



Metro-Scale Mesh Networking Defined™

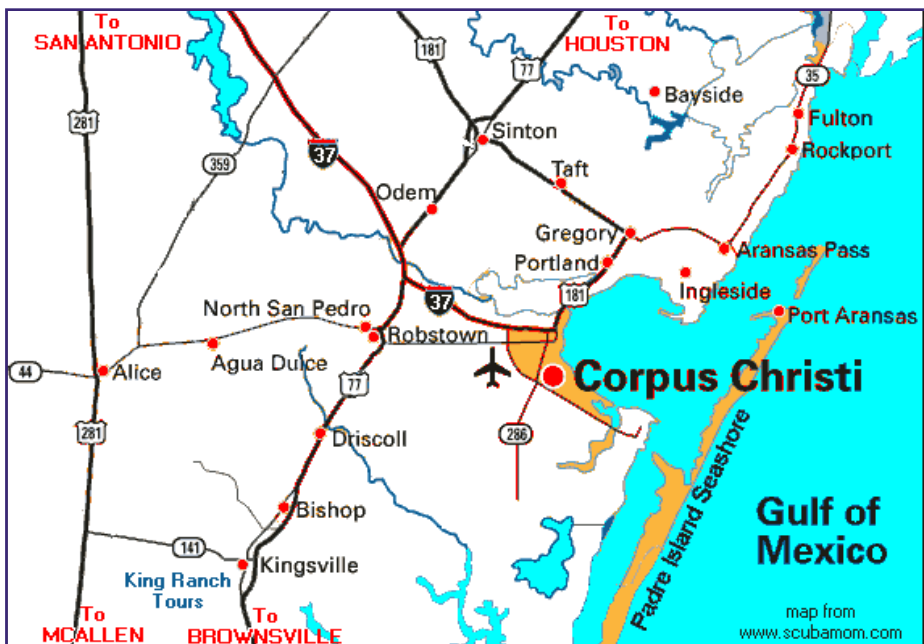
Pioneering Multi-Use Metro-Scale Wi-Fi City of Corpus Christi, Texas

A Tropos Networks Case Study
June, 2005

Scenario

Corpus Christi, Texas, rated one of the nation's top ten digital savvy cities in a Center for Digital Government poll, is innovating its technology infrastructure to increase municipal government efficiency, boost city workforce effectiveness and better serve its citizens.

The city is deploying one of the nation's first carrier-class citywide Wi-Fi mesh networks. Powered by a solution encompassing a mesh network from Tropos Networks and operations support system (OSS) for subscriber management from Pronto Networks, the citywide Wi-Fi mesh will link water and gas utilities, public safety officers, public works department employees and building inspectors to vital online information while they are in the field.



History

Discovered by Spanish explorers on the Feast of Corpus Christi in 1519, Corpus Christi is the largest city on the Texas coast and the nation's sixth largest port. More than 247,000 people live within its boundaries, which curve around Corpus Christi Bay.

With a national reputation as a public services leader – the city was honored as one of ten All America cities in 2003 – Corpus Christi employs technology aggressively to enhance the productivity and efficiency of its municipal services. A fiber optic network backbone, installed as part of a centrally managed traffic control system, covers two-thirds of the city. Municipal employees access and share data via an enterprise-wide information system. Citizens and visitors sign onto the city's Internet site, cctexas.com, to pay their utility bills and traffic tickets, apply for jobs, view real-time City Council meetings and airline flight status data, check events calendars, and pinpoint lot-by-lot zoning or right-of-way easements via an interactive Geographic Information System map.

Business Need

In 2002, Corpus Christi decided to automate meter reading for municipal gas and water services that supply a 147-square-mile area.

“Meter readers often have difficulty accessing a property because of fences or dogs,” explained Leonard Scott, MIS unit manager and program manager for the Wi-Fi project. “We average several complaints per day, every day, from customers who believe their utility statements are incorrect. If someone wants to buy a house, there is no easy way to check gas and water usage history.”

