OKC: It's All in the Air

A TROPOS NETWORKS CASE STUDY | JUNE 2008

Introduction

The Tropos wireless broadband network in Oklahoma City was designed as an extension of the City's IT infrastructure with the initial goal of using it to improve the City's public safety information system, enable new applications, reduce costs, and improve services to the community. Today it is used by mobile workers including police, fire, building inspectors, and public works personnel. Additional City services and high-value applications are gradually being added. The network covers 555 square miles of the City making it the world's largest contiguous metro-scale Wi-Fi deployment in the world.

History

Oklahoma City, crossroads of the Old West, is emerging as the Capital of the New Century. This thriving city and state capital is home to leading energy, agribusiness, aviation, biotech, and IT companies. Top educational institutions are in and around the city. Civic pride and a can-do spirit has been part of the city's culture since it was founded in a single day in 1889. Oklahoma City today embodies the same pioneer spirit on which it was founded. Citizens demonstrate strong support for, and participation in, their local government. A population of 537,000 is spread out over 555 square miles – by land area, Oklahoma City is the third largest city in America.

During the 1990s, as public safety agencies responded to emergency situations around the city, the inherent limitations of their two-way packet radio system became more apparent. As demands by police and fire departments grew, the text-based system was straining to keep up. Traditional RF systems offered minimal capabilities beyond text and voice, limited by its inherent 4,800 baud performance.

The technology advances highlighted the shortcoming of two-way packet radio. In the late 1990's, the City formed a task force. Representatives from the city's public safety agencies, the city manager's office, and the IT services group came together to analyze each of their requirements and goals. After some discussion, it became clear that the city's first responders wanted more than a faster RF system.

- The police department wanted the ability to download photos, input fingerprints, file reports and access public safety databases while out in the field. In addition, they desired to have video capabilities, enabling them to record police activity, monitor situations and get early warnings of potential problems.

- The fire department wanted the ability to download building preplans, hazardous material information, and water hydrant infrastructure information while en route to an emergency situation.

The group made the decision that if they were going to update their field communication system, they wanted something that would support their requirements for the next ten years. The IT department looked at the available technology, and how it could meet their requirements. Wireless mesh technology was selected as the best fit – it could deliver a seamless, scalable broadband connection to users over a wide outdoor area.

In March 2000 the citizens of Oklahoma City voted to approve a temporary 1/2-cent sales tax increase. The $90 million generated from the tax was dedicated to city capital projects, including the complete replacement of their existing radio and public safety information systems.

Mark Meier, Director of IT Services for Oklahoma City said the City looked at the leading providers of metro-scale wireless mesh technology, and decided on Tropos® Networks. "Tropos is head and shoulders above everyone else. No one else is close," said Meier. Installation began in late 2004. "Using Tropos products and technology enabled us to install a state-of-the-art communication system that is secure, reliable, and redundant. And it cost less than a traditional RF system."

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Mark Meier
Director of IT Services
Oklahoma City

"The Tropos metro-scale Wi-Fi system is the one solution that allows us to deploy the bets communications and investigative tools to the field, at by far the fastest, lowest cost and most reliable way possible."

Kerry Wagnon
Project Office Manager
Oklahoma City

Applications and Services

Overview

The City deployed an advanced end-to-end communications system that supports the latest technology in computer aided dispatch (CAD), in-field reporting systems, records management, GPS tracking systems, Web-based crime databases, mapping systems, and video monitoring. Because of the high bandwidth provided by the Tropos MetroMesh™ Wi-Fi system, these advanced applications are accessible by field officers anywhere in the City with full roaming and mobility capabilities. For example, police officers in the field have access to high-resolution photos, incident video feeds, and detailed crime databases through their in-vehicle computer systems. Fire officials have access to detailed mapping and GPS systems, as well as detailed structure plan databases, in their vehicles and mobile command centers. This field access to critical data is designed to be a force-multiplying technology that will enable police officers to remain out on the streets instead of traveling back to the precinct to access these applications. As a result, the safety of both the community and the officers will be greatly increased. In addition, the network is available to community partners, such as federal agencies and multi-county task forces, such as Central Oklahoma Metropolitan Interdiction Team (C.O.M.I.T).

According to Meier, the Tropos MetroMesh routers provided the ability to design for more than public safety. Public service applications are also deployed, and the system can be easily expanded to accommodate public access. "We designed the entire wireless network as an extension of the City's IT infrastructure," said Meier. "The vast majority of the City's IT applications – over 180 – are available across 555 square miles, helping to ensure its citizens and employees receive optimal services at minimal cost."

