



Wireless Broadband:
The Foundation for Digital Communities

Community Guidebook



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About the Authors

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Introduction

One year ago, Civitium released the first Wireless Broadband “cookbook” for community leaders. At that time, only a handful of communities had launched municipal wireless initiatives. Today, some of the largest cities in the US have announced plans to deploy a metro-scale wireless broadband network including Philadelphia, San Francisco, Boston, Portland, and many others. State legislators across the country have debated the proper role (if any) for municipalities who want to provide broadband service to residents and four similar bills have been introduced in US Congress.

Clearly, the momentum for municipal wireless networks is building. However, the motivations by communities are the same as they have always been – to deploy wireless broadband infrastructure to:

- Promote digital inclusion through lower prices and universal availability
- Strengthen economic development by offering businesses the infrastructure necessary to compete in a global economy
- Streamline government services and increase efficiency through Digital Community applications

This new guidebook includes lessons learned by Civitium through our work with some of the most high profile municipal wireless initiatives. The format of the guidebook has shifted to reflect what we have identified as the four major stages of a successful initiative:

- Feasibility
- Procurement
- Network Deployment
- Enhancement

Wireless broadband networks are making a powerful difference in communities across the U.S. In west Philadelphia, low-income residents have access to broadband for only \$5 per month. In San Mateo, California, police officers have a public safety network that allows them to spend their entire shift on the street, increasing visibility in the community and decreasing crime. In Scottsboro, Indiana, nearly 100 citizens were able to keep their jobs at a Chrysler plant because the city deployed the broadband infrastructure necessary to keep the plant operational. As community leaders launch new initiatives to impact their citizens’ quality of life, Civitium hopes this guidebook will provide a framework for strategic planning based on the best practices and lessons learned from other Digital Communities.

Feasibility

Before most community governments launch an infrastructure project, a feasibility study is often conducted. In a municipal wireless broadband initiative, the following areas of feasibility need study:

- **Political and regulatory feasibility:** What is the motivation for this initiative? Do stakeholders throughout the community share the local government's vision and motivation for a citywide wireless broadband network? Are there legal and/or regulatory restrictions that would limit, influence, or prohibit the initiative?
- **Economic feasibility:** What type of business models should the community consider? How can the community fund the initiative?
- **Technical feasibility:** What are the current technologies available now to meet objectives? Can the physical and RF environment support a metropolitan area network?

A comprehensive feasibility study will answer the above questions and allow leaders to decide whether to proceed with the wireless initiative, while also providing local leaders with a blueprint to follow.

Political & Regulatory Feasibility

□ Define Project Vision & Objectives

The deployment of a municipal wireless network is complex and challenging. Elected leaders and appointed executives are motivated to launch such an initiative only when a network can be used to achieve certain policy objectives, including:

- Promoting Digital Inclusion
- Strengthening Economic Development
- Streamlining the Delivery of Government Services

These visionary motivations often convince a local leader of the need for wireless broadband infrastructure. However, after the decision to launch an initiative is made, countless other objectives must be clarified. One approach is for community leaders to rank potential objectives in order of important to their unique initiative. Potential objectives could include:

- Improve public safety through better communication and interoperability
- Lower broadband prices for low-income, disadvantaged residents
- Reduce existing or avoid future government telecom costs

- Generate new revenues for community
- Streamline interaction between citizens and government
- Promote community image/brand
- Enhance health education, telemedicine, patient monitoring, etc.
- Improve efficiency of government service delivery
- Enhance education; improve interaction between teacher/student/parent
- Stimulate more private investment and competition for broadband services
- Promote job/business growth, economic development
- Improve experience for visitors to community, tourists, business travelers
- Provide backup/contingency for disaster response/recovery

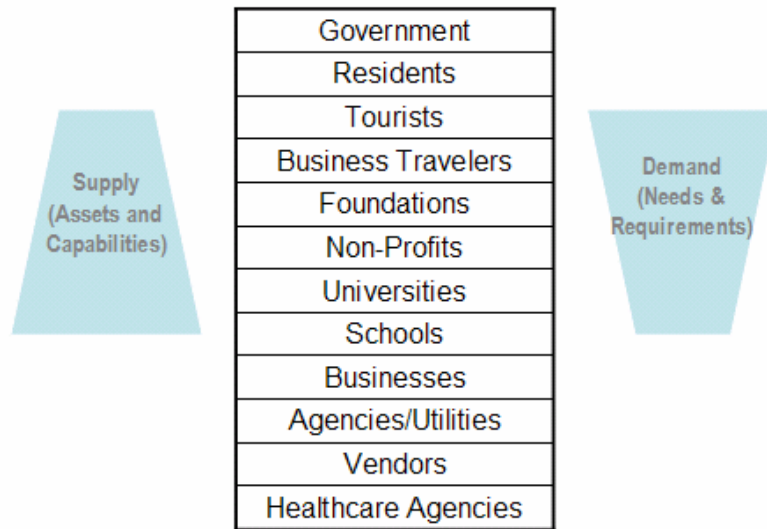
These objectives can be achieved using a number of different business models. However, each community is driven by different philosophical and political principles that must be recognized prior to evaluating business models. These principles deal with issues including:

- What is the proper role of local government in relation to municipal wireless broadband networks? Catalyst? Provider? Competitor with private sector? Cooperative partner?
- How important is a return on investment for the business model? How important is generating free cash flow?
- Should the priority be to provide access to mobile government employees or citizens and visitors? Can access be provided to both?
- Should the network provide universal access or be located in areas with certain characteristics? Commercial areas? Tourist venues? Low income neighborhoods?

