurement Rules – Entity specific and State

These are some general guidelines for procurement rules. Understand the procurement rules for the issuing entity and any others that may be purchasing from the contract, if a joint procurement. Check if any entity rules or state laws conflict with what is being asked in the procurement. Review similar procurements issued by the entity.

- Check with local procurement staff if a procurement template already exists
- There may be a minority, veteran or small business requirement of the issuing entity, whereby a certain percentage of the contract has to be allocated to a disadvantaged group, veteran, and/or small business. This should be stated in the procurement.

Vendor Evaluation

For certain procurements, e.g. RFQ, RFP an evaluation team will be required. Recruit a team of evaluators in advance of this phase. Potential evaluators can (and should) include people from the advisory board. Here are some general guidelines to help with this aspect:

- Aim to have 1 – 2 external evaluators in addition to evaluators from the entity
- Evaluators will be responsible for assigning points to the Vendor technical responses (for RFQ and RFP procurements)
- Check if the evaluators are required to sign confidentiality agreements
- Produce ahead of time an evaluation spreadsheet for the evaluators, where evaluators will enter their scores
- The vendor with the highest score should be awarded. The next phase is contract signature.
- Consider a multi-phase evaluation for the procurement. The below outlines a 4-phased evaluation but phases can be combined, based on size on complexity. When using a multi-phased approach, each proposal will be reviewed and evaluated in accordance with its contents.

Phases

1. For Phase I of the multi-phased approach, interested parties should demonstrate they are capable of performing the work by providing a capability statement.
    a. Capability statements will be evaluated based on defined criteria in the solicitation.

2. During Phase II, the public entity will conduct an initial review of the proposals received in order to verify conformance and completeness with the RFP.
3. In Phase III the public entity will review and evaluate each proposal to ensure it meets the pass/fail factors identified in the RFP.
4. Phase IV is the Detailed Evaluation. Those bidders whose proposed solutions have been determined to conform to the RFP in Phase II and successfully pass Phase III will move into Phase IV. During this phase, the public entity will commence the detailed evaluation of all information and documentation received from the Offerors based on the evaluation factors.

Contract Execution (Signature)

You've made it to the end of the procurement process and are ready to sign a contact. Congratulations! There are a few more things to look for: 1) vendors that stated exceptions in their response should minimize or eliminate these in the contract negotiation; 2) for activity after contract signature, define success and then work to achieve this success.

See? Procurement isn't that hard.

Key Takeaways

- Use the internet to obtain accelerated learning of the industry (i.e., become an "expert" in a short amount of time).
- Create an advisory board to assist with your procurement. However, do not expect the advisory board members to produce material for you; they are simply to provide advice and guidance.
- There are two common approaches suitable for Public Wi-Fi: Design-Build and Public Private Partnership (PPP) models. Each will require its own procurement vehicle and negotiations.
- PPP projects can be long and complex. They are often attractive because they require little to no funding from the agency involved. However, **the private partner should always share in the risk.**
- In a typical design-build project, follow all your agency, state, and federal rules to ensure a smooth project.
- The vendor evaluation can be broken into multiple phases and include multiple stakeholders and evaluators to come to a strong, consensus-based result.
- Always consult with your procurement teams in the project from the very beginning to avoid any unforeseen problems throughout the process.

CHAPTER 8 – TECHNOLOGY STRATEGY

A variety of technology decisions need to be made to effectively deliver good Public-Wi-Fi service, while supporting the current and future applications that cities and towns are seeking to deliver. While Wi-Fi itself is well understood and widely deployed, modern Public Wi-Fi deployments, which are often outdoor and in locations where there are no pre-existing networks, can be more complicated than traditional in-building networks. As a result, cities planning Public Wi-Fi deployment will likely need to support a growing range of new applications and face many technological decisions in the process.

It must be stressed that **cities should develop an overall strategy to guide their Public Wi-Fi deployments**. The objectives of any city or municipal Public Wi-Fi network are to improve the quality of life by increasing or expanding public services, improving city operational efficiencies and sustaining the long-term growth and development of the city. However, to do this effectively, cities need to have a clear idea of what their own goals are and what they are trying to achieve. In addition to driving the initial design and technical decisions, it can serve as a driver to align stakeholders across the city, build support for the plan, and provide a baseline to measure whether the Public Wi-Fi effort is successful. An effective strategic plan and policy development process should include the following stakeholders:

- **Citizens**, whose needs must be fully understood and who will need to utilize the Public Wi-Fi network in order for it to be successful
- **Representatives of multiple city departments** including planning, IT, security, public safety, transportation, recreational services, water and waste management, public works and others. Any of these groups may have unique ideas or requirements that can increase the value and utilization of the network. If a city has a security/cyber security team or expert, they should also be included.
- **Businesses and the local entrepreneurial community**, who can be sources of funding and new technology as well as potential sources of specific expertise
- **Colleges and universities** who may have (or can provide) research and expertise on smart city applications and emerging technologies. In many cases, local colleges, as well as K-12, may have significant interests in supporting Public Wi-Fi networks jointly with local municipalities.
- **Partner organizations** such as downtown districts, Business Improvement Districts, Chambers of Commerce, etc. who have a vested interest in public attractions and economic development strategies that involve Wi-Fi as an amenity.

Cities and their stakeholders need to agree on what they really want to achieve to drive the planning and design process. Key elements to consider include:

Target performance for Public Wi-Fi. Public Wi-Fi needs to meet or exceed minimum user expectations, or there is a risk that they will not use the network. Each city should determine what this minimum requirement is, and also, how it might change over the life of the network. Reported minimum performance targets vary greatly from as low as 500 kbps to as high as 25 Mbps or more. The right answer will be a function of end user expectations, city budgets, expected use cases, and anticipated concurrent user levels. Some cities aim to deliver relatively higher performance to encourage more end users and city departments to leverage the network.

Bandwidth shaping or rate limits. One way to manage costs and help ensure a consistent end user experience is to implement rate limiting to limit maximum speeds and prevent a handful of users from

using excessive amounts of your network capacity. This can be a strict rate limit or could be implemented by not allowing certain applications, especially video streaming, over the network. Bandwidth shaping is another technique that allows some flexibility by allowing surges of throughput to help, say download large files while preventing sustained high utilization. Suffice it to say that there are tradeoffs when limiting usage, such as risking user dissatisfaction. Agencies must decide for themselves what appropriate bandwidth limits are.[26]

Service tiers vs. the same standards for all users. Most cities prefer offering the same service to all Public Wi-Fi users, not offering any premium service levels. This avoids any complaints about how tax dollars are being spent and is the simplest model to implement. Cities should be aware that many private/for-profit Wi-Fi service providers offer multiple tiers to generate income from the network, which could be an option if a city or town needed help funding the service. Also, note that cities may implement separate WLANs over the same Wi-Fi infrastructure to provide different service levels to city staff and departments. These private WLANs may each have their own target service levels.

Time of day usage. With most Wi-Fi solutions, it is possible to set 'time of day' policies which may, for instance, turn the Wi-Fi on or off at certain hours. This can potentially be a useful mechanism to avoid attracting people to, say, a park during hours when it is closed, or to prevent loitering in particular areas late at night. However, it is up to each city or town to determine whether and how to implement such capabilities. Questions such as 'is it fair to cut off Wi-Fi if people are depending on it?' and the need to have communications in place in the event of an emergency should be discussed prior to implementing any time of use restrictions.

Customer support. Once a city invests in Public Wi-Fi, it is important to ensure there is adequate support so that people are able to connect and use the network. Cities provide varying levels of support, from simply providing it "As-Is" to offering a 1-800 customer support hotline to hosting Wi-Fi training sessions in community centers and libraries. Some cities believe that enough people know how to use Wi-Fi that no additional support is needed, especially if it is offered as a free service. In any case, we've found that, over time, actual support requirements appear to be relatively low, with bursts of support needed when something goes wrong. Thus, cities may want to consider offering and promoting some basic level of end user support and training as an additional public benefit and way to promote the system. As an additional step, smaller cities could team with each other or with a provider to share the costs of a single customer support facility.

Organizational involvement. Public Wi-Fi requires both an upfront investment and ongoing network management and access services. Cities should define the roles/participation of key departments including who owns and operates the network as well as who service level agreements (SLAs) for internal and external usage. Ideally cities should have strong, top level support to ensure all stakeholders are aware of and benefit from the Public Wi-Fi investment. Cities should also acknowledge up front that the costs and benefits of the Wi-Fi network may not align within traditional organizational structures, i.e. one department may fund the network while other departments may gain significant

[26] For the purposes of this blueprint, the discussion of "rate limiting" applies solely in a situation when used by a public agency that is deploying a free, Public Wi-Fi network under their control. When used by internet service providers (ISPs), bandwidth shaping and other throttling techniques can be construed under the terms of what's called "Net Neutrality." The authors of this paper are in no way making a commentary on this topic although, in general, we support the vision of a free and open internet.

benefits. There is no one solution to manage this, but cities should be aware of the issue upfront and determine how they will resolve any disputes.

Privacy / Security. Cities should consider what steps, if any, they wish to take to address both privacy and security. Generally, cities avoid collecting or retaining any personally identifiable information, but it may be useful to spell out exactly what information they may collect and for what use cases. Similarly, Wi-Fi networks can be wide open or tightly secured, all depending on how a city wants to manage it. In many cases cities leave their networks open and leave it to the end-users to implement their own security via a VPN or similar technology. Newer deployments typically try to offer some level of encryption as Wi-Fi becomes more widely used.

Own & Operate, or Managed Service? Public Wi-Fi is a well understood technology/application, and is not especially complicated or labor intensive to manage. However, municipal IT staffs are often fully loaded on existing projects and may or may not have the required wireless and RF skills needed to design, deploy and operate outdoor Wi-Fi. Thus, cities should consider their core competencies and whether they want to manage the network internally or hire an outside resource. They can hire systems integrators (SI) or managed service providers (MSP) for any or all of the major activities related to Public Wi-Fi, including planning and design, deployment, and ongoing network operations. Many SIs and MSPs will work with and train city staffers as needed to utilize them for things like onsite deployment and maintenance when that can lower cost and leverage an existing city work force.

City-provided Wi-Fi vs a 3rd party network. Many cities allow 3rd party network operators, including traditional service providers as well as focused Wireless ISPs to deploy and operate a Public Wi-Fi network in the city. These networks may be paid for via premium service fees and advertising, or may be offered as a brand-building opportunity to attract and retain customers. This can be an attractive option from a funding perspective as there is no upfront cost to the city. However, there are tradeoffs, such as: the city may not have access to the network for additional use cases (e.g., a secure network for public safety); the network may only be deployed in parts of town that are attractive from a commercial perspective (i.e., some residents may be left out); and cities will likely not have any control over the branding and marketing of the network – it will be associated with a for-profit provider. Cities should certainly be aware of these 3rd party options and consider them, but in the process they should understand the cities own needs and be aware of how, or if, a 3rd party network is consistent with meeting those needs. In some cases, cities will want to maintain some level of control, or specify some level of city access to the network.

General infrastructure policies. As Public Wi-Fi and other Smart City applications become more widespread and expected capabilities, cities should also consider longer term policies that will streamline and enhance their ability to roll out and expand these services. Policies such as Dig Once, where the city deploys fiber and or conduit whenever they dig up a street can position the city to move much more quickly when they want to add services. These discussions will need to part of a city's overall planning process for fiber optics and other utilities.