"To support the state-of-the art applications that are central to our redesigned public safety communications system, we needed to provide unprecedented broadband connectivity to public safety officers in the field," said Kerry Wagnon, Project Office Manager for Oklahoma City. "The Tropos metro-scale Wi-Fi system is the one solution that allows us to deploy the best communications and investigative tools to the field, at by far the fastest, lowest cost and most reliable way possible."

The following is an overview of some of the benefits of mobile public safety and mobile public service applications available in the Oklahoma City wireless network.

Police

Bringing broadband connectivity to the Oklahoma City Police Department's (OKCPD) cruisers has had a big impact on many areas of police activity. According to Meier, the broadband network enables public safety officers to have better tools to assist them in making decisions where they need to make them – out in the field. Every police unit is equipped with a laptop, which has access to nearly every application, just as if they were back at a precinct desk.

- **Field Identification:** Correctly identifying suspects is much easier and more efficient with the new system. From their police cars, officers can download pictures of criminals from city, state, and federal databases, and soon by verifying identity by uploading fingerprints to the Automated Fingerprint Identification System (AFIS). According to Meier, this helps police release innocent citizens while keeping known criminals off the streets.

- **Virtual Eyes:** Every officer has access to over 300 video cameras around the city, giving them a real time, birds-eye view of a situation. In addition to monitoring situations in progress, video surveillance cameras can provide around-the-clock monitoring at key locations around the city, freeing up personnel for other duties while helping to reduce crime rates in troublesome areas. As well, the cameras can assess road status, traffic incidents, and other situations from any public safety vehicle.

- **More Time on the Street:** Previously, officers had to process all paperwork back at the precinct, which was not only time consuming but kept them off the streets. Officers can now take advantage of improving technologies to do more and more of this work from their patrol unit, enabling them to spend more time out on the beat.

Major improvements come from using multiple applications together. The GIS system, which can integrate over 200 layers of information on a single screen, allows the police department to look at problems and solutions in new ways. For example, criminal activity can be overlaid on a GIS-map of the city. Prior to a police raid, the team can pull together information from different applications and databases – where crimes are occurring in the area, and the location of people with criminal history – and organize the squad accordingly. The increased information available over the network promotes safety and efficiency.





TROPOS networks

Fire

Before the broadband wireless network was available, firefighters had little to prepare themselves with before arriving at a fire or other emergency situation. Tactics were put in place only after they arrived on scene. Now, the Oklahoma City Fire Department (OKCFD) can start planning while en route, and makes the most of their resources to safely and effectively fight fires as soon as they arrive on scene.

- **In-route Planning:** Before arriving on scene, battalion chiefs can review site maps, building floor plans, hazardous materials locations, water hydrant locations, and then instruct incoming response vehicles on how and where to set up. Access to other databases can provide information on the number of occupants, building plans, and so on.

- **Resource Library:** The OKCFD has access to much more information to safely and effectively address virtually any situation. From the fire apparatus or mobile command center, personnel can review the best practices for mitigating a hazardous materials spill. If they need more water to fight the fire, the GIS application can show them where the nearest hydrant that's on another water main circuit.

Mobile Public Services

The prime constituency for the Oklahoma City wireless network is public safety users, but the system was built with other city uses in mind. By deploying an infrastructure that supports mobile public service, the City enabled a faster, more efficient workflow. City departments are using the broadband network to improve efficiency and reduce delays. By improving service, the City is spurring economic vitality.

Building Inspections and Permits

Every construction project requires dozens of inspections and permits. Paper-based systems are slow and expensive to process – inspectors must return back to their offices to process the paperwork. Oklahoma City averages about 15,000 inspections per month. The cumulative delays added weeks to any construction schedule, and the associated overhead was over 9,300 hours per year just for data entry. Now, using wireless handheld devices in the field, data entry is all but eliminated. Today, over 95% of inspection results are available the same day, saving citizens and contractors days of valuable construction time.

Personnel from other departments are making use of the network. Planning, zoning, licensing, and code enforcement can access city maps, building codes, and other information from out in the field. Using GIS applications, OKC personnel have access to geographic representations of all land-use, zoning, and infrastructure data associated with a parcel, permit, inspection, or plan, reducing time in the field and lowering associated costs through map analysis.

Work Orders

Different departments within the City are using an IT-based work order system that uses the wireless network to distribute and upload work orders. The system has a number of advantages, including:

More Time in Field: Work orders can be transmitted to foremen and supervisors in the field, who can upload completed work orders from their laptops. This eliminates the need to travel back and forth to the city yard, and enables work orders to be delivered to the closest crew, if required.