By stepping through a qualitative process to understand the community's vision, objectives, and principles, the leadership team is able to better understand what is most important for the initiative to accomplish and what options will support the initiative.

C Conduct Stakeholder Analysis

As the leaders consider the project vision and objectives, it is important to have dialogue with stakeholders both internally and in the community. Local government department heads may eventually be responsible for enrolling and training their employees to use the network for mobile connectivity so their input and thoughts are important. Likewise, community organizations may have assets that can support the network deployment and operation and may have demand for wireless broadband services. Therefore, local leaders should have dialogue with the following stakeholders:



Collecting feedback from numerous stakeholders is a tedious process, but can be accomplished by:

- **Focus group sessions** – Facilitated meetings with representatives from various community groups (e.g. government agencies, education, healthcare, chambers of commerce, nonprofits, incumbent service providers, etc.)
- **Town hall meetings** – Open sessions whereby the public can learn about the initiative, provide feedback on the process, voice any concerns they may have and ask questions.
- **Surveys** – By far the most complex and expensive approach for gathering stakeholder input, surveys can be used to produce statistically-valid, quantitative results, particularly for harder-to-reach parts of the community.

| Method | Type of Stakeholders | Type of Feedback | Directness |
|--------------------|----------------------|------------------|--------------------|
| Focus Groups | Representatives | Mixed | Indirect, by proxy |
| Town Hall Meetings | Open public | Qualitative | Mixed |
| Surveys | Hard to reach | Quantitative | Direct |

By taking a close, objective look at the needs of various stakeholder groups, it allows the community to:

- Uncover needs that may exist with one group in the community that may not be common across all groups
- Demonstrate the community’s goal of making their municipal wireless initiative a “community initiative” instead of another government project
- Identify and consider objections and concerns from those who may not be supportive of the project
- Educate the community about new technologies, and the steps being taken to improve the community

□ Conduct Regulatory Analysis

Once community leaders have consensus about the project vision and objectives, legal staff should conduct a regulatory analysis. In the last two years, over fourteen states have considered regulations or prohibitions on municipal wireless broadband networks. The legislative initiatives make use of a variety of tools that ostensibly aim to insure that:

- A majority of local residents are behind the initiative
- The broadband project will not negatively affect a community’s finances
- The broadband deployment does not compete or competes on a level playing field with private carriers

Policy makers accomplish these objectives by legislating the process municipalities must use to plan and deploy a wireless broadband network. The regulations range from holding public hearings or referenda to complete prohibition of fee based services. The table below illustrates the regulatory tool used by proposed and passed legislation:

| States | Hearings | Referenda | State level authorization | LEC right of first refusal | Prohibit Fee Based Service |
|---------------------------|-------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| ALEC Template | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| Florida SB 1322 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> * | | | |
| Oregon HB 2445 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| Indiana HB 1148 | <input checked="" type="checkbox"/> | | | <input checked="" type="checkbox"/> | |
| Ohio HB 188 | <input checked="" type="checkbox"/> | | | <input checked="" type="checkbox"/> | |
| Iowa HF 861 | | <input checked="" type="checkbox"/> | | | |
| Louisiana SB 126 | | <input checked="" type="checkbox"/> | | | |
| Colorado SB 152 | | <input checked="" type="checkbox"/> | | <input checked="" type="checkbox"/> | |
| Tennessee HB 1403/SB 1760 | | | <input checked="" type="checkbox"/> | | |
| Texas HB 789 | | | <input checked="" type="checkbox"/> | | <input checked="" type="checkbox"/> |
| Pennsylvania HB 30 | | | | <input checked="" type="checkbox"/> | |
| Virginia HB 2395 | | | | <input checked="" type="checkbox"/> | |
| West Virginia SB 740 | | | | <input checked="" type="checkbox"/> | |
| Illinois SB 499 | | | | | <input checked="" type="checkbox"/> |
| Michigan HB 4600 | | | | | <input checked="" type="checkbox"/> |
| Nebraska LB 157 | | | | | <input checked="" type="checkbox"/> |

* - Depending on use of bonds for financing purposes

In addition to the state bills, four similar pieces of legislation have been introduced at the federal level. Two of the Congressional bills would prohibit state prohibitions of community wireless broadband network while the other two would regulate – and even prohibit - municipal wireless deployment.