Authentication, Security and User Experience

While today's Wi-Fi user experience is familiar to millions of end-users worldwide, it requires end-users to select an SSID and typically go through a captive portal experience before getting connected. This extra step can potentially reduce Wi-Fi usage, and consequently the value of the Wi-Fi network.

Understanding the tradeoffs between different authentication options can help cities to determine the appropriate services for their town.

Helpful Key for Understanding Authentication Types

Authentication→	**What Is It? →**	**Can Be:**
	Technical method to access a network/system.	Open (i.e., no login required) Closed (i.e., requires some form of login)
	Pros	**Cons**
→Open	Can be perceived as easier to log in, thus increase usage.	Makes it easier to hack (i.e., for someone to spoof the network[27]); less ability to tailor service levels.
→Closed	City knows who is on network, can assign different policies based on role/device.	Can could deter some users and raise privacy concerns.

As there are several different authentication options available in modern Wi-Fi systems, selecting which is appropriate can be a daunting task. This section will go into these different methods and the tradeoffs with each in much more detail.

Open Network: In an open network, the Wi-Fi is configured with one or more open, unsecured SSIDs. Any end user can simply connect to that SSID and have full network access. This is a low cost, easy to deploy solution that some believe can increase network usage by removing any obstacles to getting online. However, it has a number of drawbacks. Most importantly, there is no way of knowing who is on the network (which is, in fact, illegal in some countries, although not in the United States). Open networks do not encrypt end-user traffic so they are more vulnerable to snooping[28]. It's much easier for someone to see what unencrypted web pages are being visited, what someone is typing into unencrypted web forms, and even see which encrypted websites someone is connected to. For example, someone can see if you're connected to your bank's website (although if the site is encrypted they may not know exactly what you are doing; but just knowing is concerning for many people).

This was illustrated most sensationally with Firesheep, an easy-to-use tool that allows people sitting in coffee shops or on other open Wi-Fi networks to snoop on other people's browsing sessions and hijack them. More advanced tools like Wireshark can also be used to capture and analyze traffic.

Networks that re-direct end-users to a captive portal and ask them to accept an End User License Agreement (EULA) or Terms of Use do not solve this challenge. In fact, they are still open, unencrypted networks.

Captive Portal Authentication: This is another form of open network except that the city or network operator has some form of end-user authentication. This could simply be a social network identification (Facebook is the most popular authenticator, and is used as much as 85% of the time), or could be a credit card or other form of payment. Simply adding an authenticator does not provide encryption, so the end-user still needs to use caution, and ideally a VPN, when connecting. However, authenticating, especially against a source such as Facebook, can be very useful to the operator in that it allows them to

[27] https://en.wikipedia.org/wiki/MAC_spoofing

[28] Snooping is the act of using software to capture traffic (i.e., packets) to inspect for sensitive information, such as usernames and passwords.

build up a list of network users for future marketing or outreach campaigns. Cities and their residents tend to be sensitive about end user privacy, so clear policies will be needed, but this can be valuable data to a municipal economic development agency.

802.1x: This is a strong form of security that typically has rigorous end-user identification and also encrypts all subsequent traffic. 802.1x is extremely secure, and does not allow any network access until after the end user is authenticated and a tunnel is established from the end user to the access point, protecting the wireless portion of the connection. From the AP, traffic from each end user can be directed to specific VLANs based on their user-or group-specific policies. For instance, a resident or visitor might be placed in a specific VLAN which only allows them to access the internet. A city employee may go to a different private VLAN, which gives them access to the city's internal network. [29]

802.1x is a proven and widely available solution. However, it requires additional IT infrastructure including a RADIUS server that is linked to the back-end authentication server, typically Active Directory. This is a much more complex network setup and, for these reasons, is more expensive to design and maintain. Thus, 802.1x is more commonly on corporate networks than municipal networks.

PKI Certificates: PKI (Public Key Infrastructure) certificates are the gold standard for network security and provide a fully automated and secure connection. Industry standard x.509 PKI certificates uniquely identify an end-user and device, and manage their access to the network and network-attached resources. After a user authenticates their device for the first time, it will then automatically connect to participating networks with a secure, fully encrypted connection, without requiring the user to re-enter their credentials or remember their username/ password.

Not only does this provide a superior user experience, but it provides the network operator with full visibility and control of network users. Depending on what device is connecting, and what initial credentials are delivered, the network can assign that user/device to the appropriate network resources. For instance, a visitor may be allowed access and placed in the general Public Wi-Fi WLAN. If a city employee connects with the same simple login, the network may assign them to a private network with additional privileges. Public safety and other first responders could be identified and given the highest priority network usage. Cities or network operators can even push PKI certificates to 'headless' devices such as IP video security cameras and limit their access to sending video to the relevant video management system(s).

PKI implementations, like 802.1x, are require expertise in IT security. As a result, they are far more expensive than other authentication types and are not typically found in municipal government networks.

Hotspot 2.0: HS2.0 is another industry-standard approach that promises to make Wi-Fi roaming as seamless as cell phone roaming. Just as your cell phone automatically finds a roaming partner and securely connects to a network no matter where you travel, Hotspot 2.0 delivers seamless, secure Wi-Fi roaming. It uses PKI certificates to ensure the highest level of security, but Hotspot 2.0 focuses on enabling back-end roaming relationships so that a known end-user can connect automatically, and with approved terms of service, on entirely new networks.

For instance, if the cities of Boston and Cambridge established a Hotspot 2.0 roaming relationship, then their respective users would automatically and securely connect to either of their otherwise entirely

[29] A "VLAN" is a virtual local area network and is used in network design and engineering to distinct network segments.

separate networks. Hotspot 2.0 literally extends seamless network access across a much larger footprint than any one operator can deliver, and delivers more end-users to each participating network operator.

Hotspot 2.0 ensures more users get connected more easily and with greater security. However, Hotspot 2.0 requires support from both the infrastructure and the end-user clients. While most Wi-Fi infrastructure is HS2.0 capable, only newer, high end devices support HS2.0. So while cities can plan for HS2.0, they may need additional or alternative solutions in the near term. At the time of writing, there are few if any widespread examples of municipalities deploying Hotspot 2.0 solutions.

Performing a Network Assessment

Before any network planning or design begins, cities should answer key questions related to network scope, size and fit with available network assets. Perhaps the most important question is where to deploy the network?

Here are some important considerations:

- Focus on dense, high traffic areas, or places where people spend a lot of time
- Consider business / political perspectives, such where can Public Wi-Fi do the most good? Clearly, there will be a lot of end users in the central business district and major shopping areas, but can it be equally or more important to provide coverage in low income areas where residents may not have any other form of broadband access? Cities can generally identify which areas are or are not served by commercial services.
- Identify topography and terrain challenges. Consider the environment as it can greatly impact the cost to deploy and cover a given area. Existing terrain maps, GIS and LIDAR 3D mapping services should help cities have a very good understanding of the relative deployment challenges/costs in different areas. At higher frequencies building height and materials affect coverage, but there are software analysis packages with building databases that can help predict problem areas.
- Develop and utilize a telecom asset inventory showing fiber routes, existing fiber connections, city buildings and any other asset, including streetlights and traffic lights, which could help deploy an outdoor public network. Cities that don't already have a telecom asset inventory should develop one prior to finalizing designs or plans.
- Implement a "Dig Once" policy. Digging up a street to lay conduit is expensive. If the street is already opened up for another reason, laying conduit is relatively inexpensive. Dig Once policies add opportunities for future fiber expansion at a fraction of the cost.

Once cities have considered the items above, they can begin to scope out their network and do initial planning and design work. Ultimately, they should conduct a thorough site survey to know how many APs they will need where to deliver target levels of coverage and performance.

In general, our work for this blueprint has found that cities that focus on targeted areas with small-scale deployments are typically more successful. Unfortunately, citywide approaches are extremely costly, mainly because of construction requirements. For this reason, there are not many examples of successful citywide Public Wi-Fi deployments.

A small, initial buildout can be expanded over time as more support and funding becomes available. This seems to be a winning strategy for most cities in the United States.

Wireless Technologies

Wi-Fi is one of many wireless technologies that will be deployed in cities and towns to support new and evolving services. No one solution can meet all needs, and as both the wireless protocols and solutions/applications advance, the right mix will continue to adapt and expand. The key differentiators across different wireless technologies are bandwidth, range, cost and power consumption.

Overall Landscape

Helpful Key for Understanding Wireless Protocols

Protocol/Technology	Bandwidth	Range	Cost	Device Power Consumption
Wi-Fi	High	50-100 meters	Low	High
3G, 4G LTE	High	2-3 km	High	Medium
5G, Millimeter wave	Very High	300-400 meters	TBD	TBD for access devices
Z-Wave, Bluetooth, ZigBee and other 802.15.4 variants	Very Low	50 meters	Very Low	Very Low
LTE-M, LoRa, SigFox	Very Low	3-5 km	Low	Very Low

As you can see, Wi-Fi and LTE are both well suited for general broadband access, and the difference is that LTE is generally deployed via macro-cells with a much larger coverage radius, and it costs more, as each end user needs to subscribe to a plan from service providers who own the licensed spectrum.

The other technologies, which are becoming more common with internet of Things (IoT) deployments (and this is only a sample) serve very different use cases. Millimeter wave is essentially an alternative to fiber. It can deliver multiple gigabits-per-second[30] of throughput but only for a short range and only between two millimeter wave radios. It offers a way to deploy fiber-like network speeds without the cost or complexity of deploying new fiber, which can require digging up streets and sidewalks. Fiber is almost always the ideal solution from a performance perspective as it is a physical layer that can be upgraded to deliver more bandwidth as needed by adding new electronics on either end, but sometimes it simply isn't feasible from either a budgetary or city planning perspective to deploy fiber. In these cases, millimeter wave can be an ideal alternative.

Bluetooth, ZigBee, Z-Wave and other 802.15.4 technologies are all short range, low power wireless protocols. These are widely deployed in indoor setting and increasingly being used outdoors as well. The use case is to connect sensors and other IoT devices that need to be deployed in large numbers, very little bandwidth and are battery powered. In this case, low cost and low power consumption is critical.

Similarly, LTE-M, LoRa and SigFox are examples of long range, low power networks. LTE-M is a narrowband offering that can be delivered over existing, nearly ubiquitous LTE networks, so offers very good coverage area. SigFox is a network operator that pre-deploys its radio technology in a city or region and then sells connectivity for a wide range of applications and devices. Each of these models requires some sort of fee-based subscription. LoRa is a similar technology that may be deployed by either a city itself or by a private operator.

5G will be another option, and is in trials now. However, the final 5G specifications from 3GPP, the relevant standards body, won't be complete until 2020. When it is ready, 5G will offer very high

[30] Gbps means "gigabits-per-second" and is a benchmark for high bandwidth systems

bandwidth but with relatively small coverage areas per radio, so operators will need to deploy many locations and incur associated site, backhaul and maintenance costs. It's too soon to know when and where large scale 5G will be rolled out, but some experts feel that it will initially be focused on larger cities where density issues and 'urban canyon' effects currently impact service levels for large numbers of customers.

Within this overall landscape, Wi-Fi appears to be an attractive network access solution that also has plenty of capacity to support additional applications including IP Video backhaul. Current 802.11ac Wave 2 Wi-Fi solutions offer more than 1 Gbps of throughput and can be meshed wirelessly to deliver broad coverage areas. Future Wi-Fi solutions, including the upcoming 802.11af and 802.11ax standards, will continue to deliver significantly more bandwidth as well as increased range. Current Wi-Fi deployments are typically planned with a 3-5-year replacement cycle driven primarily by new, high bandwidth use cases such as IP video, augmented reality (AR), and virtual reality (VR).

