

government would become an anchor tenant. That is, the MWN would be assured of support and use from the city government. It was decided that radical applications—if any—would be considered at a later stage. Given the time frame of the project and the unique demographics and politics of Philadelphia, the initial focus on low-cost Internet access allowed the project to focus on a concept that was relatively easy to explain, defend, promote, and implement. However, as the technology matures and the cost of Internet service continues to decline, it may become progressively harder to focus only on “digital inclusion.”

**Wireless Technology.** Given the available options, the most suitable technical infrastructure for the city was Wi-Fi mesh technology, with WiMAX backhaul. There were some problems with this technology: (1) It had not been tested in such a large network, (2) it was likely to be outdated soon, and (3) mesh technology was available only in proprietary form, with many different vendors offering incompatible solutions. However, the technology was available at a low enough cost that it could be replaced if it became outdated or replaced with new standards. Between November 2004 and January 2005, the city conducted extensive technical feasibility tests. The results showed that it was feasible to use the 2.4 GHz and 5.8 GHz unlicensed radio frequency for the MWN. This was an important step in ensuring the technical feasibility of the project because the unlicensed radio frequency spectrum is subject to interference from many different devices, including cordless phones and microwaves. Further tests showed that signal-strength parameters were within acceptable ranges and Internet access speeds ranged from 1 Mbps to 11 Mbps. The results of such testing can significantly impact the actual cost of implementation and the feasibility of certain applications. For example, a different topography of buildings and natural structures may require significantly more or less nodes.

By March 2007, Philadelphia began testing and rolling out a pilot proof-of-concept implementation covering 15 square miles, which is a very large area for a densely populated northeast city. The eventual goal is 135 square miles. The results of the pilot will likely be very useful to other cities that are interested in creating an MWN. The early indications are that the pilot will be successful and the technology is sufficiently mature to continue scaling upward.

**Management and Funding.** This part of the planning process included determining responsibility for funding the network and managing the implementation and

operations. This process is inherently controversial. For example, this project included a social consciousness dimension to address the city's digital divide. It is difficult to gauge how and to what extent such social aims can be adequately addressed by the private sector and therefore to estimate how much government sector involvement is desirable or necessary. There are many different kinds of funding and management models that are possible for MWNs:

- **Public community:** The city would fund the deployment and operation of the MWN and provide free access to all subscribers.
- **Private consortium:** Private telecommunications companies would fund the deployment and operation of the MWN. The city would provide access to assets such as lampposts for a fee and would act as an anchor tenant. However, the city would also regulate the service in favor of economically disadvantaged subscribers.
- **Wholesale cooperative:** The city would fund the deployment and operation of the MWN. Furthermore, the city would sell network capacity to private ISPs to resell on a value-added basis.
- **Public utility:** A public utility would fund the deployment and operation of the MWN and sell access like any utility.
- **Nonprofit:** Nonprofit organizations would fund the deployment and operation of the MWN through grants and donations. Access to the network would be sold on a nonprofit basis.

The foregoing discussion of models is generic. There were several important contextual considerations in Philadelphia. First, the concept of public access television in Philadelphia had been disastrously executed during the 1980s and 1990s, and for the most part this was blamed on city government interference in policy and infrastructure creation. There was considerable concern that Philadelphia could have a similar management failure with the MWN. Second, the city government had been running budget deficits for a while, and Philadelphia was already considered one of the most highly taxed cities in the nation. There was concern that unanticipated cost overruns in building the MWN would lead to increased taxes. Third, most of Philadelphia already had potential broadband Internet access. Comcast had the capability to supply cable Internet to 75 percent of the city's population, and Verizon had the capability to supply DSL over telephone lines to 95 percent of the city's population. There

was already preexisting underutilized capacity. What if the MWN were built and nobody came to use it?

In response to these concerns, it was argued that, beyond the simple availability of broadband Internet, the issue was future potential. The city was trying to lay a foundation for basic wireless infrastructure that could be as important as paved roads had been a century earlier. The MWN was not an end in itself but a means to an end—a universally Internet literate population that could take advantage of the digital economy and contribute to the city's future. The technology and installation costs were low enough that it would be negligent of the city government not to invest in the network. Moreover, current broadband Internet access was expensive, and there were no associated services or products offered by commercial providers to help people use the Internet. Wireless Philadelphia contended that the city government was not interested in the business of providing Internet access and was more interested in acting as a catalyst to build capacity in a way that would be managed by the private sector. Finally, Pennsylvania had a goal to ensure universal broadband access by 2015, and Wireless Philadelphia and its champions argued that this would be impossible to achieve unless radical and drastic new techniques were attempted to increase Internet access.