The regulatory analysis should indicate whether the municipality is able to move forward, take extra steps required by statute, adjust the project vision and objectives, or stop the initiative. Civitium is not a law firm and recommends that every municipality considering a wireless broadband network consult with an attorney to review any applicable state law.

Q Develop a Marketing & Communications Plan

At some point, each community planning a wireless initiative must publicly announce their plans. This point often comes shortly before a community releases a Request for Proposals or other public document welcoming input from the private sector. A well

executed communications plan can strengthen an initiative by helping it gain momentum among community leaders and the public.

The marketing campaign should reinforce the project vision and objectives and explain the effects of the network in a way that easily gains support. For example, a network designed for public safety use could be positioned as a network to increase police visibility in high crime areas and decrease crime. Not many people will express opposition to a goal of this nature.

Once the message has been crafted, it must be distributed through various channels including:

- Creating of frequently asked questions
- Launching a website and update it regularly
- Holding press conference(s) to update the community on milestones
- Conducting seminars targeted to special groups about the network (students & teachers, healthcare, large employers, unions, etc.)
- Favorable newspaper articles and editorials

Economic Feasibility

C **Evaluate Business Models**

Choosing a business model that provides sufficient funding and allows the community to meet its project objectives is critical – and can be very difficult. Approximately six business models are being used in community wireless broadband deployments with success. Each model has a different focus, can be funded in different ways, and is driven by different objectives.

C **Community Network**

There are at least two hybrid community network models. The first involves the community or a non-profit entity obtaining funding from taxpayer funds, foundation grants, donations from citizens and businesses, and advertising revenue from a splash page. The community or non-profit entity then builds the network and provides marketing and customer service. This model is being used in Hermosa Beach, California.¹

The second model involves a non-profit or government entity that acquires funding to educate business owners about the benefits of deploying a Wi-Fi hotspot. The community or entity acts as a catalyst to encourage the organic build-out of a Wi-Fi network in highly populated areas. Since the community or non-profit organization is not funding the network deployment, the capital and operational costs that require community funds are substantially lower. The network, however, may not be ubiquitous. This model is being used in Austin, Texas.²

Cooperative Wholesale

The Cooperative Wholesale model provides two options for local political leaders. The first is a community-owned model in which the community makes a 'build versus buy' decision regarding broadband service. The community builds a broadband network to provide its broadband and telecommunications needs.

Funding for the network comes from taxpayer dollars, state and federal grants, foundation grants, and/or bonds. After securing funds, the community issues an RFP for the design, deployment, and management of the network.

After the network is deployed and the community has completed in-sourcing its broadband needs, the excess capacity is sold to private providers (WISPs, ILECs, CLECs, MSOs, dial-up ISPs) at wholesale prices. The providers then compete for business and residential subscribers and provide marketing, technical support, customer care, and billing. Free cash flow generated from the wholesale fees can be used to fund a number of programs including economic development and digital divide initiatives.

While the first model meets many municipal leaders' needs, it still requires taxpayer dollars and community employees to be successful. For communities interested in deploying wireless broadband networks but adverse to spending public dollars, another approach can be used. Instead of the community funding and managing the network, the community creates a non-profit organization to accomplish the following tasks:

- Raise funding for the wireless broadband network deployment
- Outsource network design, deployment, and management to a private sector company
- Provide broadband service directly to community agencies and employees (fixed and mobile)
- Market wholesale service to WISPs, ILECs, CLECs, MSOs, and dial-up ISPs
- Develop and administer social and/or economic development programs funded by free cash flow

The local government provides access to light poles and other assets for the network deployment and acts as an anchor tenant for the network. With a social and/or economic development charter, the non-profit is able to secure funding for the network deployment from state and federal grants and private foundation donations. Additional monies can be obtained through bank loans, which are easier to obtain with a secure anchor tenant like a community government.

The non-profit partners with private companies to both build and manage the network, resulting in a smaller staff. The non-profit's focus is to monitor network management, develop effective social and/or economic development programs, and attract and develop relationships with retail providers.

Internal Government Use

The Internal Government Use model allows the local government to in-source its broadband needs instead of using privately owned fee-based network services. The community provides funding from general or enterprise funds and potential grant monies from the state or federal level to support the network deployment costs. The network can be designed, built, and maintained by a private sector company chosen through a competitive RFP process, thereby allowing the private sector to be involved in the value chain. The wireless network uses community infrastructure including street and traffic lights, and can provide mobile wireless broadband service to community agencies. The City of Miami Beach is using this model.³

Depending on the community's objectives and security requirements, the same physical network can also provide public access.

By building the network instead of buying it, the community may realize a costs savings for their mobile broadband needs. Depending on the community's project vision and objectives, the community may dedicate some or all of the cost savings to Digital Divide or Economic Development programs.

