Summary of

City of College Station
Wireless Network Plan
By
Office of Technology and Information Services

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Full version available in the City Secretary's Office

Executive Summary

As technology booms, more and more computer "office functions" are being accomplished in "the field" via wireless technologies. Examples of College Station's existing wireless infrastructure include Public Safety Mobile Data Terminals (MDTs), point-to-point microwave SCADA data transmissions and Air Tablets used in the Council Chambers.

College Station has completed a fiber optic cable network that connects 18 of the City's 27 buildings. The Network Infrastructure Plan created in 1997 called for many of the City's edge facilities to be connected via wireless technologies.

In an effort to assure good stewardship of City funds, the Wireless Network Plan proposes that the wireless network needed to connect edge facilities be constructed in such a way that it could accommodate future mobile field computer applications. Some funding for the wireless network backbone is available in the network infrastructure project. Funding for the remainder of the backbone will be brought forward through the budget process and rolled into the Technology Plan.

The Wireless Network Plan is a roadmap to converging multiple technologies and products into a seamless wireless network backbone that will hopefully meet and exceed City Departments' mobile data requirements. As such, the plan's intended audience is the technicians who will implement the plan. However, sections such as "Issues" and "Potential Wireless Applications" provide information to City Management for future key decision points. Computer equipment and applications connecting to and through the wireless network will require funding as individual projects through the budget process.

Background

In 1997 the City of College Station retained the engineering firm of New Signals Engineering Corporation to develop a comprehensive data/telecommunications network plan. The plan provided a roadmap that would allow the City to migrate to a higher performance network and a more reliable topology. Initial implementation stages were to create local area networks (LANs) and a wide area network (WAN) via a fiber optic SONET ring that connects the City's "major buildings" with a self healing network topology. Later stages depended upon a cost/benefit matrix that determined whether specific edge facilities/equipment should be connected via fiber optic cable, copper cable, leased lines, or wireless technology.

The Office of Technology and Information Services (OTIS) is currently implementing the final stages of the 1997 network plan by connecting many of the edge facilities via wireless means. However, wireless network technology has exploded since the 1997 network plan was created. What was once thought of as an "office function" in 1997 can now be accomplished in "the field" via wireless methods. Such technology could increase City staff efficiency and productivity.

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Departmental interviews were conducted in April, May and June of 2003 to get a flavor of the City's needs and to help create a budgetary estimate.

Proposed Wireless Network Plan

Needs Assessment

Before a Wireless Network Plan was developed, a needs assessment was developed by conducting staff interviews with College Station Utilities, Police Department, Development Services, Fire Department, Parks and Recreation and Public Works from March, 2003 through May, 2003. Based on these departmental interviews, the following applications were the most requested to be available in the field:

- Access to Department-specific applications
  - Public Safety CAD, incident reporting, and staffing
  - HTE applications
  - Departmental work order systems
  - Building inspection
  - Code enforcement
  - GIS mapping
- E-mail messaging
- Internet access
- SCADA applications
  - Utilities
  - Traffic signal control
  - Security
  - Lighting, irrigation, gate control
  - Electronic signage control
- Digital still photography
- "Live" video

Based on both the needs described in departmental interviews and the capabilities of the various technologies, the method of accessing and utilizing the wireless network typically fit into three scenarios:

- Real Time Entry requires that communications be real time and have extensive radio coverage due to the variety and nature of locations. Example: Public Safety CAD and Reporting.

- Docked Entry allows a terminal device such as a tablet PC to be used to record and/or complete forms in an area that does not have sufficient radio coverage. Then the user moves to a nearby Access Location to upload the saved data to the host application. Example: Building Inspection and Code Enforcement applications.

- Access Location Entry allows users such as work crew leaders who don't require coverage in all locations within the City, but need to access desktop/network resources periodically to retrieve and update Work Orders, use e-mail, internet, etc. Example: various departmental work order systems and typical desktop applications.