Wi-Fi Architecture

There are only three main items in the Wi-Fi architecture:

1. Access Points (APs);
2. Network and AP Management
3. Backhaul

Access points
Access points (aka "APs") deliver the wireless access network to which end-users and devices connect. They are based on IEEE 802.11 standard protocols which are updated every few years to deliver better performance, new features and stronger connectivity. For Public Wi-Fi networks, the key considerations are:

- Use the most current Wi-Fi standards. To provide the best network performance and highest level of future-proofing, deploy the most current standard of access point.
- Wi-Fi coverage area. Most APs will offer a fairly similar coverage radius, but since outdoor Wi-Fi often requires costly backhaul and/or site permits, any advantage from stronger RF can lead to significant cost and performance advantages.
- Ease of mounting. Most cities and towns are proud of their streetscapes and do not want to have a bunch of visible electronics change the look of the town. Smaller physical sizes and especially internal antennas can reduce the visibility of Wi-Fi APs and allow them to be mounted on a wider range of street-level assets.
- Power over Ethernet. Most enterprise class APs support PoE power, which can be very helpful be eliminating the need to connect to electricity near the AP, or can provide a universal plug in via the RJ45 data port.
- IP67 outdoor rating. IP67 ratings are based on the IEC standard for "Ingress Protection" and show that a device has been tested to withstand a wide range of physical intrusion and humidity conditions.

Wi-Fi Management
Wi-Fi Management allows an operator to monitor the network, report on performance, update software and update specific parameters on a per-AP or group of AP basis. Most large Wi-Fi networks are managed by a Wi-Fi controller which can be deployed either in a city or operator data center or in the Cloud. The key requirements for cities are to have clear reporting on network usage and performance, and to have easy access to this information via a web-based interface. This can be delivered by a controller operated by the city, or via a controller operated by an SI or MSP.

Backhaul
Wi-Fi performance is ultimately only as good as the backhaul network. In your home for instance, if you've purchased a new AP within the last year or two, the wireless performance of over 1 Gbps is likely at least 10-20 times faster than the backhaul connection you have to the network, which in the U.S. is typically less than 50 Mbps. For cities, the preferred and primary backhaul mechanism is fiber. Fiber is essentially future proof and offers excellent performance, but unless it is already in place near any locations where you want to mount an access point, it can be extremely expensive.

One option to help manage backhaul costs is to wirelessly "mesh" your Wi-Fi access points. Meshing is simply connecting the APs wirelessly so that 2 or more APs can share a single backhaul connection. While meshing can work effectively over as many as 3-4 hops, most Public Wi-Fi deployments should limit meshing to one or at most 2 hops to ensure a consistent, high quality network connection. By meshing 4-5 APs back to a single AP that is connected to fiber, the cost of deploying and connecting those APs can be reduced by 60-70%.

Another option that is becoming increasingly attractive is to use millimeter wave radios to deploy a point to point or point to multipoint backhaul network. Millimeter wave radios can deliver throughput of several gigabits per second over 300-400 meters at a very cost-effective price.

Key Takeaways

- Cities should engage multiple stakeholders, including businesses, residents, universities, and civic groups to develop a strategy to guide their Wi-Fi design and deployment.
- Cities should consider HS2.0 or PKI certificate-based security to deliver the best end-user experience with the highest level of end-to-end security.
- Most cities have significant telecom and related assets which should be considered while planning and designing their Wi-Fi network.
- No one wireless solution can meet all of a city's needs; they will generally need several wireless networks.
- Mesh has become an integral part of Public Wi-Fi designs; particularly for outdoor and exterior coverage
- Wi-Fi is the most ubiquitous and lowest cost access solution for IP networking, and it continues to be enhanced to deliver higher and higher performance. Cities should leverage this as a core infrastructure for public access, bridging the digital divide, and to support other new city services.

CHAPTER 9 – PROJECT MANAGEMENT

Overview

While Public Wi-Fi deployments differ in purpose, reason, and size from agency to agency, the need for solid project management is consistent across the board. The collective ideas in this section provide **a modular project management approach by breaking groups of task areas into milestone clusters**.

Agencies looking for specific aspects and considerations to Public Wi-Fi implementation can leverage individual, parts of and/or all segments of this guide to fulfill their Public Wi-Fi implementation needs. The type of Public Wi-Fi program and system covered in this document is presumed to be commercial and industrial grade, as opposed to consumer grade, for commercial grade has a greater robustness for interior and exterior Public Wi-Fi design.

Each milestone cluster will include practical and relevant examples, templates, and worksheets that can be readily adopted by agencies using this blueprint document. **These can be found in the Project Management Supplemental Materials at the end of this section**.

Milestone 1 – The Decision Process: Crafting the Project Proposal ● Basic Requirements ● Cost Analysis ● Justifications for Public Wi-Fi (Use Cases)
Milestone 2 – Planning and Pre-Staging: Site Selection & Agreements ● Site Selection ● Pre-Staging Agreements
Milestone 3 – Project Execution ● Site Pre-Execution ● Procurement ● Site Execution ● Optional Execution Activities
Supplemental Materials ● Basic Requirements Worksheet ● Cost Analysis Worksheet ● Justifications Worksheet ● Internet Bandwidth Estimator Chart ● Full Project Proposal Example Template ● Site Identification Worksheet ● Site Inspection Checklist ● Site Qualification/Finalization Worksheet ● Public Wi-Fi Terms of Use Sample ● Public Wi-Fi Project Management GANNT Charts

Milestone 1 – The Decision Process: Crafting the Project Proposal

The first milestone in a Public Wi-Fi project is the crafting and finalizing the Project Proposal. Following our modular project management approach, this document will be used to gain approval (and funding) from executive sponsors to proceed with the project. **A strong Public Wi-Fi proposal must address at least three main considerations: A) Basic Requirements; B) Cost Analysis; and C) Project Justification**. These three considerations are described below.

Basic Requirements for a Public Wi-Fi Program[31]

There are two basic requirements to determine if a Public Wi-Fi Program is technically feasible: 1) internet service; and 2) Wi-Fi implementation expertise. These can each be accomplished in several ways.

Internet Service Provider Availability

A Public Wi-Fi program must have internet services available from an Internet Service Provider (ISP). **Put another way, *lack of an ISP will curtail any Public Wi-Fi program***. An ISP could be your telecom/telephone provider, cable/television service provider, or any service provider that provides commercial/industrial grade internet service. Once ISPs are identified, it needs to be determined if they have services at the site where the Public Wi-Fi program is proposed be installed. If the services are available, the speed and adequacy need to be vetted or amended for the appropriateness of the Public Wi-Fi program. If the ISP is not directly at the site location, fiber Backhaul services to connect internet services from a central location to the proposed site can be one option, while another option is to use wireless backhaul over moderate unobstructed line-of-site distances.

NO ISP AVAILABLE?

It is important to note that if ISP services are not available – and the Public Wi-Fi project cannot continue as a result – this is an issue that falls under the umbrella of "Digital Divide." Legislators at the state and federal level have debated this topic, with common ideas such as infrastructure bills to fund construction for underserved and unserved communities. If your jurisdiction is in such a situation, persistent outreach to your legislators should be ongoing for them to recognize the need and feasibility to bridge this divide.

Assuming internet service is available and the project can proceed, **the speed of the internet services should be vetted**. This will depend on how many average connections per hour that the system would need to scale towards. A good rule of thumb would be 1 Mbps per active user per hour – e.g., if the system needs to scale upwards to a maximum of 50 active users per hour then a 50 Mbps connection would be the minimum bandwidth. The activity rate (i.e., how much internet data a user consumes) of users connecting to the internet would typically be between 2% to 5% and high activity would come closer to 10%. Hence, a 50 Mbps system can handle populations of 500 (10% usage rate) to 2,500 (2% usage rate)[32].

[31] See Supplemental Materials Section for **Basic Requirement Worksheet Template**

[32] See Supplemental Materials Section for **Bandwidth Estimation Chart**

Important questions to ask:

- Are Internet Services available?
- Is an ISP logistically near to deliver Internet services?
- Can you leverage an existing municipal Internet connection?

Implementation Expertise

Wi-Fi implementation experts have specialized experiences and skill sets in deploying Public Wi-Fi systems. While most experienced network engineers have the same ability in physically deploying these systems, Wi-Fi implementation specialists leverage tools to measure RF signals for directional strength and have greater experience in specialized tools that work to optimize Wi-Fi signal delivery for all scales of implementation. The agencies who participated in the GCTC workshop had all engaged contraction Wi-Fi implementation specialists to work on their Public Wi-Fi implementations. While this is not an inference that an agency must use an implementation expert, the GCTC team recognizes the value and efficiencies from the use of such specialized resources.

Important questions to ask:

- Should the agency contract with Wi-Fi implementation specialists?
- Can the agency leverage In-house technical specialists?
- How can in-house specialists be developed?
    - Send in-house staff to specialized training.
    - Recruiting in-house Wi-Fi implementation specialists.

Cost Analysis of Public Wi-Fi Program

Capital Costs

The capital cost of the Public Wi-Fi project must be estimated in order to complete a final draft of the Project Proposal. While these costs vary greatly, the GCTC team has identified some overall ballpark figures that can provide an idea of Public Wi-Fi costs.

A simple small-scale Public Wi-Fi system that has minimal coverage (small public facility), and requires few equipment (e.g., one ISP line, one access point, etc.) could be US$10,000 or less. Meanwhile large-scale systems that span multiple sites (e.g., a library, city hall, community center, etc.), and that require additional cabling and/or fiber/wireless backhaul, with many access points could cost between US$25,000 to US$50,000 per site or more.[33]

[33] The numbers given are purely ballpark estimates and actual project costs will vary greatly. See Supplemental Materials Section for **Cost Analysis Worksheet Template**

Ongoing costs
It is important to note that on top of the capital costs associated with deploying a Public Wi-Fi system, there are also ongoing and agency staff costs (which can sometimes be hidden if not fully recognized before deployment). These can include:

- Internet Service Provider Costs (i.e., monthly bandwidth)
- System and Equipment Support Costs (i.e., technical support and maintenance)

Agency Staff Time & Support Hours
An agency should plan for staff time required to maintain and support the Wi-Fi system. For example, the County of San Mateo's annual implementation of twelve sites averages 1,300 to 1,500 hours of agency staff time and falls into typical site implementation hours.

Here are some general guidelines:

- **Planning Estimates**
  - Small Scale – from 50 to 100 hours
  - Typical – from 100 to 200 hours
  - Large Site – from 300 to 600 hours
- **Public Wi-Fi Per Site Estimates**
  - Small Scale – from 50 to 100 hours
  - Typical – from 100 to 200 hours
  - Large Site – from 300 to 600 hours

Justifications for Public Wi-Fi Program[34]

Agencies proposing to engage in Public Wi-Fi implementation do so with a purpose that provides added value, fulfill service needs, look to solve problems, or any combination of these three. **Such justifications fall into several categories and are covered in-depth in the Use Cases & Outcomes section of this blueprint**.

However, in the project management templates in the Appendix, we have outlined four primary purposes identified by participants from the GCTC Public Wi-Fi Workshop that agencies should consider in justifying for a Public Wi-Fi program. Please note that the justification for implementing a Public Wi-Fi program may change once data is collected and adaptations are made to optimize the program to fit the model that works for the agency.