Private Consortium

The private consortium model involves one or many private sector provider(s) offering broadband service to end users. Funded by private investment, the provider offers access to both the community and to subscribers for a monthly fee. The provider is responsible for operating and maintaining the network and providing technical support, customer service and billing. A number of communities have encouraged private broadband deployment by offering low cost access to community assets including utility poles in exchange for low-cost wireless broadband for government employees and/or low-income neighborhoods. The City of Minneapolis has pursued this model.⁴

However, deciding where to deploy broadband networks under this model is based on building business cases and return on investment models. Such profit-driven decisions can limit the addressable markets for broadband providers and prevent the deployment of a ubiquitous broadband network.

Public Utility

The public utility model requires that a local government establishes a new community department or combines with existing water, gas, and/or electric utilities to deploy, operate, and manage broadband service for citizens. The broadband utility's capital cost is funded through the use of taxpayer dollars and revenue bonds. The public utility installs the network, markets the service, and provides customer support and billing. In addition, the local government may choose to provide both fixed and mobile broadband to its agencies. The City of Chaska, Minnesota, has used the public utility model to deploy a citywide Wi-Fi mesh network.⁵

Most states allow municipalities to form enterprise funds for utility projects. Unlike a general fund, which must be balanced each fiscal year, enterprise funds are able to show annual profits or losses.⁶

Q Develop Financial Models

Once a community has decided which business model will meet their objectives, then the leaders must create a viable funding model that answers the following questions:

- How much will the proposed network cost to deploy?
- How much will the proposed network cost on an ongoing basis?
- How much should the community set aside for network upgrades to avoid obsolescence?
- What will the community's costs savings be if in-sourcing broadband needs?
- What is the return on investment for this initiative?

In order to build a relevant financial model, one must make assumptions based on past performance or industry accepted figures. Assumptions made can be classified into the following categories:

- General Assumptions
- Capital Expense Assumptions
- Operating Expense Assumptions
- Revenue Assumptions

Communities building a financial model will benefit from making the following assumptions:

General Assumptions

- Level of service to be provided to end users
- Network architecture including backhaul strategy and peering point
- Any objectives that affect the community's ability to provide financial resources

Capital Expense Assumptions

- Coverage area
- Capacity required within the coverage area
- Density of access points
- Amount of backhaul capacity required
- Cost of Network Operations Center (NOC) & network management tools
- Cost of Operational Support Systems (OSS)
- Amount of money reserved to support network upgrades and expansion
- Amount of spare equipment

Operating Expense Assumptions

- Personnel requirements

- Technical Support
- Sales & Marketing
- Administration
- Level of technical support required
- Annual cost for mounting rights and electrical costs
- Equipment maintenance
- Annual costs for backhaul and public Internet peering
- Marketing & communication expenses
- General expenses

Revenue Assumptions

- Different classes of service to be offered and respective price points
- Fee charged to end users and/or retail service providers
- Churn rates
- Penetration rate defined as the percentage of potential customers that will subscribe to the newly offered service over time

Assigning numbers to this list of assumptions will allow a community to create an order of magnitude estimate for the capital and operational expenses and revenue projections. Once the community understands how much the network will cost and how much money will be generated, the leadership team can develop a funding strategy.

q Create a Funding Strategy

Depending on a community’s unique characteristics, a number of funding sources exist to support a metro-scale wireless broadband initiative. Federal and state grants, loans, bonds, and general fund reserves can all be used to fund a wireless broadband deployment. Grants, loans, and bonds all have requirements that must be met so communities should make sure they are qualified to pursue these opportunities. A number of federal grants exist to promote broadband access in rural or low-income areas including:

| <u>Grant Opportunities</u> | <u>Program Outline</u> | <u>Requirements</u> | <u>Contact</u> |
|---|---|---|---|
| <u>Rural Utility Service (RUS)</u> | The U.S. Department of Agriculture's Rural Broadband Access Loan and Loan Guarantee Program made \$2.1 billion in loans and loan guarantees available in 2005 to provide broadband services in rural communities. These | “The Rural Broadband Access Loan and Loan Guarantee Program will offer three types of loans: (1) A direct cost-of-money loan, bearing interest at the cost of borrowing to the Department of the | Kenneth Kuchno, Director, Broadband Division, Telecommunications Program, RUS/USDA (202) 690-4673 |

| | | | |
|---|--|---|--|
| | <p>loans can be used to facilitate deployment of technologies to provide two-way data transmission of 200 kbps or more, in communities with populations up to 20,000.⁷</p> | <p>Treasury for obligations of comparable maturity; (2) a direct 4 percent loan; and (3) a private lender guaranteed loan.”⁸</p> <p>RUS gives priority to rural communities who:</p> <ol style="list-style-type: none"> 1) do not have broadband access 2) have broadband access that is more expensive than more urbanized areas <p>However, cities can only apply for RUS funding if no private provider has committed to provide broadband service.⁹</p> | |
| <p><u>Technology Opportunities Program (TOP)</u></p> | <p>The U.S. Department of Commerce's TOP Program is designed to fund grants for state, local and tribal governments, health care providers, schools, libraries, police departments, and community-based non-profit organizations. To date, the TOP program has awarded 583 grants, totaling \$218.9 million and leveraging \$297</p> | <p>The TOP Program did not receive funding for FY 2005 and the program is not accepting applications at this time.</p> | <p>Amy Borgstrom, Program Officer, Technology Opportunities Program, U.S. Department of Commerce 202.482.8338 aborgstrom@ntia.doc.gov</p> |

| | | | |
|--|--|--|--|
| | million in local matching funds. ¹⁰ | | |
|--|--|--|--|