Reduced Liability: Because the process is nearly paperless, the City now has a complete record of every aspect of the work order life cycle. According to Meier, liability is reduced when the City can show when a work order was received and completed, determining when a hazardous situation was resolved. Reports are now automatically generated, enabling department managers to track personnel and equipment usage.

Public Works

Like many large cities, Oklahoma City has a very large infrastructure to keep track of. Major interstate freeways, railways, and waterways pass through the city, and there are hundreds of miles of roads and hundreds of bridges. The wireless network enables the public works department to instantly update the condition of the public facilities. For example, if an inspection results in the reclassification of a bridge to a lower capacity, heavy trucks, including fire trucks, are immediately routed around it.

Other Uses

Meier stresses that with the wireless network in place, the City can do many things more easily than they could before. For example, the City host dozens of major events each year, such as the State Fair and the Amateur Softball Association Hall of Fame Championship Tournament. Hundreds of vendors converge on the City for these events. The wireless network facilitates the permit process, and provides vendors with network access for credit card sales. The City is much easier to do business with.

Deployment

Oklahoma City's wireless network is built out using Tropos MetroMesh 5210 routers and Tropos 4210 Mobile MetroMesh routers, which are designed for in-vehicle applications. Routers are mounted on city assets, such as buildings, utility poles, and storm siren poles. Tropos 4210 Mobile MetroMesh routers are mounted in the city's public service vehicles, and other city vehicles as required.

Oklahoma City's MetroMesh network delivers true broadband speeds (four megabit per second is typical performance) to users who access the network with standard, inexpensive, and widely available 802.11 b/g adapters and devices. No proprietary equipment or software is required for access. These users have the ability to freely roam throughout the coverage area, while the Tropos MetroMesh

routers seamlessly and transparently perform mesh router-to-mesh router handoffs, ensuring the client continually has an optimal, uninterrupted Internet connection. Centralized administration means that any changes to the system, such as registering new laptops or users, are immediately communicated to hundreds of routers, reducing overhead costs and maintaining customer satisfaction. The network is an extension of the city's wireline network and maintained by the Oklahoma City IT department. The wireless network connects into the city's 10-gigabit Ethernet backbone at access gateways protected by firewalls.

For redundancy purposes, public safety vehicles are also equipped to use a Sprint EVDO cellular modem in the event a Wi-Fi signal is unavailable. Many Tropos MetroMesh Solution Partners participated in the successful completion of this network, including:

- Accela Government Software, which enabled web-based access to the city's IT applications.
- Motorola's Canopy platform, which provided point-to-point backhaul and point-to-multipoint capacity injection.
- NetMotion Wireless automatically and seamlessly switches network connectivity to an available network as required.

