

What Local Governments Should Consider in Planning Municipal Wireless Networks

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Take care on political decisions, identify all applications, make a technology choice and maintain realistic expectations when building a business plan for municipal wireless networks.

WHAT YOU NEED TO KNOW

Municipal networks using Wi-Fi technology can provide much-needed mobility to local government applications, which in turn can increase productivity and save money. Careful planning is essential to success. However, a business model for low-cost or free Internet access for all citizens is going to be difficult to sustain over the medium and long term, so set expectations accordingly.

STRATEGIC PLANNING ASSUMPTION(S)

By 2010, WiMAX will replace Wi-Fi as the technology choice for municipal wireless networks (0.8 probability)

ANALYSIS

Growing Interest

Citywide wireless networks started in the U.S. in 2004 and are now attracting more and more municipal authorities around the world. During 2006, more than 500 requests for bids are expected from North American and Western European cities. Municipal wireless is a hot topic and has created inflated expectations, poor business planning and rushed political decisions. This document outlines the choices facing a city and advises on best practices.

Authorities plan municipal wireless networks for at least one of the following reasons:

- **Internal applications** — The list of internal local government applications that can benefit from a low-cost broadband network is a long one. Many of these applications demand a wireless network that provides portability. Local governments are finding it increasingly difficult to provide cost-effective and efficient services when limited to wireline communications at office locations. They need employees, such as social workers or those performing site inspections, to have portable data communications while working outside the office. There is also growing demand for the networking of monitoring equipment for applications such as security and transport management. In addition, schools, colleges and public buildings are demanding access to low-cost broadband communications. These add up to a wide variety of applications, some quite novel — such as noise measurement — and others more critical, such as security cameras. Despite these application needs, in more than 90 percent of cases, municipalities fail to get a business plan passed that aggregates the needs of different departments. In most cases, for a municipal wireless project to proceed, one of these two reasons needs to be added to the business case:
- **Universal access** — Most local politicians hope to provide all citizens with electronic access to municipal information and online services, as well as close the digital divide. Wireless technologies, and Wi-Fi mesh networks in particular, are being pushed by suppliers as the way to achieve these objectives. In turn, municipal wireless is viewed as the best way forward by the local government. Problems often can arise when proposals are pushed through with unrealistic expectations of the performance and accessibility of the network and insufficient regard for internal applications. Political drivers must be integrated with other municipal requirements, and there must be close scrutiny of the business plan to ensure long-term success of the project.

- **Commercial interest** — Left to their own devices, commercial service providers will rarely meet the needs of municipalities. Problems include no provision for priority for internal applications, coverage only in selected areas and subscription charges that do not meet the objective of affordable access for all. However, some service providers are becoming agreeable to forming partnerships with local government to provide services that meet the needs of both parties. Such partnerships can cut costs for local taxpayers. They can also mean the city does not get involved with Internet service provider (ISP) services or the maintenance and operation of the network — things that local authorities are unlikely to do well. But municipalities should be aware that vendors underestimate the ability of unlicensed Wi-Fi spectrum to deliver an acceptable quality of service at a viable maintenance cost. Commercial partners are liable to cut their losses if their expectations are not met, starving the network of its vitality.

Typical Technology Options

Public Wi-Fi

Wi-Fi is the most common technology used in municipal wireless networks. Wi-Fi functionality operating in the 2.4GHz unlicensed frequency band is present on most laptop PCs in use today and is readily available for PDAs. The technology's prevalence in established client devices, unlicensed frequency, established standards and a large selection of infrastructure vendors with competitive proposals make Wi-Fi an attractive proposition.

Municipalities need to bear in mind the downsides of using Wi-Fi when setting expectations for a network:

- Unlicensed frequency means that you do not own exclusive rights to the airwaves, which must be shared with wireless LAN infrastructure in offices, homes and "hot spots" in shops and hotels. Commercial Wi-Fi "hot zones" may already exist in downtown areas. Sharing bandwidth will result in poorer service, and this needs to be taken into account when planning the network. Levels of interference will vary over time, making it near impossible to cover a large area with any sort of guarantee of service quality or even availability. It is a "best effort" network. In practice, municipal Wi-Fi networks, if planned well, can expect to cover 70 percent to 80 percent of outside areas with a broadband service.
- With public access points operating at power levels of no more than 1 watt at 2.4GHz, expect limited indoor coverage. Municipal Wi-Fi should be regarded as a network that paints the outside of buildings with radio coverage. Access to the network indoors would often require an antenna located in a window or mounted externally.
- Outside North America, the transmitting power of Wi-Fi access points is limited to 100 milliwatt, further reducing the coverage area. Infrastructure costs increase as directional antennas or a higher density of access points are required. Network planning becomes more difficult.
- Operating and maintaining thousands of access points are significant tasks. Provision of these tasks must be built into the business plan. Costs vary considerably, depending on the demographics and the technology used, but a midsize city should expect to spend more than \$500,000 a year, excluding backhaul communications. Backhaul costs can double or even quadruple expenditure if no mesh technology is used.