In addition to federal grants, a small number of states have programs to promote broadband network deployments at the community level including:

- [Michigan’s Broadband Authority](#)
- [Rhode Island Wireless Innovation Network](#)
- [ConnectKentucky](#)

In order to finance a community-wide broadband deployment, additional funds from the community are sometimes required. A number of options exist for communities to finance the capital cost including:

| <u>Bank Financing</u> | <u>Background</u> |
|------------------------------|--|
| <u>General Bonds</u> | Cities can use general bonds to incur debt for infrastructure and capital projects. Bonds are then repaid over a period of years based on the total debt service. |
| <u>Revenue Bonds</u> | Cities can issue revenue bonds to incur debt for an infrastructure or other capital project that will provide a future revenue stream. Commonly used for water, sewer, and gas projects, revenue bonds can also be used for municipal wireless broadband networks that will provide public access for a fee. |
| <u>Loans</u> | Cities can secure loans from private institutions to provide capital expenses for a project. |

If additional revenue is required, then communities can look within their general fund reserves or capital improvement fund for the infrastructure rollout. Communities should seek advice from their accounting and legal departments when considering which funding options will work best for them.

Depending on the business model selected, public monies need not be used. A number of companies exist who deploy, own, and operate community wireless broadband networks in exchange for favorable terms from the community regarding infrastructure assets and

anchor tenant agreements. This type of funding approach is being tried by Portland and Minneapolis.

Technological Feasibility

□ Examine Technology Options

When a community is planning a wireless broadband network, a certain level of understanding about the broadband landscape (both wired and wireless) is important to understand how wireless will better meet the community's objectives. The following describe the characteristics of broadband service:

| | Fixed | Nomadic | Portable | Mobile |
|------------------------------|---------|-------------|------------|-------------------|
| Scenario | Res/Bus | Hot-spot | Cruiser | Cell phone |
| Provisioned | Address | Subscriber | Subscriber | Subscriber |
| Motion of Subscriber Unit | None | Little/None | <30 Mph | <100 Mph |
| Handoff (persistence) | None | None | Slow | Fast |
| In Motion Quality of Service | N/A | N/A | Degrading | Minimum Degrading |

The terms fixed, nomadic, portable, and mobile can be interpreted in many different ways. Below are standard characteristics of these different types of broadband connectivity:

- The term *fixed* refers to a service that supports broadband connectivity by a stationary subscriber at a single, designated location
- The term *nomadic* refers to a service that supports broadband connectivity by a stationary subscriber at a variety of locations
- The term *portable* refers to a service that supports broadband connectivity by an in-motion subscriber at a variety of locations throughout the community
- The term *mobile* refers to a service that supports broadband connectivity by an in-motion subscriber in nearly all locations throughout the community

Currently, two standardized wireless broadband solutions exist and can be used across the metro scale.

Wi-Fi

Wi-Fi solutions adhere to at least three approved standards. The Wi-Fi designation means that a certain vendor’s Wi-Fi product is interoperable with other vendor’s Wi-Fi products and that the solutions meet certain theoretical throughput speeds and coverage areas. The following chart summarizes the current Wi-Fi standards:

| Standard | Throughput Speed | Coverage Area |
|----------|------------------|---------------|
| 802.11b | 11 mbps | <300 feet |
| 802.11a | 54 mbps | <60 feet |
| 802.11g | 54 mbps | <300 feet |
| 802.11n | 108 mbps | <1000 feet |

Only the 802.11 b/a/g standards are ratified. The 802.11 n standard is in the process of ratification by the IEEE. The 802.11 b and g standard use the 2.4 GHz unlicensed band while the 802.11a standard uses the 5.8 GHz unlicensed band.

Unlicensed bands are open to any user and interference is possible. Usage of a wireless broadband device on unlicensed spectrum cannot be prioritized by user and there are no legal penalties for causing interference or jamming the band. However, unlicensed spectrum is free to the public. In contrast, licensed spectrum can be purchased by telecommunications providers or set aside for special government purposes.

Though Wi-Fi solutions were originally created for local area networks in a building, cities have been using the technology to create metro-scale wireless broadband networks since 2002. However, since each Wi-Fi access point requires a wired connection to the Internet (via DSL, cable, Ethernet, or fiber), deploying a traditional Wi-Fi network across a community can drive capital and operating expenses quite high.

As a response to this need, Wi-Fi mesh solutions were created. Wi-Fi mesh solutions use standardized technology combined with proprietary mesh protocols to reduce the number of access points with a wired backhaul connection to the Internet. Only a certain number of “gateway nodes” with wired connectivity to the Internet are required as the mesh technology allows regular access points to route traffic to the “gateway nodes.”

