Newtowne Court Case Study
January 2007

Introduction

Beginning in the summer of 2006, the IT Department in the City of Cambridge, Massachusetts, in partnership with the Massachusetts Institute of Technology, began the deployment of a free wireless network for the residents of Newtowne Court as a pilot project for Cambridge Public Internet.

The purpose of the pilot is to gain insights into the costs, performance, and other issues related to the deployment of a city-wide wireless network. In particular, this dataset includes issues related to indoor access to the wireless network, the performance of various types of networking hardware, and the costs and logistics associated with providing technical support and computer education to city residents.

Background on Newtowne Court

Newtowne Court is a federally funded low-income housing project administered by the Cambridge Housing Authority. It is located on Main Street between Windsor Street and Portland Street, just off the MIT campus. The project contains a total of 268 domicile units with over 800 residents.

The buildings are brick with wood framing and each building is comprised of multiple sections that are separated by thick brick walls. Each section has a separate exterior door and no section can be accessed from another section. There are six buildings in the project, two large buildings with eleven sections each and four smaller buildings with two sections each. Every building is three stories tall and most sections contain two apartments per floor, although some sections contain three apartments per floor.

Occupancy averages between three and five individuals per unit, and there are many young and school-aged children. Creole and Spanish are the two primary languages spoken by residents of Newtowne Court. Over sixty percent of the households in Newtowne Court have incomes of less than 50% of the Area Median Income (or less than about $20,000 per year).

Network Design

The network uses three injection points, which provide the connections between the City's fiber optic network and the wireless mesh network. Five lamppost-mounted units and three rooftop-mounted units (on Newtowne Court buildings) repeat the signal from the injection points into the apartment units. Thirty-six indoor units are installed in 2nd floor apartments throughout the complex, repeating the signal throughout all of the buildings.

Initial testing shows greater than 1 Mbps download and 500 kbps upload throughput with light network traffic, speeds that are roughly equivalent to DSL service. However, the network performance may decrease as more users connect to the network.

Key Findings

There are three key findings from this pilot project: network design and management needs; technical support needs; project expenses.

1. MIT's Roofnet software enables the network to be self-assembling, which means that the can be installed quickly and inexpensively without the complex routing issues that hamper other wireless mesh network deployments. However, network monitoring and management is difficult with the current version of the Roofnet software. While such issues are tolerable during a pilot project, they will need to be resolved for a city-wide network deployment.

2. Technical support is a challenge because many people have difficulty accessing the network, most often due to a lacking or improperly configured computer system. Support of a city-wide network will require a sizeable staff to handle such requests and much of the support is unrelated to the performance of the network.

3. The capital expense of this network deployment is $21.34 per apartment for the 268 apartments in Newtowne Court. While this capital expense is lower than the expense of a full-scale network deployment due to the type of equipment used and donated time and equipment, the cost-savings delivered by this network deployment is unparalleled in U.S. telecommunications.

Network Design and Management

The network is built using MIT's open-source Roofnet software, which creates a mesh network using the Wi-Fi protocol (IEEE standard 802.11b/g). Mesh networks are wireless networks that repeat the radio signal from a wireless router connected to a DSL or Cable modem or a fiber optic network, in order to extend the range of the network. Roofnet is run on the Netgear WGT634U – a wireless router like the ones used in millions of homes across the U.S. – and replaces the OEM software originally installed on the Netgear.

The Newtowne Court network is utilizes thirty-six Netgear units placed indoors – one in the 2nd story of each section in the complex. There are five outdoor units, which are Netgear units that have been placed inside a weatherproof housing and connected to a more powerful antenna. In addition to the Netgear units, there are three outdoor and two indoor JJ Plus units. Two outdoor units are placed on lampposts and the third outdoor unit is placed on a nearby rooftop and connected to the City's fiber optic network.

Currently, there is little network management implemented. Each unit can report all of its neighboring units and to which neighbors it is linked but that is the extent of the current network management solution. For a city-wide network deployment, every node in the network (not including CPE) must be monitored and controlled from a central location.

We have also experienced problems with units being unplugged due to tenant concerns about the electricity consumption of the unit. For a city-wide network deployment, a better system for installing equipment in indoor areas is required. In particular, such a system must ensure that units will not be tampered with, vandalized, or disabled.

Technical Support and Education

This pilot project demonstrates that technical support and user education are the most important issues to solve in a network deployment. Since users – particularly in low-income housing developments – have a wide variety and age of equipment, it is difficult to provide a universal set of guidelines that will work for every user. Therefore, a technical support call center providing users with assistance for their specific problems is absolutely necessary for a full-scale deployment.

In order to get the most out of a community network, education is also a critical issue. Education can include a wide variety of topics from email usage to network management to website development and everything in between. By providing such education opportunities – both on and offline – a community can derive the greatest benefit possible from its wireless network.

Cambridge already has a network of community learning centers that teach computer skills. By bolstering the services at these CLCs, Cambridge can rapidly extend its digital education capabilities at minimum expense.

Capital and Operating Expenses

The capital expenses for the deployment of a wireless network break down into a few categories: indoor hardware, outdoor hardware, electrician fees. While Newtowne Court was unusually low-cost due to the use of the Netgear equipment, there are vendors like Meraki Networks that make inexpensive wireless mesh network solutions. Calculations show that exclusively using Meraki units would raise the capital expense of the network deployment to $26.21 per apartment in Newtowne Court – less than $5 more per apartment than the cost of this pilot project.

Operating expenses are incredibly low in Cambridge due to the city-owned fiber optic network. This network enables the aggregation of all of the network traffic onto just a few DSL connections, a T3 connection, or another backhaul system. The operating expense for Newtowne Court consists of one DSL line costing $125 per month. This system is scalable and experiences at Castle Square and Tent City housing projects in Boston suggest that the backhaul capacity will need to be increased as network usage increases.

Conclusion

The Newtowne Court pilot project demonstrates that wireless mesh networks are the most cost-effective way to deliver broadband Internet services. It also demonstrates that the City of Cambridge owns a unique set of assets that reduces both the capital and operational expenses further than what most other cities experience.

This pilot project has also highlighted the need for technical support and education in a full-scale deployment, as well as issues concerning network management and maintenance. These issues are surmountable with some degree of effort and should be incorporated into future network deployments for Cambridge Public Internet.