Mesh Networks

The majority of new municipal wireless networks include some amount of mesh technology. A mesh interconnects access points to reduce the number of wired backhaul links. Providing a leased line or DSL link at every wireless access point is not only impractical in some cases, but fixed-line carrier charges make it very expensive. In addition to cutting backhaul costs, mesh networking can help improve network resilience by eliminating single points of failure. More vendors are offering mesh solutions. A comprehensive list is outside the scope of this report. By way of example, solutions are available from established enterprise vendors, such as Cisco; established providers of wireless WAN products, such as Nortel and Motorola; and startups such as Strix and SkyPilot. Technical solutions vary and can incorporate Wi-Fi at 2.5GHz and 5.2GHz to 5.8GHz, WiMAX, and proprietary wireless technology. The cost of a municipal mesh wireless network ranges from \$50,000 to \$100,000 per square mile.

Emergency Networks

The growth in broadband wireless networks for use by emergency services coincides with growth in municipal wireless networks. In the U.S., 4.9GHz has been allocated as the frequency band for emergency services. It is likely that other countries will allocate frequencies during the next three years. To cut costs, cities should look at using some of the same equipment in both networks. This combines two business cases, making the network more viable.

WiMAX

There are two particular attractions of WiMAX for municipal networks: wider area coverage than Wi-Fi and operation in licensed as well as unlicensed spectrum. WiMAX is already in use as the wireless backhaul part of some mesh networks, and fixed WiMAX is being deployed for wireless links to municipal buildings. Unlike Wi-Fi, the technology needs to develop further before users can use it on portable devices. Low-cost products that have been tested for compatibility with the 802.16-2005 standard are not expected until late 2007, and integration into large numbers of PCs and PDAs is not expected before 2010. The scant availability of licensed spectrum will also delay the use of WiMAX in municipal networks in many countries. Despite this, city trials of pre-standard products are taking place in both licensed and unlicensed bands. In the long term, WiMAX will likely become an alternative to Wi-Fi for wireless municipal networks. Improved coverage with fewer access points and licensed frequencies will be the main drivers.

Best Practices

Best practices include the following:

- Understand all the needs of applications on the network for the next three to five years. Not only take into consideration commercial services to citizens and businesses, but research the needs for access to public information and internal municipal government applications. Often, local governments fail to identify all the internal applications that can achieve efficiency and productivity benefits from a wireless municipal network. This results in a lower success factor for the project.
- Integrate internal applications into any service agreement. The commercial partner is likely to welcome a three-year contract to supply municipal applications over the network. Make sure the service agreement does not exclude the municipality from running essential applications.
- In any negotiations with commercial service providers, make the most of your key assets: access rights to street furniture and through them access to your citizens. Emphasize access to services in city centers when discussing services in suburban or rural areas. In general, access to city areas will be more attractive as a business proposition than access to rural areas.

- Issue a request for proposal (RFP) and consider commercial partnerships with a variety of service providers: ISPs, competitive fixed-line carriers, mobile operators and possibly even search-engine businesses. Do not enter into a partnership with a service provider whose business model is to charge beyond the limits affordable to the citizens you are trying to provide access for.
- The municipality cannot guarantee the success of a commercial service. When citizens are required to pay, they will expect a predictable and reliable service. When the service is free, revenue (typically from advertising) may not be enough to maintain the network. Provisions should be made in any contract with a commercial partner that the municipality can continue to provide citizens and employees with broadband communications if the commercial partner fails or pulls out of the agreement. Remember that in three to five years, essential internal applications may rely on this network. Consider owning the network infrastructure while working with a partner for Internet service provision, network operations and maintenance.
- Ensure that the network implementation is based on standards and that equipment has passed interoperability tests. This will affect the cost of replacement and network expansion.
- Run a trial service before committing to full network deployment.
- Look toward owning your airwaves. This will become increasingly important as wireless connectivity becomes a critical part of a growing list of internal government applications. Aggressively pursue licensed spectrum, lobby central government and the frequency regulation authorities. Such efforts are starting to make some progress, but there is a long way to go. Look for spectrum below 3.6GHz, preferably from 2.3GHz to 2.7GHz, in which better wireless propagation characteristics will reduce infrastructure costs while accommodating available standards-based products. Consider establishing a target of gaining access to licensed spectrum in time for the availability of low-cost WiMAX semimobile networking in 2008 through 2010.

Communications Service Providers

The service goals and business models of a municipality do not match those of providers of fixed and mobile communications. If this were not the case, interest in alternative municipal networks would never have grown. The typical business model, average revenue and service mix of service providers are at odds with the municipal needs of low-cost access for all citizens and the operation of bandwidth-hungry applications, such as wireless security cameras. This difference should be seen as a warning: We know the service providers' model works; the other is unproven. Local government has assets it can exploit, and the growing momentum behind municipal networks is starting to persuade established carriers to reply to cities' RFPs in the U.S. In the U.K., some city governments have negotiated the building of wireless LAN hot zones with operators that want to site picocells for third-generation mobile networks on street furniture. Municipalities should keep an open mind about alternative solutions, including those from established carriers.

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