While mesh technology decreases capital and operating expenses associated with a metro-scale network, both Wi-Fi and mesh have advantages and disadvantages:

| | Advantages | Disadvantages |
|--|------------|---------------|
|--|------------|---------------|

| | | |
|-------------------|---|--|
| Wi-Fi | <ul style="list-style-type: none"> § Standardized equipment § Supports portability | <ul style="list-style-type: none"> § Each AP requires connectivity to Internet |
| Wi-Fi Mesh | <ul style="list-style-type: none"> § Coverage area & speeds similar to Wi-Fi § Uses mesh technology to allow access points to communicate with each other § Decreases the number of access points that require backhaul to the Internet § Works with Wi-Fi standardized CPE | <ul style="list-style-type: none"> § Intermesh technology is proprietary so different mesh solutions cannot be mixed together § Slight loss of throughput due to mesh “overhead” |

WiMAX

Since Wi-Fi has been ratified by the IEEE, it has become an extremely popular solution for broadband access. However, Wi-Fi is limited by a short coverage area usually limited to 300 feet. The IEEE has been working to standardize another wireless broadband technology, WiMAX, to address this challenge. The two most prevalent WiMAX standards are:

| | Speeds | Coverage | Service | Status |
|--------------------|---------|-------------------|-------------------|-------------------------|
| 802.16 2004 | 72 mbps | Up to 10-15 miles | Fixed | Ratified by IEEE |
| 802.16e | 72 mbps | Up to 5-7 miles | Portable & Mobile | In ratification process |

Only the 802.16 2004 standard has completed the ratification process. However, very few if any WiMAX products made to operate on U.S. spectrum are available as of October, 2005. Vendors are in the process of submitting potential WiMAX certified products to the WiMAX Alliance for interoperability testing. Once a product is shown to be both interoperable with other solutions and meet the standard’s requirements for throughput speeds and coverage area, WiMAX certified products will be available.

Currently, the 802.16 2004 standard only supports fixed wireless broadband connectivity. A WiMAX base station is installed (often on a tower or rooftop) and it provides omnidirectional point-to-multipoint coverage to subscriber units installed at the customer premise. WiMAX products are used to provide backhaul connectivity to the Internet for mesh “gateway nodes” or Wi-Fi access points in a citywide network. WiMAX can also be used to provide T1-like service to fixed government buildings or businesses.

C Measure Existing RF Environment

Communities should measure their existing RF environment to identify levels of interference. The RF study should include the following:

- Spectral analysis in the 2.4 GHz band and the 5.0-6.0 GHz band to measure the level of noise generated by all devices in these bands including existing wireless network services, baby monitors, garage door openers, cordless phones, consumer electronics, toys, keyless entry, and security systems.
- Site survey conducted in both indoor and outdoor areas to measure the existing noise generated by Wi-Fi devices throughout the community.

These tests should yield valuable information about the:

- Number of access points located in the community
- Channels in use by access points
- Signal noise levels
- Signal strength
- Areas with peak noise levels that may present challenges to the network

This information, when shared with prospective bidders seeking to configure, deploy, and maintain the network can assist them in designing the network in a way that minimizes interference and maximizes network performance.

Procure a Solution

□ Define Requirements

One of the most effective ways to define detailed technical requirements specific to a community's project is to first outline categories of requirements. Some of the most common categories are listed below:

- Network Infrastructure
- Security Infrastructure
- Network Management
- Business Support Systems (BSS)
- Operations Support Systems (OSS)
- Leased Telecommunications Services
- Architecture and Design Services
- Deployment and Installation Services
- Warranty, Maintenance and Upgrades Services
- Software Hosting and Data Center Services
- Customer Service and Technical Support Services
- Program and Project Management Services

In each of these categories, communities should outline specific requirements that result in a network that meets the project vision and objectives. A number of resources exist to help communities define appropriate requirements including muniwireless.com's [RFP Heaven](#), which provides actual RFPs issued by communities. The [Wireless Philadelphia RFP](#) also outlines basic requirements for the sections outlined above.

While developing the RFP requirements, communities should consider the level of specificity used for technical requirements. The definition of technical requirements for the network is a delicate issue, mainly due to the need for the community to communicate architecture, design and other assumptions, while at the same time not dictating a "hard coded design" to the vendor community that limits flexibility and creativity in vendor responses. However, the purpose of the RFP process is to allow the community to measure the expertise of the vendor community.

So, the trick in defining requirements is to state *what* is needed, but not *how* it is to be achieved, allowing the vendor community the flexibility to architect and propose a solution.