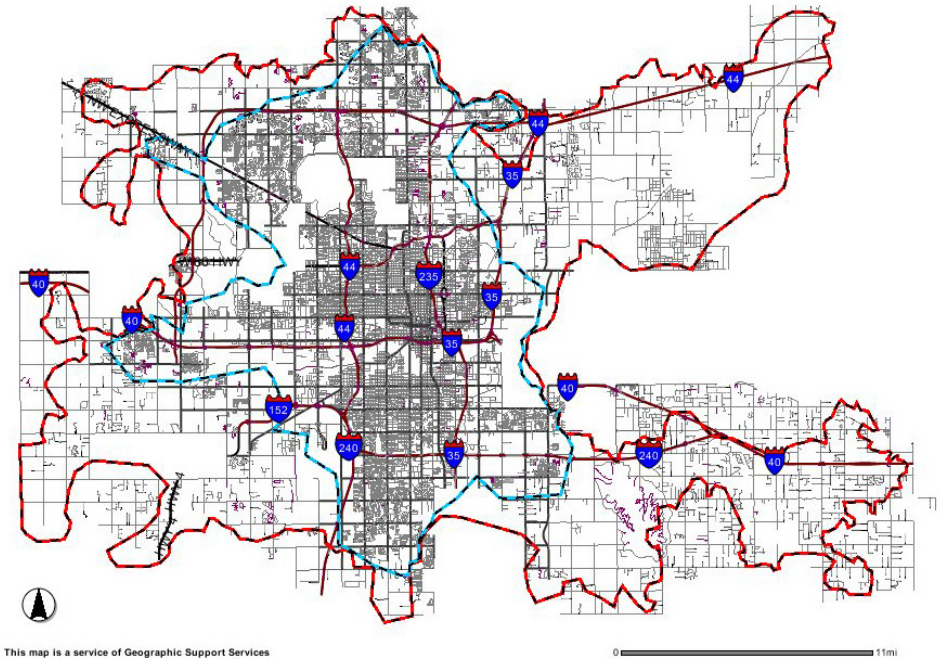


Figure 1: Oklahoma City broadband wireless coverage

Security

Tropos MetroMesh routers support the strong, multilayered security mechanisms specified by Oklahoma City, enabling end-to-end security. The single Tropos MetroMesh network supports different user communities. A user's login determines what security measures are required, their class of service, and which applications they are entitled to use. For example, a fire captain on his way to a situation can access video cameras in the area, and network traffic associated with this application will have higher priority than other non-essential traffic. Conversely, a public work meter reader would not have access to video surveillance applications.

Now that the wireless network is in production use, the security technologies and policies have worked well, protecting the network and delivering the performance needed for each user and application. Security technologies include:

- 802.1X authentication and key management, which supports Extensible Authentication Protocol (EAP) and Transport Layer Security (TLS).
- Wi-Fi protected Access (WPA).
- 128-bit AES encryption is used to encrypt all end-user data traffic through the mesh, across multiple hops, until the traffic reaches a wired gateway.
- Access Control Lists (ACL) based on client MAC addresses means only those devices approved by the IT department have access to the network.
- Port filtering allows only that application-specific network traffic approved for a unique login.
- VPNs and firewalls also control network access and secure data transmission.
- Strong security measures are in place for all management layer traffic and authentication related to the Tropos routers and other infrastructure technologies.



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Mark Meier

Looking Ahead

"Tropos helped us achieve our goals in creating a completely independent mobile network," said Meier. "Now that the first phase of the system is in place, it's easy to build off of it, expanding capacity and adding applications as needed." The City has a number of projects in the planning and deployment stage:

- The City is working to deploy an automated vehicle location (AVL) and computer-aided dispatch CAD system by May 2008. The new dispatch system integrates GPS and traffic information to direct units that can respond the fastest to the scene. Recommendations on which unit should respond will be made according to which can arrive first, not which is closest.

- OKCFD is working toward a goal of a paperless environment, which is expected to streamline activities. They are working with Accela to complete building inspections while in the field, while keeping their database of building information (such as hazardous materials) more up to date.

- The City is considering the development of an intelligent transportation system (ITS) to improve traffic flow and reducing commute time. The ITS networks will use real-time communications between a wide variety of field devices and a traffic control center (TCC). Collecting traffic data using video cameras and pavement sensors, the TCC will actively manage and coordinate traffic signals to reduce congestion and moderate traffic speeds, smoothing traffic flow and reducing auto emission levels. The ITS could also be capable of:

    - Broadcast information such as Amber Alerts, road conditions, and other local information to drivers.

    - Longer term, publish to the web up-to-the-minute information on busses and other public transportation vehicles.

- Oklahoma City is working with the National Weather Service (NWS) to provide more detail on the effects of severe weather, such as tornados. Typically, the NWS installs one monitor per county, because it is expensive to run a network connection to each site. This makes it difficult to understand the path of a tornado and the problems it causes, especially in a city that stretches as far as 60 miles from one side to another. Because of the city's broadband wireless network, the City and NWS are working to install between 30 and 50 monitors in the surrounding counties, providing a greater understanding of the weather, with the goal of saving more lives.

- Installing in-vehicle video cameras will enable monitoring and auditing of traffic stops to increase officer safety.
- Voice over IP (VoIP) telephone capabilities are being considered as a means to reduce the city's cellular costs.
- Automated utility meter reading is being considered for major customers of the city's water system.

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Mark Meier

Longer term, Meier would like to see the network opened up to schools, businesses and public users. "The network is in place. It is making our work force safer and more efficient. Now we can expand it to address the social and digital divide," said Meier. "The Tropos wireless network is part of what makes Oklahoma City a great place to live."

About Tropos

Tropos Networks is the market leader in delivering metro-scale wireless mesh network systems with more than 500 customers in 30 countries around the world. The patented Tropos MetroMesh™ architecture delivers the ultimate scalability, high capacity at low cost and great user experience demanded by enterpries and network users. Tropos Networks' unique expertise includes high reliability and performance mesh software development, mesh RF engineering, metro-scale network planning, deployment and optimization, and navigating the municipal approval process. Tropos Networks is headquartered in Sunnyvale, California. For more information, please visit www.tropos.com, call 408-331-6800 or email to info@tropos.com.

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