With this section complete a full project proposal can be drafted[35].

[34] See Supplemental Materials Section for **JUSTIFICATIONS Worksheet Template**

[35] See Supplemental Materials Section for **PROJECT PROPOSAL FULL SAMPLE TEMPLATE**

Milestone 2 – Planning and Pre-Staging

The Planning and Pre-Staging section divides into two phases: **1) Site Selection; and 2) Pre-Staging Agreements**. Site Selection has two components: Identification, which focuses on compiling a list of sites and Assessment, which details qualifying the sites. The Agreements section focuses on the contracts and arrangements that must be in place with vendors, host sites, and suppliers.

Site Selection

Site Identification

The below guideline is intended to help factor the types of sites by assessing their viability. The subsequent list can be generally applied to any municipality and is based on our research of commonly used Public Wi-Fi sites and attributes.

Common Types of Public Sites for a Wi-Fi Deployment

- Civic – City Hall and or Civic Center
- Civic – Community Centers and Facilities
- Civic – Publicly Accessible Agency Facilities
- Civic – Recreation and/or Park Facility
- Education – Publicly Accessible Education Facilities
- Education – Library Facility
- Housing Oriented – Underserved Housing Complex
- Business Oriented – Business District/Shopping Center
- Business Oriented – Downtown District
- Business Oriented – Meeting or Convening Facility

Important Questions to ask:

- Does site have regular people/foot traffic and common areas to sit (e.g., tables, benches, etc.)?
- Does site have access to an internet Backhaul or Service?
- Does site have power resources and appropriate areas for equipment?

Site Assessment

Once the first draft of a Sites Identification Checklist (a/k/a Compiled List of Sites) is complete[36], the next steps would be to perform Site Assessments to qualify the sites. The Site Assessment process may also disqualify unsuitable sites.

Due to the length of some lists, the Site Inspection can take sufficient time and may span require visits and traveling is the sites are far apart. Time wise, a single site inspection may take half a day to a full day.

[36] See Supplemental Materials Section for **COMPILED LIST OF SITES TEMPLATE**

Site Inspection
A Site Inspection will collect information for assessing the viability of the site. The below criteria represent the basic requirements. Agencies can amend the criteria to fit their objectives[37].

Criteria:

- Total Coverage Area of Wi-Fi Site (Dimensions)
    - Number of WAPs and Backhauling or Meshing for WAPs
- Appropriate Facility Site(s) for WAP(s)
    - Power at each WAP designation
    - Construction if required
- Site Use Approval Requirements
    - Site authority permission.
- Estimated Cost of Equipment and Backhauling Construction
    - Total estimate costs. If the site implementation exceeds the capital expenditures threshold, the decision needs to be made for qualifying this assessment.

Finalize Site Selection
Finalizing the Site Selection is to narrow the list specific to sites that can be completed in the current program year or later program years. The system for prioritizing the sites come from the site assessment and any criteria established for the process[38].

Pre-Staging Agreements

The Pre-Staging Agreements within Milestone 2 cluster focuses on preparing agreements before the actual execution of site implementations, which will be detailed in Milestone 3. This section covers three subsections:

1. Terms of Use
2. Site Use Agreement
3. Vendor Agreements.

Terms of Use Consideration[39]
Agencies may consider whether or not to employ Terms of Use (TOU) disclaimers as part of their Public Wi-Fi implementation. This topic is discussed more in the Technology Section of this blueprint. But for the purpose of the Project Management section, the purpose of the disclaimer is to serve as an agreement between the prospective end-user and the Public Wi-Fi system so that they will not use the system for unlawful or inappropriate means. Consulting with legal counsel on the appropriate language that's specific to the agency's jurisdiction is highly recommended. Below are suggested inclusions for the TOU. Agencies can customize TOU's to fit the legal requirements of their jurisdiction.

- Use agreement for users of the system within legal statutory requirements of the agency's jurisdiction.
- Owner of system and exclusive rights of owners to control access to system.

[37] See Supplemental Materials Section for **SITE INSPECTION WORKSHEET**

[38] See Supplemental Materials Section for **FINALIZE SITE SELECTION WORKSHEET**

[39] See Supplemental Materials Section for **TERMS OF USE EXAMPLE**

- Disclaimer on lawful use of system.
- Disclaimer on any warranties to user.

Site Use Agreement

Site Use Agreements are required when implementing Public Wi-Fi on a site that is not owned by the agency. Site Use Agreements provide clear understanding between the site owner and the agency on the responsibilities of the parties on the Public Wi-Fi system. This section provides the minimum guidelines to consider for preparing Site Use Agreements. These agreements should be composed by the agency's legal department to comply with the existing laws of the agency's jurisdiction.

Below are the minimum requirements to include for the Site Use Agreement. Agencies may customize the agreements to comply with existing laws in their jurisdictions and/or appropriate requirements allowable for the agency to place.

- Title of Agreement for Equipment Placement and Site Usage
- Recitals for clarity
    - Background Summary of the agency's Public Wi-Fi Program
    - Equipment placement on owner's premises
    - Owner's support of Public Wi-Fi program (site and power)
- Terms of Site Use Agreement
    - Mutual Placement of Equipment and Support (power subsidies)
    - Terms
        - Effective time of agreement
        - Site owner's termination requirements
        - Agency's termination requirements
    - Payments
        - No fees, rents or reimbursements from parties
        - Owner to provide electrical power for Wi-Fi equipment
    - Access to Premises – clarity on access definitions
        - Conditions of Access to Premises
    - Installation by whom and compliance with applicable laws
    - Maintenance and Repair – owned by agency
    - Liens – Agency's commitment to keep owner free from Liens as a result of Public Wi-Fi system
    - Waiver of Claims and Indemnification
        - Owner's Indemnity
        - Agency's Indemnity
    - Removal of Equipment
    - Notices Requirements
- Signature Page for parties to sign

Services Agreements

The last stage of Pre-Staging Agreements would be to confirm the agreements with the professional service vendors who perform the implementations, provide the ongoing system support services, and provide the internet service. These Services Agreements need to be pre-staged and signed for service delivery.

Each agency may have different requirements for services request such as Request for Proposal (RFP), Request for Quote (RFQ), etc. This blueprint focuses on the services that need to be requested and not on processes specific to each agency. There are three services that are required at a minimum but Agencies may consider other Service Agreements as optional to meet their needs or requirements.

- Wi-Fi Implementation Specialist Service
- Ongoing Wi-Fi Service and Support
- ISP Service
- Optional Service Agreements to Consider

Wi-Fi Implementation Specialist Service
While some larger agencies may have internal resources with the skill sets to implement Public Wi-Fi systems, the blueprint highlights the fact that Wi-Fi Implementation Specialists specialize in this type of work and the cost savings of leveraging their services will generally provide significant savings for agencies. The Service Agreements for Wi-Fi Implementation Specialist Service must be confirmed and signed to complete Milestone 2.

Ongoing Wi-Fi Service and Support
Public Wi-Fi systems require ongoing monitoring, servicing and support on a 24x7 basis unless not required by the agency – this is highly unlikely since the system is public facing. A well monitored, serviced and supported Public Wi-Fi system has optimal uptime. While larger agencies may have the appropriate staffing to perform 24x7, maintaining 24x7 staffing resources may not be cost effective unless the Public Wi-Fi system is within a large municipality with a few hundred sites requiring dedicated and consistent monitoring. Some Wi-Fi Implementation Specialist vendors have these services as an offering or can provide referral to vendors specializing in 24x7 monitoring, servicing and support. The Service Agreements for Ongoing Wi-Fi Service and Support must be confirmed and signed to complete Milestone 2 but can be done incrementally during Milestone 3.

ISP Service
Identifying the backhaul sources was the initial consideration in Milestone 1. If the agency has pre-existing ISP services, adding more services at different sites through the same ISP may provide negotiation advantages for volume services procurement. For completely new services, the agency may engage in new RFPs or RFQs. If the goal is to continue the Public Wi-Fi program for multiple years, the new RFP/RFQ process may also have negotiation advantages. The Service Agreements for ISP Services must be confirmed and signed to complete Milestone 2.

Optional Service Agreements to Consider
Other Optional Service Agreements to consider are for the purpose of leveraging tools to add value to the program.

- Data Platform to capture metrics for reporting
- Dashboard and Monitoring Management System
- Security Platform to secure devices connecting to Public Wi-Fi system
- Filtering and Site Restriction Platform to block sites
- Public Private Partnerships to fund Public Wi-Fi System
- Subscription Management System to register user access

Milestone 3 – Project Execution

Site Pre-Execution is the first stage to Milestone 3's Project Execution. Two actions need to occur to prepare sites for implementation:

- Site Use Approval
- Design Assessment

Site Use Approval

The Site Use Approval document covered in Milestone 2 is used to secure the site between the agency and the site owner for implementation. This document needs to be signed and appropriately filed by the parties before proceeding to Design Assessment. This can take anywhere from a week to a month subject to the availability of the Site Owner and can be done concurrently with the Design Assessment.

Design Assessment

The Design Assessment is an action that is to be performed by the Wi-Fi Implementation Specialist Vendor. They are to define the Scope of Work and determine the Equipment Procurement Requirements. Experienced Wi-Fi Implementation Specialists are efficient in these assessments and can accomplish typical implementations within two weeks and very large implementations within a month.

Scope of Work – Professional Services
The Wi-Fi Implementation Specialist performs the site visit to define the Scope of Work. This scope of work will provide the following services.

- Coordinate the ISP services construction and installation
- Scope the site facility for appropriate electrical power
- Scope the site facility for equipment connectivity wire installs
- Scope the site facility for optimal Wi-Fi Access Points location installation
- Scope the equipment and software license procurement requirements

Equipment and Services Procurement Order
The scope of work will include all equipment and services (software) for the Public Wi-Fi installation. This will be within the same time frame as the Scope of Work.

Procurement (for Project Management)

Procurement is covered in more depth in the Procurement section of this blueprint. However, for the purposes of Project Management, it will be covered in two areas, defined below.

1. Contract Submission
2. Equipment Purchase Submission

Contract Submission
The Scope of Work from the Wi-Fi Implementation Specialist is submitted subsequent to the Design Assessment. Terms of Payment are generally pre-negotiated with respect to payments for services rendered – e.g. Net 15, Net 30, etc. This must comply with the agency's payment policy for services rendered or to be rendered. In special cases, partial payment may be a condition of services to be rendered may be a factor which can extend timelines.

Equipment Purchase Submission
The Design Assessment produces the equipment purchase requirements that need to be compiled for the agency's procurement submission process. Allocating one to two months for submission, processing and receiving equipment is allocated to the project timeline.

Site Execution

Site Execution is the process of executing the site installation with the Wi-Fi Implementation Specialist. Site Execution with an experienced Implementation Specialist can take a week to a month depending on the scale of the scope of work. Typical installations may take one or two weeks while large installations may take a full month with appropriate scheduling. The steps are outlined below.

1. Scheduling
2. Construction Staging
3. Implementation
4. Closing
5. Other Considerations

Site Execution – Scheduling
The Scheduling function will be where the project manager involves all the key stakeholders on the implementation (site owner and Wi-Fi implementation specialists). This scheduling which covers all the Site Execution functions may take a week to a full month as noted above. Scheduling scopes the time frames required for Construction Staging, Implementation, and Closing the Site Execution.