With automated data collection, gas and water customers can check meter data online and view a property’s gas and water consumption history. Instead of monthly meter readings, meters could be read daily, or even more frequently in the case of commercial customers and other large users. Close monitoring of consumption would allow the city to match daily gas usage with gas price fluctuations and better control water flow to reduce system breaks.

Development plan

Corpus Christi teamed with Public Technology Inc. (PTI), a national technology research and development membership organization, to work out specifications for the automated meter reading system. The team weighed the pros and cons of two possible implementations:

- Employ the city’s already-existing fixed fiber optic network as part of an automatic meter reading (AMR) system
- Equip meter readers with RFID-based mobile equipment and have them drive by properties and capture meter data from a distance.

The mobile solution was slightly less expensive. But it was clear that the fixed network plan would provide the customer service benefits that Corpus Christi wanted to implement.

Challenges

Corpus Christi’s existing fiber optic network did not extend to the outlying eastern and western flanks – about a third of the area that the AMR system would need to cover.

The development team issued a Request for Information for a wireless network that would connect the outlying areas with the fixed network.

“Most of the proposals we got back were too expensive and/or did not meet our needs,” Scott said, “but the one from Tropos Networks met all of our requirements.”

Corpus Christi selected Tropos Networks as the sole-source vendor for a metro-wide Wi-Fi mesh network that would relay gas and water meter data from AMR concentrators to the city's Utilities Business office system. The Tropos 5110 outdoor MetroMesh routers combine the high bandwidth of the 802.11 Wi-Fi standard with mesh routing capabilities that enable economical Wi-Fi connectivity over large areas. Mounted on a traffic signal pole, they can pick up signals sent from up to a mile away.

The AMR application uses only a portion of the Wi-Fi mesh network's bandwidth. City departments immediately saw the potential for a host of other services: vehicle equipped laptops for police, fire and other public safety officers; mobile desktops for field supervisors and managers; and anywhere, anytime access for residents and visitors to city resources such as the library, City Hall and museums.

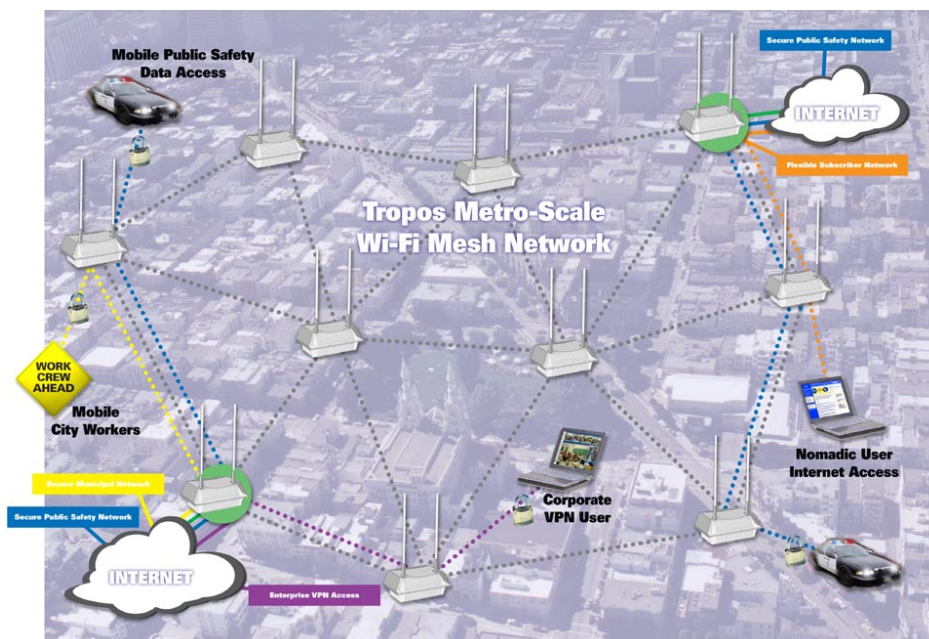
The problem was how to permit broad use of the wireless network and at the same time, restrict the municipal system to authorized users and shield the highly confidential public safety system.