In November 2004, interim business plans were submitted by partner universities, and Wireless Philadelphia started the process of finalizing the business plan. At the end of November, House Bill 30 became Act 183 in the Pennsylvania legislature. The state government now required all municipalities in the state to submit proposals for MWNs for approval before January 1, 2005. If they submitted proposals on or after that date, the municipalities would first have to get a waiver from the major local telecommunications provider. However, because Philadelphia's chief information officer and mayor had negotiated with state legislators as well as with Verizon, there was an understanding that Philadelphia would be exempt from this act. Soon after Act 183 was passed, Verizon officially granted Philadelphia a waiver.

### Stage 3: Implementation

In February 2005, Wireless Philadelphia submitted its final business plan to the mayor. A hybrid business model was proposed after evaluating the candidate business models on their ability to support the following criteria:

- Free service in parks and public spaces
- Low cost or free for disadvantaged citizens
- Cost neutral for city
- Generate return or profit for city
- Universal access and coverage
- Ability to revitalize communities
- Ability to respond to technology change
- Wide range of service offerings

The hybrid model, a cross between the nonprofit model and the cooperative wholesale model, required a \$10 million investment. The network would be built by a private sector entity and would be owned by a nonprofit organization, namely, Wireless Philadelphia. The city would guarantee a line of cheap credit to Wireless Philadelphia toward operational costs, and network capacity would be sold on a wholesale basis to private sector ISPs. The ISPs would resell network access on a retail basis to end consumers. Based on what it considered conservative subscription estimates, the business plan predicted that the city government would recover its investments in less than five years.

In April 2005, the mayor approved the business plan and announced a request for proposals to build the MWN. The request, which attracted 12 complete proposals, included detailed technical, coverage, service level, and network management specifications. The network was to support a diverse set of users, including low-income residents (see Table 10.1). The request was a watershed in that it clearly established that the network would be built by a professional private contractor. By requiring discounted service for low-income subscribers and coverage in specific low-income areas, the city was staying true to its original vision of digital inclusion, and by requiring support for different types of users, the city was creating room to realize the economic development aspects of its vision.

In October 2005, Philadelphia announced an agreement with Earthlink to build the MWN. The final agreement, which became effective on February 21, 2006, included the following key elements:

- Earthlink would undertake the entire cost of building and operating the network over the 135 square mile radius of the city. Upon completion in about two years, the network was expected to require more than 4,000 nodes and 24 towers to cover the city and to provide access using industry standard 802.11b and 802.11g technologies.

**Table 10.1 Proposed Services and Subscribers**

| Service Types                                      | Definition                                                                                                                                                                                                                      | Examples                                                                                                                                            |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Residential and Low Income Fixed & Nomadic Service | Access for a single device, provisioned for primary use at a residence, with access throughout the City. Service features include basic Internet access to support service provider applications such as e-mail and Web access. | Residential user with single desktop or single laptop, with support for roaming throughout the City, discounted service for low-income subscribers. |
| Standard Business Fixed Service                    | Access for multiple devices, provisioned for primary use at a business location. Service features include basic Internet access to support service provider applications such as e-mail, Web access, VPN, etc.                  | Businesses with fewer than 20 employees are target customers                                                                                        |
| Educational Institution Fixed & Nomadic Service    | Same as Residential Fixed & Nomadic service                                                                                                                                                                                     | * Bulk purchase resident and non-resident student access, with comparable features as Residential Fixed & Nomadic                                   |
| Premium Business Service                           | Same as Standard Business service plus optional service provider services such as VPN, firewall, etc.                                                                                                                           | Businesses with more than 20 employees are target customers                                                                                         |
| Occasional Use Nomadic Service                     | Basic internet access for a daily or weekly fee                                                                                                                                                                                 | Tourists, business travelers                                                                                                                        |
| Secure Private Business Portable                   | Roaming access across city w/service features such as VPN & firewall                                                                                                                                                            | Business customer employees, field workers                                                                                                          |
| Secure Government Portable                         | Mobile access by City agency users using mobile computing devices                                                                                                                                                               | Inspectors, public safety officers, meter readers, surveyors, etc.                                                                                  |
| Secure Government Fixed                            | Fixed access for City agency locations (T-1 like service alternative)                                                                                                                                                           | Municipal office locations                                                                                                                          |

Source: Wireless Philadelphia request for proposals (2005).

- The network would be owned by Earthlink, and the agreement allowed Earthlink to directly sell retail access to end consumers, as well as to sell capacity on a wholesale basis to other potential service providers.
- A key element of the final network would be the provision of full-service Internet access accounts subsidized by Earthlink. These accounts would be made available to qualified low-income and disadvantaged persons in the city for \$9.95 per month.
- Earthlink would also provide a complete set of network management, maintenance, support, and upgrade services. In parallel, the city empowered Wireless Philadelphia to manage the agreement with Earthlink, oversee the build-out of the network, and assume responsibility for championing the digital divide goal.
- Earthlink would initially pay \$2 million over two years for the right to build the network and use city light poles to install its equipment. The \$2 million would be paid in installments tied to the proof of concept, with the largest payment