Site Execution – Construction Staging
Construction Staging is the process of physically preparing the site for the Public Wi-Fi equipment and services. The amount of work for construction staging is pre-defined by the Design Assessment. This includes bringing in the ISP services, drawing in the networking communications lines, and establishing needed equipment power lines for the WAPs.

Site Execution – Implementation
Implementation is the installation and activation of the WAPs that enables the Public Wi-Fi system to go live. This process includes validating the WAPs through extensive Wi-Fi signal testing leveraging download and upload tools by the Wi-Fi Implementation Specialist and the Agency's project specialist to confirm the system.

Site Execution – Closing
Closing is the agency's sign-off process after the site has been extensively tested and confirmed fully functional. The documentation process may include the test results and confirmation statements from the agency's project specialist. This would include the documents signed by the agency and the Ongoing Services and Support for the Public Wi-Fi System.

Site Execution – Other Considerations
Other Considerations may be the Optional Service Agreements for consideration noted at the end of Milestone 2. These may add to the timeline if these options are part of the Site Execution.

- Data Platform to capture metrics for reporting

- Dashboard and Monitoring Management System
- Security Platform to secure devices connecting to Public Wi-Fi system
- Filtering and Site Restriction Platform to block sites
- Public Private Partnerships to fund Public Wi-Fi System
- Subscription Management System to register user access

Optional Execution Activities

Optional Execution Activities are activities that have no impact to the Public Wi-Fi site implementation but may have impact to the use and performance of the Public Wi-Fi system. This covers activities that work to promote the implemented Public Wi-Fi site and system. These are optional activities and are not part of the blueprint timelines but may be integrated if so chosen by the agency looking to promote and spur usage.

1. Site Communications and Promotion
2. Site Programming

Site Communications and Promotion
Site Communications and Promotion activities should be planned after a Public Wi-Fi site implementation has gone live. This works to create public awareness of the site's added value to the facility or community the site will be serving. This may involve creating or updating the agency's website to promote the location as having Public Wi-Fi service. Other communications mediums may be leveraging social media, news print, blogs, etc.

- Agency Website
- Social Media
- News Media
- Blogs
- Promotional Material

Site Programming
Site Programming engages the site for use of the Public Wi-Fi system. Examples include Hackathons, Coding Camps, Online Learning, etc. Programming depends on the type of facility so other Public Wi-Fi examples could be Little League Parks where participants leverage scoring applications from their mobile devices or visual equipment to stream live action to those wishing to view the activities.

- Social Technology
    - Hackathons
    - Coding Camps
    - Online Learning
    - Online Job Placements
- Activity and Streaming
    - Little League Scoring
    - Live Streaming

CHAPTER 10 – CASE STUDIES

This chapter section will feature several real-world case studies provided by the Public Wi-Fi SuperCluster Leadership team. Cities have achieved economic development, digital inclusion, emergency communications, rural connectivity, tourist attractions, and much more.

City of Schenectady, NY: Enhanced City Services

As part of Schenectady's Lower Union Street reconstruction Project that started in late 2015, Smart Lights have recently been installed that allow the control of lighting and other sensors to monitor devices as well as provide a small scale Public Wi-Fi deployment. This deployment, activated on June 20th 2017 as Schenectady's contribution to World Wi-Fi Day[40], gives residents, and visitors within a 5-block area of State Street (from Broadway to Lafayette) access to the internet and is helping to identify value for further Wi-Fi deployment.[41] Wi-Fi access points also allow the city to control smart lighting and other IoT sensors that help in evaluating the benefits of various accessories. This project is in coordination with additional Wi-Fi access in front of City Hall on Jay Street that is also available for residents and visitors to the city.

Through the implementation of this project, the city is also beginning to collect data which will help improve the operation of our local government. For example, the city is using data collected through this project to calculate the expected annual savings from a conversion to LED lighting with motion sensing and demonstrate its effectiveness for a city-wide layout. The city has currently identified a 4-zone approach for installation of these smart lights and plans to have a preliminary timeline in place within the second half of 2017 to begin the transition of all streetlights to an updated smart lighting network.

Keeping in mind the city's ultimate goal of creating a replicable Smart Lighting model that other municipalities can examine and learn from, the City of Schenectady has partnered with private companies, educational institutions, non-profits, and other governments and governmental agencies in an effort to bridge the digital divide, stay current and relevant to the needs of the community, and provide information to improve government services and responsiveness.

City of San Leandro, CA: "SL Wi-Fiber" Provides Economic Development

Background: Since the creation of Lit San Leandro[42] – a public-private partnership that yielded an 18 mile, fiber optic loop – installing a free, Public Wi-Fi system in the city's downtown core had been one of the City Council's long-standing goals.

The System (Design and Architecture): The city did not own any facilities in the downtown core and there were no commercial buildings with direct access to the Fiber loop. However, City Staff determined that the ideal location for a system was on an historic 50-foot sign in the Pelton Plaza shopping center in the center of downtown. Additional mesh access points could be deployed on the city's decorative street lamps. This innovative design would achieve a blazing fast network, utilizing both commercial downtown buildings and the city's own infrastructure.

[40] http://worldwifiday.com/

[41] http://www.cityofschenectady.com/540/Public-WiFi

[42] http://sanleandronext.com/lit-san-leandro-a-tutorial/

To achieve this, the city formed a second public-private partnership with the commercial property owners of the Pelton Plaza to gain exclusive access to the sign in exchange for building and managing a Wi-Fi system on the property. The historic sign was connected directly to the city's fiber loop and mesh access points were deployed around the area. "SL Wi-Fiber" was born.

Impact and Quality: The downtown Wi-Fi system was deployed primarily as a tool for economic development. It is now a downtown attraction, activating previously unused outdoor space, and provides patrons of local businesses, such as restaurants and cafes, with a great amenity: free, Public Wi-Fi. In addition, expansion of the system to the city's community centers and libraries has provided gigabit internet access to people in the community who lack broadband at home. Lastly, one of the San Leandro City Council's stated goals is to transform the city into an innovation hub in the SF East Bay. The downtown Wi-Fi system has worked toward this goal by the helping the city cultivate an image as a welcoming center for technology and innovation. The project received extensive media coverage.[43][44][45]

Town of Walnut Cove, NC and City of Europa, MS: Economic Development

Walnut Cove Downtown Wi-Fi
Walnut Cove is a very small town (population 1409) located in Stokes County, North Carolina. The Town installed a Public Wi-Fi system throughout the downtown business district. The system will provide internet access to merchants, customers, students, and tourists. The project is expected to benefit 15 businesses located in Downtown Walnut Cove.

Downtown Eupora Wi-Fi
This project provided the equipment necessary to provide Wi-Fi access in downtown Eupora, Mississippi. Eupora is a small city in an economically distressed county. The grant provided for an outdoor Wi-Fi antenna, routers, cable and assorted hardware. This was a very small project, under US$7,000 total.

County of San Mateo, CA: "SMCPublic" Delivers Public Safety & Emergency Communications

The remote town of Pescadero in San Mateo, CA has a population of 600 people, mostly made up of migrant farm workers. San Mateo County deployed Public Wi-Fi in this rural community bringing high-speed internet access to many who previously did not have it. The town is often impacted by floods during heavy rain storms and typically the area experiences multiple communication systems and utility power systems failures in these events. **However, in 2017 the County's Public Wi-Fi system stayed online throughout a major storm and flood** and allowed the township people to utilize their mobile devices for emergency communications, including contacting public safety services, posting social media statuses, and staying in contact with their friends and family.
The W-Fi system is also providing economic and education benefits to residents by closing the digital divide.

[43] http://www.mercurynews.com/breaking-news/ci_27744535/san-leandro-provide-free-wi-fi-downtown

[44] http://www.govtech.com/network/San-Leandro-Calif-Launching-Free-Downtown-Wi-Fi.html

[45] http://www.marketwatch.com/story/city-of-san-leandro-and-ruckus-wireless-team-to-build-one-of-the-most-progressive-public-wi-fi-networks-in-the-bay-area-2015-07-27

City of Houston, TX: Enhanced City Services & Digital Inclusion

The City of Houston built a private broadband wireless network leveraging 4G WiMAX and Wi-Fi technologies. The network was based on 3.65 GHz shared spectrum and unlicensed spectrum with 60 cell sites for the WAN (wide area network) and 250 outdoor hotspots. The network was able to be funded for immediate need for water management saving and grow to serve multiple city and public services. Services covered:

- Fixed Network Water Automated Meter Reading – 500-thousand customers.
- Traffic and Transportation ITS – 2500 Signalized Intersections and 1500 School Zone Flashers
- Water and Waste Water Plant Connectivity (T1-Replacement), SCADA, and Security – 500 Locations
- Public Library Digital Inclusion – 250 Hot Spots and 75 Public Computer Centers in Underserved Houston Areas
- Electronic Parking Pay Stations

The network also allowed Houston to develop a comprehensive digital Inclusion program covering:

- Extending Excess Network Bandwidth to serve a public good by sponsoring the Houston Public Library.
- Extending the reach of online library services to include covering 10 underserved communities.
- Public Access: 75 locations.
- Public Computer Systems: Connecting over 500 PCs.

Washington D.C.: IoT/Smart City Connectivity & Public Benefits

The Washington D.C. PA2040 project, led by the DC Office of the Chief Technology Officer (OCTO), provides ubiquitous broadband Public Wi-Fi connectivity through a mesh backhaul infrastructure supporting Smart City/IoT deployment throughout a 3-square block area along the 1,700 to 1,900 blocks of Pennsylvania Avenue, NW, Washington D.C.

The platform enables no-cost public internet access and enhanced connectivity for government operations. Wi-Fi backhaul currently supports sensor based lighting, environmental sensing, and smart parking applications. Additional applications may include public safety monitoring, smart waste management, smart water/hydrant management, intelligent signage and traffic management, and others.

The project has involved city technology, planning, and transportation agencies, local Business Improvement District, federal District planning agencies, local universities, the regional utility, and technology solution providers.

Since the Phase 1 deployment in October 2016, the PA2040 footprint has been expanded to include enhanced coverage in Farragut Square Park and DC OCTO is currently working with stakeholders to evaluate and prioritize future applications within the footprint and identifying other areas within the city for replication.

Ute Indian Tribe (Utah): Closing the Digital Divide in a Rural Community

In 2010, NTIA awarded a US$1.4 million grant to the Ute Indian Tribe of the Uintah and Ouray Reservation to install fiber-optic cable and address the significant lack of infrastructure on their reservation. At that time, the Ouray Reservation had low education rates, high crime rates, and an unemployment rate of almost 77 percent. Tribal leaders believed that high-speed broadband could enhance educational opportunities, spur economic development, and improve the delivery of telehealth, public, and social services.

By project completion in August 2013, the tribe deployed nine-and-a-half miles of fiber-optic cable, connected 43 community anchor institutions to the network, installed ten Wi-Fi hotspots, and provided free Internet to all tribal entities and residents, including 180 previously unserved households. For example, Ute connected the Little Mesa Head Start facility to online learning tools that helped pre-K learners keep pace with their peers at a critical point in their educational development.

The grant also connected three vital healthcare institutions, allowing medical providers to manage case files on a secure network, connect with specialists off the reservation, and participate in remote training to improve their treatment. Broadband access on the Ouray Reservation helped its citizens and public leaders gain access to critical resources that improved their opportunities for educational and economic advancement, public safety, and personal health.