□ Conduct Asset Inventory

One of the outputs from a thorough stakeholder analysis process should be an inventory of assets that are owned by the community government and relevant stakeholders. This inventory plays an important part in the procurement process as prospective proposers consider a community's assets including:

- City-owned utility poles
- City-owned street lighting
- City-owned buildings where rooftop rights may be available
- Water towers and/or tanks
- City-owned fiber optic cabling
- Community (and/or county) owned communications towers
- Existing conduit and/or duct work
- Existing public works initiatives (e.g. a new sewer project)
- Geographic Information Systems (GIS) data showing multiple layers of data
- Information on community ordinances governing the use of all assets
- Information on established prices for lease rights to all assets

In addition to an inventory of these assets, detailed information about each asset is also required in most cases. For example:

- For utility poles, valuable data might include the GIS coordinates, street intersections, height above ground level, characteristics of power availability and connections, statement as to whether power is supplied 24x7 (or only at nighttime), etc.
- For communications towers, valuable data might include GIS coordinates, ground elevation, height of the structure above ground level, availability of mounting rights at various heights, availability of facilities at the base, physical security of the tower, etc.

C Develop Procurement Strategy

Communities have great flexibility regarding the procurement process. However, a poorly executed procurement process can give private sector companies an unfavorable impression and result in a legal challenge to the process or the community's vendor selection decision. Communities should consider the following when developing their procurement strategy and schedule:

- Will the community disclose the names of vendors who register during the RFP process? Attend the pre-proposal conference? Submit bids?
- Will attendance at the pre-proposal conference be mandatory?
- Will the community publish their evaluation criteria for proposals?
- Will the community require a proposal bond? If so, how much?
- Will the community consider counter proposals for a business model (e.g. ownership of the network) that differs from the community's plan/assumption?
- Will the community disclose a contract template and ask bidders to agree to general terms and conditions during the RFP process?
- Does the community plan to invite finalists for an oral interview/presentation?

- Does the community plan to “short list” more than one bidder and move to a “best and final” negotiation with multiple bidders?
- Will the community require a winning bidder to deploy a pilot network before proceeding to a larger deployment? If so, how will milestone payments be negotiated for the pilot?

Fortunately, the procurement process for a wireless broadband initiative will be similar to the community’s procurement process for other items. A successful procurement process creates a level playing field for all prospective proposers and reduces the likelihood of challenges to the process.

Q Evaluate the Proposals

Though each community’s RFP is different, some general guidelines exist for evaluating proposals submitted by private firms. The first level of evaluation should include reviewing all proposals for responsiveness to basic requirements outlined in the RFP including:

- Signed cover letter
- Completion of any required forms
- Attachment of any required financial consideration (proposal security)
- Response meets required formatting guidelines

Once the first round of evaluations is complete, the community should review the responses based on the following non-technical and technical criteria:

Non Technical Review Criteria

- Project understanding and soundness of approach
- Respondent’s financial qualifications
- References provided by Respondents
- Compliance to applicable minority-owned, women-owned and disable-owned business participation ranges
- Commitment to meet RFP start/complete/schedule
- Cost of proposal

Technical Review Criteria

- Soundness of proposed technical proposal
- Respondent’s technical qualifications
- Compliance to RFP requirements

Based on the above evaluation process, the community should then be able to eliminate the majority of proposers and short list to between one and three finalists. The

community must then decide how to further evaluate or negotiate with the finalists. The following options exist to help a community make a final decision:

- **Bakeoff:** The community has the finalists deploy pilot networks to be tested for performance, coverage, and reliability.
- **Dueling Negotiations:** The community begins parallel negotiations with the final two vendors to reach a best and final offer.
- **Final Selection:** The community selects a vendor to move forward with network deployment and requests the runner up extend the terms outlined in their proposal should the selected vendor not meet the community's requirements.

Through these steps, the community can provide a fair procurement process that promotes competitive bids and meets the community's unique project requirements. However, state and local laws regulate the procurement process for most communities. Therefore, each community should involve their procurement and legal departments during the procurement process.

Manage Network Deployment

Once a vendor is selected and begins the network deployment process, the community needs to project manage the deployment. Of greatest concern to a community during the deployment phase are the following:

- Deployment schedule agreed to by vendor is met
- Network is built to meet the community's requirements

Q Assign a Project Manager

Since the community has a large interest in making sure the wireless broadband deployment is successful, the leadership team should assign a project manager to oversee the deployment. While each project manager has a unique approach, their responsibilities should include:

- Constructing and executing a day level schedule for the deployment with the selected vendor
- Insuring that the selected vendor has access to community assets based on terms and conditions
- Working with community department heads to assist with deployment
- Providing weekly updates to the leadership team on project progress

Q Validate Network Architecture

The selected vendor will be responsible for developing the network architecture in a manner that meets the community's requirements, and the community should validate the proposed network architecture. The following have the greatest effect on network performance across a metro-scale:

- Access point density
- Backhaul capacity injected
- Backhaul strategy (wired vs. wireless)

Q Assist Vendor with Government Processes

Before and during deployment, the project manager should assist the selected vendor in accessing community assets and acquire the required permits including:

- Access to utility poles
- Access to rights of way
- Permits for towers if required
- Business permits & licenses

These issues can cause substantial delays in the deployment process. However, with the assistance and guidance from the community leadership team, these processes can be sped up.