Solutions

The development team looked at several hardware solutions but none offered the combination of flexibility and security that the city required. Pronto Networks' carrier-class OSS solution provided both the required IP-based security and subscriber management elements of authentication, authorization and service and billing plans to meet the city's current and future needs.

Pronto's Wi-Fi platform supports VLANs that enable the network to be separated for public and private use. Corpus Christi's public safety departments can be on one network, its municipal systems on another, and residents and visitors on yet another, all sharing the same infrastructure.

The city also can set network privileges and control access. Municipal employees can be authenticated by their laptop's MAC address while residents and visitors must supply a username and password.



The Tropos MetroMesh Architecture allows multiple user communities to operate independently on the same fixed infrastructure

Corpus Christi Demonstrates MetroMesh Benefits

For security, the Pronto solution provides a SSL-encrypted registration and authentication process and supports corporate VPN clients that allow city employees secure, encrypted access to the municipal information system.

Corpus Christi plans to partner with Internet Service Providers to deliver a host of revenue-generating services over the Wi-Fi network. With the Pronto solution, the city can set up a variety of service plans: for example, free access for public safety and municipal users, a monthly fee for residents and a 24-hour charge for visitors.

Finally, with Pronto, Corpus Christi can custom-tailor the main splash page and offer a walled garden – free unauthenticated access to government, utilities, zoning, and public safety sites. Each network in the system can have its own, distinct splash page as well.

Implementation

Corpus Christi is implementing the Wi-Fi mesh network in two phases: A pilot followed by a complete-build out to cover 147 square miles.

In the first phase, a Wi-Fi mesh network consisting of 300 Tropos 5110 outdoor MetroMesh routers, plus accompanying Pronto Hotzone Gateways and Pronto OSS software, now covers 18.5 square miles of the city. Coverage areas include the downtown and the Convention Center/Arena complex, and two test areas. The city's work crews are installing the MetroMesh routers on traffic signals, street lights, water and radio towers, buildings, wooden poles and other city-owned assets. The average density is 18 MetroMesh routers per square mile.

In October, the city started providing the public with walled garden Internet access throughout the two-square-mile downtown coverage area. In the other test areas, AMR concentrators use the wireless mesh network, as do policemen, firemen, EMS and public works crews, and any other city workers with vehicles equipped for VPN access. When they are in the field, all of the workers can access every application available in their offices. When the entire network is built out, the system will also manage its fleet of 315 public safety vehicle with GPS-based asset and vehicle tracking applications.

Results

Local governments across the country are giving Wi-Fi a close look and many are beginning to consider wireless Internet access across areas ranging from downtown hotspot districts to hundreds of square miles.



Corpus Christi's planning partner, PTI, used the Wi-Fi pilot to develop a roadmap that other cities and counties can replicate. The city's experience formed the keystone for the PTI National Summit for Local Governments held in Corpus Christi, October, 2004.

Among the lessons learned: "Whatever you budget for hardware and miscellaneous expenses, you will spend half again as much for implementation costs," Scott said. The city set aside \$1 million to purchase Wi-Fi equipment, figuring to save money by having its own traffic signal technicians install the MetroMesh routers. However, the technicians were stretched thin with other duties, which slowed the installation process. Also unforeseen was the need to upgrade traffic controller switches and weatherproof Category 5 cabling.

What Lies Ahead

Corpus Christi's Wi-Fi network opens up endless vistas for economic development and enhanced civic services.

the Tropos MetroMesh architecture allows effective delivery, with mobility over a metro-scale, of advanced voice, video and data services never before available. Equipping firemen and SWAT teams with locator chips and helmet-mounted wireless video cameras would help incident commanders and field personnel at the scene share knowledge during emergencies.

Securing the safety of the nation's ports is a major national concern. The city's port authority can equip containerized shipments with smart chips and precisely track their location as they travel from truck or train to ship.

Laptop-equipped schoolchildren can do research, check homework assignments and interact with their teachers from home. Their parents can telecommute to their offices downtown, or across the country.

Without the fast, low cost, and simple wireless broadband delivery provided by the Tropos MetroMesh architecture, paired with the advanced management provided by Pronto Networks, these and other never before seen applications would not be possible.



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