Overview

The City's wired network is an integrated network composed of different technologies and products. The City's network needs are so diverse that there is not one technology or product that could adequately meet the City's network requirements. Similarly, the Proposed Wireless Network Plan converges multiple technologies and products into one wireless network that will hopefully meet and exceed City departments' "field" data requirements.

Due to required radio coverage, bandwidth requirements, radio power limits, and available standards, equipment and services, it is apparent that as of now and in the near future, no single technology can provide for all of the City's wireless needs. Therefore the Wireless Network Plan recommends a layered design that includes retaining a Low Speed/High Availability Network in the form of our current 800 MHz Mobile Data System and developing a new High Speed IEEE 802.11 wireless backbone that will provide for our current and future high bandwidth needs.

The Wireless Network Plan does not call for the elimination of the existing Motorola 800MHz mobile data system. The 800 MHz system's reliability and 9600 Bps maximum data throughput via Mobile Data Terminals (MDTs) is adequate for Public Safety's low bandwidth, text based reporting and messaging. The 800 MHz system backbone has proven reliable and generally provides excellent coverage throughout the City. Although the Motorola RD-LAP wireless communications protocol is proprietary, once the Motorola radio modem device converts the data to a standard serial format, a multitude of terminal devices such as MDTs, conventional laptops, notebooks/tablets, and PDAs can communicate through the current system. Motorola continues to offer new terminal devices in all these forms, and Motorola licenses other vendors' products to support the RD-LAP protocol as well. This allows integrated modems with RD-LAP capabilities in other vendors' terminal devices.

However, the increasing need to have "desktop" applications available in the field will require much greater bandwidth than is possible with the 800 MHz system or other conventional mobile data systems. The Wireless Network Plan proposes implementing the IEEE ratified protocols under the 802.11 specification. These protocols operate in the 2.4 GHz (802.11b and 802.11g) or 5.3 GHz (802.11a) radio band and provide maximum data rates of 11 Mbps to 54 Mbps. It is a property of these frequencies and FCC power limitations that in most outdoor

environments they require an unobstructed line of sight from the client radio antenna in the terminal device (PC, PDA, etc.) to the Access Point (AP) radio. An AP allows a radio to communicate with multiple client radios and an Ethernet interface that communicates with the same wired network that typical users access at their desktop. The AP allows multiple clients to share its radio-to-Ethernet network interface, and in turn it communicates to all other access points (APs) via the City's fiber optic backbone network. The proposed AP backbone network communication allows client radios to roam from one AP to the next (assuming the coverage overlaps). As a user moves from one AP cell to another, the APs negotiate over the fiber connection to determine which AP is providing the best wireless connection to the client. The backbone AP network also enhances overall security and management by allowing each AP to have knowledge of the topology of the network by building a “network configuration map”, as well as sharing Access Control Lists (ACLs) that limit the specific clients and applications allowed to access the system.

The use of 802.11 equipment has become widespread in both the home and business markets due to its near “wired” speeds and low cost. These protocols have finally made wireless network access to bandwidth intensive desktop and specialized applications a possibility. The 802.11b specification was the first non-proprietary protocol utilized by vendors and provides up to 11 Mbps operating at 2.4 GHz. The next protocol was the 802.11a specification that provides up to 54 Mbps operating at 5.3 GHz. Finally, 802.11g was ratified in June, 2003 and provides up to 54 Mbps operating at 2.4GHz. The 802.11g APs and clients provide backward compatibility with the 802.11b equipment since it operates at the same 2.4 GHz frequency and utilizes the same antenna infrastructure. Cisco has developed the Aironet 1200 Access Point that allows the user to choose between the a, b, and g variants by simply adding or replacing the radio module. Since the ratified version of the specification is so new, there are a limited number of vendors supplying standards compliant equipment at the time this report was written. However, even at the 802.11b speed of 11 Mbps, these new systems are 1100 times faster than the City's MDT system which operates at 9600 Bps.

Appendix A
Diagrams