City of San Jose, CA: “Wickedly Fast Wi-Fi” in Downtown, McEnery Convention Center, and Mineta International Airport

San Jose’s is the informal “Capital of Silicon Valley” and is the tenth largest city in the United States and the third largest in California. Having rolled out one of the first municipal outdoor Wi-Fi deployments in the nation using legacy Wi-Fi technology, San Jose was challenged to keep up with a growing number of users armed with multiple and more powerful Wi-Fi enabled devices. Moreover, user expectations for access to stream video and multimedia rich applications predicated a smarter and more industrial strength wireless infrastructure. And beyond free and fast public access, the city viewed a reliable Wi-Fi infrastructure as essential to future economic development, attracting new businesses downtown and efficiently delivering and supporting a whole new generation of city services — from Wi-Fi-enabled parking meters to streaming video.

Former CIO at the City of San Jose, now CEO of CivicFoundry, Vijay Sammeta realized the city needed to replace its existing municipal Wi-Fi network to support higher capacity public access, streaming video, and city service employees over a larger footprint of the city. However, Sammeta said, “We were reluctant to upgrade the existing network unless we could provide an ‘over the top’ experience to users that reflects our heritage as the world’s center of technology innovation.”

The City of San Jose’s new Wi-Fi infrastructure would initially cover 1.5 square miles of outdoor space downtown. The city also needed to extend Wi-Fi within high density indoor environments, including San Jose’s Mineta International Airport and the McEnery Convention Center.

Deploying the new Wi-Fi network was a snap. The City partnered with SmartWAVE Technologies and Ruckus Wireless for the design/build and equipment. Rich with fiber assets and bandwidth coming from MAE West, an Internet peering point located downtown at 55 Market Street, backhaul capacity wasn’t a problem. However, running this fiber to every Wi-Fi node where service was required was a problem.

Instead, San Jose utilized Wi-Fi meshing on the APs. Using Ruckus 3-Stream, dual-band 802.11n outdoor units, the City easily expanded network capacity and coverage throughout the city without expensive fiber trenching to AP locations. Ruckus ZoneFlex outdoor APs were installed on outdoor light poles and building facades.

After the successful launch of its "Wickedly Fast Wi-Fi" outdoor network, San Jose began deploying indoor Wi-Fi. Hundreds of dual-band, 3-Stream 802.11n access points were installed in the McEnery Convention Center and the Mineta International Airport to ensure a consistent and high-speed user experience. Looking forward, the City is planning to leverage new Hotspot 2.0 technology to give users seamless roaming between other Hotspot 2.0 networks as well as automatic and secure provisioning of end devices without tedious configuration to find the right Wi-Fi network. A terabyte of throughput is now commonly pushed through the network daily as data traffic continues to increase.

City of San Francisco, CA: Digital Inclusion & Economic Development

Following an unsuccessful attempt to provide free and affordable wireless service through a 2006 partnership with EarthLink and Google, San Francisco regrouped and decided that the best way to connect underserved residents to the internet would be to leverage existing city-owned fiber infrastructure as the backbone for a new municipal wireless service. The city chose four of the largest public housing communities because of its built-in demographic of low income, disabled, at-risk youth and senior dwellers to serve as the initial locations to pilot the service. The city then partnered with a non-profit (Internet Archive) and select commercial (AT&T) internet service providers to provide the connectivity to the internet and with companies like Cisco to provide the hardware. By the end of 2010, roughly 40 affordable housing communities had access to free ubiquitous Wi-Fi service that residents could get while indoors or outdoors.[46] While the project was largely successful, the ongoing service at public housing communities is unknown due to the lack of adequate funding.

Also in 2010, San Francisco received a US$7.9 million Broadband Technology Opportunities Program (BTOP) grant from NTIA to promote the use of the network and provide free computer and internet access, tutoring and training in more than 50 technical lab sites serving more than 1600 participants throughout the city. The grant was awarded in part because of the city's expansive free Wi-Fi service in Public Housing.

Highlights of the success of this service included: The Bayview Hunter's Point Center for the Arts and Technology and Streetside Stories[47], two non-profit media arts organizations provided digital youth programs that prepared students for careers in website design and content generation. Offered at 13 locations across the city, these programs taught participants website design, principles, digital film making and storytelling and content creation techniques. The students were able to leverage these skills at home or at recreation centers on the city's free Wi-Fi network. The Community Living Campaign[48], a non-profit organization dedicated to improving the lives of senior citizens, provided digital literacy classes in more than 50 senior centers. Many of these classes included computer basics, internet fundamentals, internet safety and social media techniques. In many cases, seniors could practice these skills in their own homes.

[46] https://bits.blogs.nytimes.com/2008/03/28/low-income-residents-get-high-speed-access/?_r=0

[47] https://baycat.org/

[48] https://www.sfcommunityliving.org/

In late 2013, San Francisco launched a free Wi-Fi service on Market Street[49], which is the city's busiest and most economically diverse corridor. It is visited by nearly a quarter of a million people every day. This enabled street merchants a means to provide point of sale purchasing power by using square on their mobile phones. There are also stories how many of the immigrant workers suddenly had a way to keep in touch with family members in their home countries by using apps like Skype. The service is also a big hit with tourists, attendees of the city's various parades, users of ride-sharing apps and homeless seeking services.

More recently, the city received a grant from Google to provide Wi-Fi service to 35 parks and plazas. The service has been a boom with young skaters, artists, and park event attendees who use the service to go live on social media or to just tap into city services.

[49] http://sfgov.org/sfc/sanfranciscowifi

APPENDIX 1 – PROJECT MANAGEMENT SUPPLEMENTAL MATERIALS

Basic Requirements Worksheet

Basic Requirements for Public Wi-Fi	
o Internet Service Provider Availability	• Compile list of available ISPs • Request and review ISP Terms and Conditions • Request product pricing sheets from ISPs
o Implementation Expertise	• Compile list of Wi-Fi implementation experts • Solicit implementation and servicing estimates • Solicit equipment procurement estimates
Gather list of available ISPs, their Terms and Conditions, and product pricing sheets. Review the Terms of Conditions to ensure compliance with agency standards and program requirements which will provide initial framework for ISP pre-qualifying. Compile product pricing and checklist for each list of available ISPs and project out one-time costs and annualized pricing costs. Solicit Wi-Fi implementation experts through other agency channels and/or leverage existing public documentation on proven experts. Solicit prospective implementation estimates and ongoing servicing costs for system maintenance and support and compile information. Solicit equipment procurement estimates from implementation experts and compile information. See below for a sample compilation template.	

Cost Analysis Worksheet

Costs of Public Wi-Fi	
o How much does it cost?	• Simple, Typical or Large implementation? • Does the agency have the budgetary funds?
o How much agency staff time is required?	• Estimate approximate staff time for planning and per site implementation
o Ongoing maintenance costs?	• Estimate ongoing maintenance costs
The compilations from the Basic Requirements will form the basis of rough costs for the Public Wi-Fi program from a modular perspective. Agency staff time will equate additional costs through the estimate of hours times the cost. Ongoing costs such as ISP and Servicing must be annualized to project annualized costs for annual budgeting.	

Justifications Worksheet

Justification for Public Wi-Fi	
o Economic Development	• Will Public Wi-Fi add value to the business area? • Will businesses partner with the program? • What are the metrics of success? • Program costs will be typical to large.
o Municipal Infrastructure Modernization	• Is this adjunct to the agency plan? • Will this provide cost savings to the agency? • What are the metrics of success? • Program costs will be large.
o Education Outcomes	• Do the schools have the tech infrastructure? • Is there a gap between technology and schools? • What are the metrics of success? • Program costs can be small to typical.
o Bridging the Digital Divide	• Identify the digital divides in jurisdiction? • Education, Workforce, Communities, etc. • Analysis of federal information on divide. • Program costs can be small to typical.

Every agency will have different justifications or combinations of justifications for their Public Wi-Fi program. The summary ideations identified above provide a basis for formulating the narrative for the given agency.

The City of San Leandro initiated their first Public Wi-Fi program in their downtown business district in 2015 at a cost of about US$70,000 after working through their public private partnership municipal infrastructure modernization. The Public Wi-Fi program was an investment into their downtown to provide high-speed internet services for a growing office worker workforce nearby which benefited the downtown economically. The success of the program has spurred San Leandro's City Council to expand their Public Wi-Fi program by US$300,000 for two more fiscal years.

The County of San Mateo initiated their Public Wi-Fi program in 2013 by targeting twelve locations throughout the County with goals of Bridging the Digital Divide and focusing on better Educational Outcomes – the initial investment was about US$500,000. It was recognized that the town of Pescadero CA (population 600+, largely migrant farm workers) had no internet services available and a high unlikelihood that cable or DSL internet providers would go in without significant investments. This became the showcase for the County of San Mateo by putting the significant investments into building the first Public Wi-Fi system which brought the services into the town. The services became well-used with the local towns people putting in their own expense into purchasing devices to connect to the Public Wi-Fi system. The County of San Mateo now has 36 Public Wi-Fi sites and has been adding 12 sites annually.

Bandwidth Estimation Chart

Description	Mbps per User Minimum	Estimated Usage Rate	Estimated Population Per Hour	Suggested Bandwidth	Optimal Number of Devices per Hour
Passive device traffic (downtown district, etc.)	1 Mbps	1%	5,000	50 Mbps	50 devices
Semi passive device traffic (community center, etc.)	1 Mbps	2%	2,500	50 Mbps	50 devices
Semi active device traffic (coffee shop, etc.)	1 Mbps	5%	1,000	50 Mbps	50 devices
Active device traffic (library, etc.)	1 Mbps	10%	500	50 Mbps	50 devices

Full Project Proposal Sample

The flow of Milestone 1 in the blueprint is focused on the consideration elements for an agency sponsored Public Wi-Fi Program. This covers the basic requirements, costs, justifications and other discussion points for consideration. The below outline and sample provides the minimum elements required for drafting the proposal by using a fictitious county (Metropolis County) – note that other elements and styles can be integrated with the below outline.

- Executive Summary
  - Overview and Summary of Program Objectives
- Purpose of Program – Program Justification
  - Background and Situation
  - Consideration Narrative
  - Use Cases
- Costs of Program – Program Implementation and Ongoing Costs
  - Summary and Narrative of Costs
- Appendix – supplementary supporting documents

Executive Summary

The Executive Summary needs to be concise while outlining the objectives of the Public Wi-Fi program. It should briefly note the current situation, the end state, and what the Public Wi-Fi program objectives will accomplish.

Sample Executive Summary

Metropolis County is actively engaged in bridging the digital divide which is estimated in the area of 80,000 in the county. About 70% of the land in Metropolis is rural and 30% is urban which poses terrain challenges and high costs for internet services in areas that have no service. The urban areas continue to grow economically with an increase use of internet services but have left a divide for those lacking online services. This includes our County school districts that mandate students to perform their schoolwork online. The National Telecommunications and Information Administration (NTIA) has quantified the digital divide at 20% in Metropolis County and further states that nearly one third of the 80% that are connected only on mobile phones. To spur connectivity and technology adoption, staff recommends that Metropolis initiate a Public Wi-Fi program to provide public access to the internet to bridge these divides with an initial investment of US$2,000,000. This Public Wi-Fi program will put Wi-Fi sites in select County facilities and areas of the County that lack broadband access and areas where underserved/unserved populations exist. This program will benefit the underserved/unserved populations in the Metropolis County

by providing them access to internet Services, increasing adoption of internet devices, and provide County staff and the local populace with

Purpose of Program – Program Justification

The Purpose of Program expands on the Executive Summary's coverage of background history and current situation with details. Subsequent to the background will be a narrative analysis based off the considerations.