C] Perform Network Validation Testing

Once the network is completely deployed and configured, the community should perform network validation tests to insure the network meets the community's requirements for performance, coverage, and reliability.

The community's acceptance of the wireless broadband network should be made contingent upon satisfactory test results.

Enable Digital Community Applications

Once the network is deployed and operational, the value of the network is generated by the number of users and the value of the content delivered over the network. Therefore, a community benefits the most from a wireless broadband network when it supports applications to increase efficiency of government employees and streamline the cost of delivering government services.

From the stakeholder analysis work completed by the leadership team in the feasibility phases of the broadband initiative, the community should know the government departments that have the greatest need for Digital Community applications.

Q Explore potential Digital Community applications

For the last two years a number of communities have experimented with Digital Community applications that utilize a metro-scale wireless broadband network. The following applications have been developed:

| <u>Government Responsibilities</u> | <u>Digital Community Solutions</u> | |
|------------------------------------|---|--|
| <u>Public Safety</u> | <u>Police</u> <ul style="list-style-type: none"> • Mobile broadband access in police cars to allow real-time intelligence sharing and remote access to records. • In-car video to allow real-time streaming back to police station. • Remote controlled cameras placed in high crime areas. • Use Voice Over IP (Internet Protocol) to replace costly cell phone/push to talk services. • Easily set up a mobile command station with wireless connectivity during emergencies. • Support “smart” parking meters & mobile enforcement officers in metropolitan areas. | <u>Fire</u> <ul style="list-style-type: none"> • RFID technology to track firefighters in burning buildings. • Mobile, high throughput broadband to download GIS, building blueprints in route to emergency calls. • Computer Aided Dispatch to coordinate proper and timely emergency unit response. |

| | |
|--|--|
| <u>Education</u> | <ul style="list-style-type: none"> • Support 1:1 laptop initiative with broadband connectivity • Track buses and install streaming video cameras in buses to monitor safety and student behavior. • Use WiMAX network to provide inexpensive backhaul to schools. |
| <u>Healthcare</u> | <ul style="list-style-type: none"> • High bandwidth allows telemedicine programs for rural communities who need specialists. • Wireless cameras in ambulances so ER doctors can monitor patient in transit to hospital. • Mobile access allows nurses and EMTs to enter vital information into networked patient database in real-time. • Replace expensive T1 broadband service. |
| <u>Intelligent Transportation</u> | <ul style="list-style-type: none"> • Provide mobile connectivity to buses and trains. • Monitor buses during the day and wirelessly share real-time schedules over wireless network. • Install wireless remote controlled cameras at high traffic intersections for monitoring and information sharing. • Wirelessly control stop lights and other traffic controls during emergencies or evacuations. |
| <u>E-Government</u> | <ul style="list-style-type: none"> • Provide online bill pay for citizens • Increase transparency of government by allowing anytime, anywhere access to government meeting agendas, minutes, studies, and city/county government information. • Allow government inspectors to use mobile technology in the field. |
| <u>Public Works</u> | <ul style="list-style-type: none"> • Install automated meter reader technology that saves time and increases accuracy. • Wirelessly monitor water and sewer plants and major pipeline infrastructure using SCADA systems. |

□ Review Best Practices from Existing Digital Communities

A number of communities have been recognized for their use of wireless broadband to enable Digital Community applications. Case studies exist about the best practices and lessons learned through such deployments. The community leadership team should strongly consider learning more about the following communities:

| Community | Applications Used |
|----------------------------|--|
| Cleveland, Ohio | Education Public Safety Telemedicine |
| Corpus Christi, Texas | Automated Meter Reading Public Safety |
| Houston, Texas | Smart Parking |
| Philadelphia, Pennsylvania | Public Safety |

The OneCleveland initiative and the City of Corpus Christi have been recognized for their use of Digital Community applications by Intel Corporation. Both networks are currently operational and applications are increasing government efficiency. Houston and Philadelphia are in the final planning stages before network deployment and have already developed a strategy for Digital Community applications.

□ Provide Training for Employees

After the application has been integrated into existing government systems, employees must be trained to use the mobile computing devices and wireless broadband to access the Digital Community applications. During this stage, it is imperative for the network and applications software to work – otherwise employees will get frustrated and never fully trust or use the solution.

Conclusion

As more communities launch wireless broadband initiatives, a process has emerged whereby the following steps are taken:

- Feasibility
- Procurement
- Network Deployment
- Enhancement

Each of these steps provide communities the opportunity to develop and clarify their objectives while retaining maximum flexibility to pursue their unique vision. Of the four sections, one may notice that the feasibility portion is the longest in this document. Rightly so. An initiative based on a clearly defined vision broken into smaller goals, confirmed through stakeholder analysis, and grounded in an understanding of the political & regulatory, economic, and technological realities of wireless broadband will most likely succeed.

Just as community leaders had a responsibility to build the infrastructure of paved roads and water systems in the last century, today's local leaders recognize their responsibility to compete on a global level – and understand that wireless broadband infrastructure is the foundation of the Digital Community.

Endnotes

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