Sample Background and Situation

Metropolis County is a West coastal region covering 500 square miles with eight cities and three coastal towns surrounded by protected farming lands. The North, South and East bordering the county lines have rolling hills that continue on outside of the county to mountain ranges that provide water resources to the cities and towns through an aging aqueduct system. The county population is approximately a half million with 90% residing in the cities and the remaining 10% in the coastal towns. Most of the cities have a mix of income levels and diverse immigrant populations with the larger cities containing manufacturing and service based industries. Eateries and beverage shops in the larger cities provide Wi-Fi services for their patrons while the smaller cities have fewer services that provide Wi-Fi. The towns have a greater immigrant population composed primarily of migrant workforce living in communes and multi-family housing complexes. Each of the townships has downtown districts providing the basic services and markets to the local populace and visitors but no businesses providing Wi-Fi. The larger cities have excellent telecommunications services while the other cities have good coverage. The telecommunications coverage in the towns is extremely limited due to the challenging roads and terrain that connect these coastal towns. There are over forty thousand students in the public schools and all are required to perform their school work online and every school facility has broadband access to the internet. Government services and facilities all have broadband access to the internet and are located throughout the county in key locations that are accessible to the cities and towns.

Sample Consideration Narrative

The combined digital divide for Metropolis County is 20% per the NTIA which quantifies to a population of 80,000 residents. The digital divide is significant in the coastal towns with nearly 80% of the population (~40,000) have no broadband whereas a bit over 10% of the urban city populations (~40,000) have less broadband outside the schools – businesses and services in the cities have frequent traffic from students who do their schoolwork with personal devices. The digital divide is greatly amplified in the coastal towns for students having the need to do schoolwork online.

The Metropolis County facilities have broadband access to the internet for the County workforce but no Wi-Fi services. Adding Wi-Fi to the facilities and strategic locations provides added municipal communications infrastructure for County workforce and the public to access as additional channels to communicate with mobile devices.

Sample Use Cases

- San Mateo County's town of Pescadero represented a great example where the digital divide was bridged. There were no broadband services available in Pescadero due to the fact that it was nearly 20 miles away from other towns and cities that had services and the population of 600+ was not significant enough for the ISPs to put in the investment. San Mateo County's investment

into expanding their network services to the facilities allowed for capital costs to allow for putting out a Public Wi-Fi system in the downtown that supported the local population, local businesses, and added value to the downtown for transient stops by tourists who would spend their money in the area.

- The city's Public Wi-Fi program encouraged a Bay Area non-profit group to offer coding boot-camp education service to train students in coding. This allowed for San Leandro's local education non-profit and the City of San Leandro to partner in the process for coordination and providing a facility that had access to the Public Wi-Fi system.
- San Mateo County's Human Services Center in Pescadero provided a single kiosk computer connected to the Public Wi-Fi system to assist low-income workers in composing resumes to apply for jobs online and supporting their kid's education three years back. The popularity of this kiosk has encouraged families to adopt technology through personal purchase of devices to connect to the Public Wi-Fi at this facility. Many families now come to the facility often parking outside with their personal devices to continue with their employment development or children's education simply by connecting to the Public Wi-Fi system which provides the internet services to them freely.

Costs of Program – Program Implementation and Ongoing Costs

The Costs of Program needs to be aggregated and summarized in this section of the Proposal. The details compiled can be facilitated in the Appendix of the Proposal.

Sample Costs of Program

This proposal is requesting US$2,000,000 for the Public Wi-Fi Program with US$1,000,000 to be spent by the coastal towns and US$1,000,000 to be spent in the cities. The division of these costs is based off the fact that the digital divide between the towns and cities are nearly equal. These costs factor capital and operation expenditures with county staff time as a function of the total program costs.

The three Metropolis County towns currently represent half of the County's digital divide where local residents and businesses have absolutely no broadband services due to high costs to bring in such services. Staff has analyzed the costs to bring in services to key facilities in each town through a combination of backhauling strategies. The total CAPEX costs have been estimated to be US$850,000 which will bring in direct backhaul of internet lines to each of the three towns. The ongoing OPEX costs with three year contracts will be US$150,000.

- Public Wi-Fi Services to three Metropolis County towns.
    - Capital expenditure costs for 12 sites - US$850,000
        - ISP Connectivity Construction Costs - US$700,000
        - Wi-Fi and Backhaul Equipment Costs - US$150,000
    - Ongoing operational expenditure costs - US$150,000
        - Three year ISP services costs - US$110,000
        - Three year Site and Services Maintenance Contract - US$40,000

The eight Metropolis County towns represent the other half of the County's digital divide where approximately 10% of the local residents and businesses have limited or no access to broadband services. Staff has analyzed the costs to bring in services to key facilities in each city. The total

CAPEX costs have been estimated to be US$700,000 and the ongoing OPEX costs with three year contracts will be US$300,000.

- Public Wi-Fi Services to eight Metropolis County cities.
    - Capital expenditure costs for 24 sites - US$700,000
        - ISP Connectivity Construction Costs - US$400,000
        - Wi-Fi and Backhaul Equipment Costs - US$300,000
    - Ongoing operational expenditure costs - US$300,000
        - Three year ISP services costs - US$220,000
        - Three year Site and Services Maintenance Contract - US$80,000

Appendix – Supplementary Supporting Documents
In this section, attach detail and/or summary documents in this section. Documents to add should include but are not limited to:

- Summary Costs of Services Quotes
- Summary Costs of Equipment Quotes
- Analysis Summary from Justifications for Public Wi-Fi Program
- Prospective Contracts and Agreements
- Statistics, Data and Studies to Support Proposal
- GIS Maps to Support Proposal
- Letters of Support from local constituents
- Use Case Examples (Real or Proposed)

SITES IDENTIFICATION CHECKLIST (COMPILED LIST OF SITES)

The below table is an example of a Compiled List of Sites. Lists can span into the hundreds of sites for consideration and are always subject to change and additions. The attributes to the right of the sites are to determine feasibility. Additional attributes may be added to meet the specificity or requirements of the agency.

Compiled List of Sites	People Traffic	Places to Sit	Internet Backhaul	Electrical Power	Wi-Fi Equipment Facility
Metropolis County Center, Civic Court Yard, Metropolis City	□	□	□	□	□
Ohlone Town Coastal Community Center	□	□	□	□	□
Martin Luther King, Jr Community Center, Metropolis City	□	□		□	□
Jefferson Library, City of St. John	□	□		□	□
Washington Elementary School, City of Orange				□	□
San Pedro Valley Park, Town of Barbary		□		□	
Lorenzo Shopping Center Fountain Plaza, City of Lorenzo	□	□	□	□	□

Site Inspection Worksheet

Site Name	**Martin Luther King, Jr Community Center, Metropolis City**
Site Address	**123 Martin Luther King Jr. Way, Metropolis City**
Site Coverage Assessment	This Community Center is about 60,000 square feet. • 1 main auditorium at 24,000 square feet • 2 large event rooms each at 8,000 square feet • 5 mid-sized rooms each at 2,000 square feet • 10 regular rooms each at 1,000 square feet All of the rooms are wired up with network connections; however, some construction will be required for placement of the WAPs and wiring that leads to the WAPs.
WAP Facility Assessment	Power and connectivity will need to be drawn to the WAPs in each of the rooms. The facility is already pre-connected to ISP services so additional contracts will need to be put in place for a separate ISP connection to the Wi-Fi system. An electrical cabling vendor will be need for the power and network cabling.
Site Use Approval Assessment	The facility management is tied to Public Works and has received approval for wiring this facility for Public Wi-Fi. Appropriate MOUs need to be put in place to allow for the Public Wi-Fi system to be installed.
Estimated Costs	• 12 WAPs and associated accessories required - estimate US$36,000 • 1 Gbps ISP services installation annual service - estimate US$20,000 • Electrical Cabling Construction - estimate US$20,000 • Ongoing Wi-Fi Service and Support annual service - estimate US$5,000 Total Estimated Costs: US$81,000
Assessment	**Exceeds site threshold of US$75,000. Decision Committee to determine**
Decision	**Approved by Decision Committee**

Site Qualification Template

Finalizing the Site Selection is to narrow the list specific to sites that can be completed in the current program year or later program years. The system for prioritizing the sites come from the site assessment and any criteria established for the process.

The below example assumes that the budget will allow for two sites to be done per year and shows the result of the assessment based off the Qualified column. The final site selection provides the brief comments or justifications on the priority of each site.

For example, the County of San Mateo initiated the Public Wi-Fi program in 2014 with an initial list of over 80 sites. The list has since grown to over 130 sites (including completed sites) and goes through an annual vetting process to decide on 12+ sites to implement each fiscal year.

Compiled List of Sites	Qualified	Current Year	Next Year	Later Years	Comments
Metropolis County Center, Civic Court Yard, Metropolis City	□	□	□	□	Heaviest use by public with moderate cost, Current Year
Ohlone Town Coastal Community Center	□	□	□	□	Moderate use but high cost to implement, Next Year
Martin Luther King, Jr Community Center, Metropolis City	□	□	□	□	High use with high cost to implement, Current Year
Jefferson Library, City of St. John	□	□	□	□	Moderate use but high cost to implement, Next Year
Washington Elementary School, City of Orange	□	□	□	□	Washington Elementary School, City of Orange
San Pedro Valley Park, Town of Barbary	□	□	□	□	No infrastructure, costs high - later years
Lorenzo Shopping Center Fountain Plaza, City of Lorenzo	□	□	□	□	No agreements with Shopping Center owner - later years

Public Wi-Fi Terms of Use Sample

Below is a sample TOU found on the County of San Mateo's Public Wi-Fi system.

Terms of Use

By accepting this agreement and accessing the wireless network, you acknowledge that you are of legal age, you have read and understood, and agree to be bound by this agreement.

(*) The wireless network service is provided by the property owners and is completely at their discretion. Your access to the network may be blocked, suspended, or terminated at any time for any reason.

(*) You agree not to use the wireless network for any purpose that is unlawful or otherwise prohibited and you are fully responsible for your use.

(*) The wireless network is provided "as is" without warranties of any kind, either expressed or implied.

This wireless network is powered by Ruckus Wireless.

Project Checklist and GANNT Timeline for Milestone 1

This section has the basic checklist and GANNT Timeline for Milestone 1 for items covered in the blueprint.

Project Checklist - The checklist can be customized to the agency's program requirements.

Milestone 1The Decision Process – Checklist	Check
Milestone 1 - The Decision Process	□
Considerations	□
Basic Requirements	□
Internet Service Provider	□
Internet Backhaul Source	□
Usage Scaling	□
Implementation Expertise	□
Contracting	□
Internal Staff Resources	□
Cost of Public Wi-Fi Program	□
Sizing the Public Wi-Fi Program Capex Costs	□
Ongoing Maintenance Costs	□
ISP Costs	□
System Maintenance and Support Costs	□
Justifications for Public Wi-Fi Program	□
Economic Development?	□
Municipal Infrastructure Modernization	□
Education Outcomes	□
Bridging the Digital Divide	□
Proposal	□
Getting Answers to the Considerations	□
Basic Requirements for Public Wi-Fi Program	□
Internet Service Provider	□
Internet Backhaul Source	□
Usage Scaling	□
Implementation Expertise	□
Contracting	□
Internal Staff Resources	□
Cost of Public Wi-Fi Program	□
Sizing the Public Wi-Fi Program Capex Costs	□
Ongoing Maintenance Costs	□
ISP Costs	□
System Maintenance and Support Costs	□
Justifications for Public Wi-Fi Program	□
Economic Development?	□
Municipal Infrastructure Modernization	□
Education Outcomes	□
Bridging the Digital Divide	□
Other Discussion Points for Consideration	□
Data from Studies, Surveys, and other sources.	□
Visualizing data using GIS systems.	□
Proposal Outline and Narratives	□
Executive Summary	□
Overview and Summary of Program Objectives	□
Purpose of Program – Program Justification	□
Background and Situation	□
Consideration Narrative	□
Use Cases	□
Costs of Program – Program Implementation and Ongoing Costs	□
Summary and Narrative of Costs	□
Appendix – supplementary supporting documents	□

GANNT Timeline - The GANNT Timeline collapses the Project Checklist into the key task groups which incorporate all the sub-tasks under that task group. The timeline below is suggested for an agency as a guideline but does not mandate the timeframes are fixed. The timeline can be customized to the agency's requirements.

Milestone 1 - Tasks	Month 1	Month 2	Month 3	Month 4
Milestone 1 - The Decision Process				
Considerations				
Basic Requirements				
Cost of Program				
Justifications of Program				
Proposal				
Consideration Analysis				
Other Discussion Points				
Draft Proposal				

Project Checklist and GANNT Timeline for Milestone 2

This section has the basic checklist and GANNT Timeline for Milestone 2 for items covered in the blueprint.

Project Checklist - The checklist can be customized to the agency's program requirements.

Milestone 2 Pre-Staging Agreements - Checklist	Check
Milestone2 – Planning and Pre-staging	☐
Site Selection	☐
Site Identification	☐
Type of Sites	☐
Attributes to Consider	☐
Compiled List of Sites	☐
Site Assessment	☐
Site Inspection	☐
Total Coverage Area	☐
Appropriate Facility Site(s) for WAP(s)	☐
Site Use Approval Requirements	☐
Estimated Cost of Equipment and Backhauling Construction	☐
Finalize Site Selection	☐
Pre-Staging Agreements	☐
Terms of Use Consideration	☐
Site Use Agreement	☐
Services Agreement	☐
Wi-Fi Implementation Specialist Services	☐
Ongoing Wi-Fi Services and Support	☐
ISP Services Agreement	☐

GANNT Timeline - The GANNT Timeline collapses the Project Checklist into the key task groups which incorporate all the sub-tasks under that task group. The timeline below is suggested for an agency as a guideline but does not mandate the timeframes are fixed. The timeline can be customized to the agency's requirements.

Milestone 2 - Tasks	Month 5	Month 6	Month 7
Milestone2 – Planning and Pre-staging			
Site Selection			
Site Identification			
Site Assessment			
Pre-Staging Agreements			
Terms of Use Consideration			
Site Use Agreement			
Services Agreement			

Project Checklist and GANNT Timeline for Milestone 3

This section has the basic checklist and GANNT Timeline for Milestone 3 for items covered in the blueprint.

Project Checklist - The checklist can be customized to the agency's program requirements.

Milestone 3 - Checklist	Check
Milestone 3 – Program Execution	□
Site Pre-Execution	□
Site Use Approval	□
Design Assessment	□
Scope of Work – Professional Services	□
Equipment and Services Procurement Order	□
Procurement	□
Contract Submission	□
Equipment Purchase Submission	□
Site Execution	□
Scheduling	□
Construction	□
Implementation	□
Closing	□

GANNT Timeline - The GANNT Timeline collapses the Project Checklist into the key task groups which incorporate all the sub-tasks under that task group. The timeline below is suggested for an agency as a guideline but does not mandate the timeframes are fixed. The timeline can be customized to the agency's requirements.

Milestone 3 - Tasks	Month 8	Month 9	Month 10
Milestone 3 – Program Execution			
Site Pre-Execution			
Site Use Approval			
Design Assessment			
Scope of Work – Professional Services			
Equipment and Services Procurement Order			
Procurement			
Contract Submission			
Equipment Purchase Submission			
Site Execution			
Scheduling			

Construction			
Implementation			
Closing			

GANNT Timeline for Milestone 1, 2 and 3

Full GANNT Timeline for all three Milestones

Milestone - Tasks	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10
Milestone 1 - The Decision Process										
Considerations										
Basic Requirements										
Cost of Program										
Justifications of Program										
Proposal										
Consideration Analysis										
Other Discussion Points										
Draft Proposal										
Milestone2 – Planning and Pre-staging										
Site Selection										
Site Identification										
Site Assessment										
Pre-Staging Agreements										
Terms of Use Consideration										
Site Use Agreement										
Professional Services Agreement										
ISP Services Agreement										
Milestone 3 – Program Execution										
Site Pre-Execution										
Site Use Approval										
Design Assessment										
Scope of Work – Professional Services										
Equipment and Services Procurement Order										
Procurement										
Contract Submission										
Equipment Purchase Submission										
Site Execution										
Scheduling										
Construction										
Implementation										
Closing										

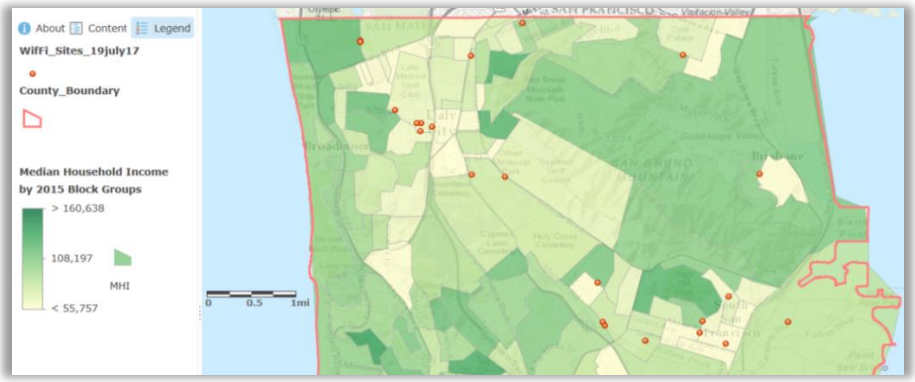
Proposal – Other Discussion Points for Consideration (GIS INTEGRATION TIPS)

Other discussion points for consideration add support on the decision process by leveraging data points to aid in the consideration process.

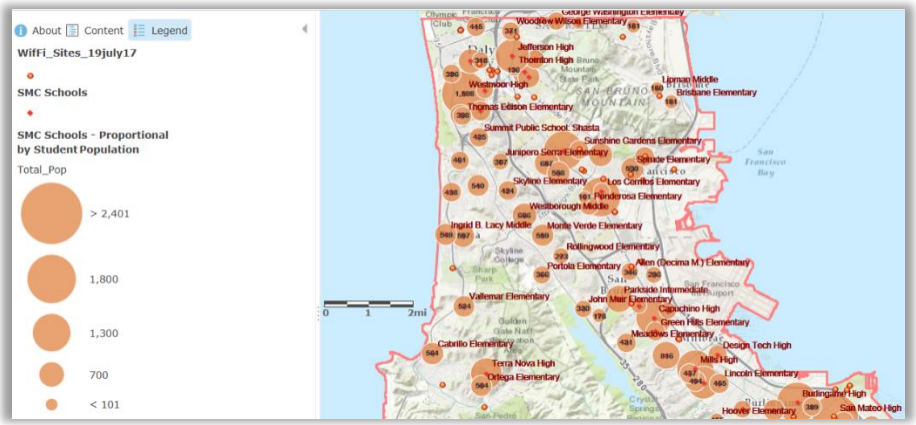
- **Data from Studies, Surveys, and other sources.**
  - When justifying the Public Wi-Fi Program, other sources of information may be available and/or leveraged. Broadband connectivity is discussed at every level of government from local to federal with a specific interest in public access to internet services. The data does not need to be specific to broadband in that it supports assertions to broadband needs. For example, digital divide studies often demonstrate larger divisions as a result of income classifications so such information can be cross-combined to impute gaps that need to be addressed.
  - Decennial Income Data
  - Census – American Community Survey.
  - Digital divide data from federal information studies and sources.
  - Proximity to Facilities.
    - Schools
    - Community Centers
    - Convening Facilities
    - Business Districts
    - Recreation and Leisure Facilities
    - Libraries

- **Visualizing data using GIS systems.**
  - Visualizing data is method of codifying information noted above through the use of a GIS (Geographic Information System) that marks and color codes maps to provide a visual perspective of the data.
  - The below map lists Live, Potential and Suggested Public Wi-Fi sites.
  -

Decennial Income Data to identify underserved/unserved areas – this data can median household and family incomes. The below County of San Mateo GIS map provides an example of potential and suggested Public Wi-Fi sites based off census block group median household incomes. Lower income family groups have a wider divide with respect to internet services and this map provides a visual perspective for targeting and implementation decisions.



The below County of San Mateo GIS map merges the potential and suggested Public Wi-Fi sites with a visual representation of all the schools in the county based off the enrollment numbers classified by grouped population circles.



APPENDIX 2 – ADDITIONAL RESOURCES

Digital Inclusion

DigitalLearn.org – Public Library Association
https://www.digitallearn.org/

Everyone On
http://everyoneon.org/

Nonprofit Technology Network (NTEN) Digital Inclusion
https://www.nten.org/interest-category/digital-inclusion/

National Digital Inclusion Alliance (NDIA)
http://www.digitalinclusionalliance.org/

Joint Venture Silicon Valley, Civic Technology Initiatives
http://www.jointventure.org/wireless
http://www.jointventure.org/smart-region
http://www.jointventure.org/community-broadband

Reports

Digital Inclusion and Meaningful Broadband Adoption Initiatives
Colin Rhinesmith, Benton Foundation
https://www.benton.org/sites/default/files/broadbandinclusion.pdf

Digital Inclusion Toolkit: Resources and Case Studies from the Digital Inclusion Fellowship
Nonprofit Technology Network
https://www.nten.org/NTEN_images/reports/2016.DIF_Toolkit.pdf

After Access: Libraries & Digital Empowerment - Building Digitally Inclusive Communities
Larra Clark, American Library Association and Karen Archer Perry, Clarion Collaborative
http://www.ala.org/advocacy/sites/ala.org.advocacy/files/content/ALA%20DI%20After%20Access_final_12%2017%2015.pdf

BroadbandUSA: Connecting America's Communities Home Broadband Adoption Rates Percent of Households, 2015 ND SD NE KS OK TX MN MO 74% 74% TN ME
https://www2.ntia.doc.gov/files/homebroadbandadoptionrates_2015.pdf

Federal Funding

http://www2.ntia.doc.gov/files/ntia_guidetofedfunding_062317.pdf

BroadbandUSA: Guide to Federal Funding of Broadband Projects

Planning

Using Partnerships to Power a Smart City: A Toolkit for Local Communities
http://www2.ntia.doc.gov/files/smartcities-toolkit_111516_v2.pdf

Planning a Community Broadband Roadmap: A Toolkit for Local and Tribal Governments
http://www2.ntia.doc.gov/files/ntia_planning_community_broadband_roadmap_052417.pdf

Technical Assistance

BroadbandUSA: Serving American Communities
https://www2.ntia.doc.gov/files/bbusa_factsheet_161215.pdf