



Metro-Scale Mesh Networking Defined™

Metro-Scale Video Surveillance: High-Profile Criminal Trial

A Tropos Networks Case Study
August, 2004

Video Surveillance over Metro-Scale Wi-Fi

Scenario

When the circus comes to town, it usually generates an economic boost for local businesses as well as a security challenge for local public safety agencies. This is certainly the situation in Redwood City, California, although here it is the media circus that has created increased excitement and the security problems associated with it.

The San Mateo County Sheriff's Office has the public safety responsibility for the San Mateo County Center campus, including the County Hall of Justice. This location was selected for the Scott Peterson trial after it was moved from Modesto, California.

Dozens of television networks and several hundred reporters cover the trial, not to mention the several hundred members of the public who want to attend this high-profile event. The trial's change of venue created an unexpected, challenging and unbudgeted public safety requirement. The trial's expected five-to-six month duration added a significant burden to a Sheriff's office already suffering budget cutbacks due to the downturn in California's economy.

Part of the solution was to use new technology to assist the Sheriff's deputies by providing additional "eyes" and enhanced communications. Enter a group of companies led by Tropos Networks, with a new metro-scale video surveillance solution. This system provided rapidly and economically deployed video surveillance of the public areas of the San Mateo County Center campus.

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History

In January 2004, San Mateo County was selected as the venue for the Scott Peterson trial after Mr. Peterson's defense team successfully argued that it would be impossible to assemble an unbiased jury in the Modesto area, where the alleged crime was committed. The San Mateo County Hall of Justice is located in Redwood City, 35 miles south of San Francisco. The Hall of Justice is part of the San Mateo County Center campus, a collection of official buildings containing the County Courts, the County Jail, municipal administrative offices, and the County Museum. The four blocks of the campus fall within the jurisdiction of the San Mateo County Sheriff's Office whose headquarters is in the Hall of Justice building.

The media attention and public interest created by this high profile trial significantly increased security requirements for the campus. Areas were made available for television reports and interviews, live TV feed transmission equipment, and parking for up to fifty outside broadcast vans. The attendance of hundreds of reporters and members of the public created crowd control and parking issues, and a court injunction against any photography above the first floor of the Hall of Justice required strict enforcement. Public interest in the trial was so high that daily lotteries were held for the limited public court seating available.

So, how to ramp up security over the area without dramatically increasing manpower resources over the duration of the trial? One factor that can obviously help is to have more eyes on the street and in the public areas, and to make those eyes readily available to officers and deputies in the command center and on the beat. Comprehensive video surveillance coverage can deliver those eyes, but until now, such coverage has been prohibitively expensive and difficult to deploy. The use of wireless networking technology, combined with the latest developments in digital video cameras and recording software effectively removed these barriers for the San Mateo County Sheriff's Office.

Deployment

The video surveillance system used by the San Mateo County Sheriff's Office is the result of three converging technologies: powerful digital, IP-based video cameras, digital video recording and management software running on standard PCs, and metro-scale Wi-Fi networks.

Together these components enable video surveillance on a scale never before possible, delivering the ability to rapidly and economically cover campuses and entire cities.

The location of the five cameras used to cover the County Campus area is shown in Figure 1.

Camera Locations

Three Sony PTZ (Pan/Tilt/Zoom) cameras were mounted on the roofs of municipal buildings. Two of the cameras were located at the corners of the five-story County Office Building at 555 County Center Drive where they took advantage of their panoramic mobility and zoom capabilities to deliver excellent fields of view of the west end of the campus.

Camera A overlooked the pedestrian plaza in front of the entrance to the Hall of Justice and where the television encampments were established for interviews and daily reports. This camera could be zoomed in to monitor personnel going in and out of the public entrance. It could also swing around to cover the entrance to the parking structure and provided an excellent view of Hamilton Street and vehicles parked in front of the Small Claims Court.

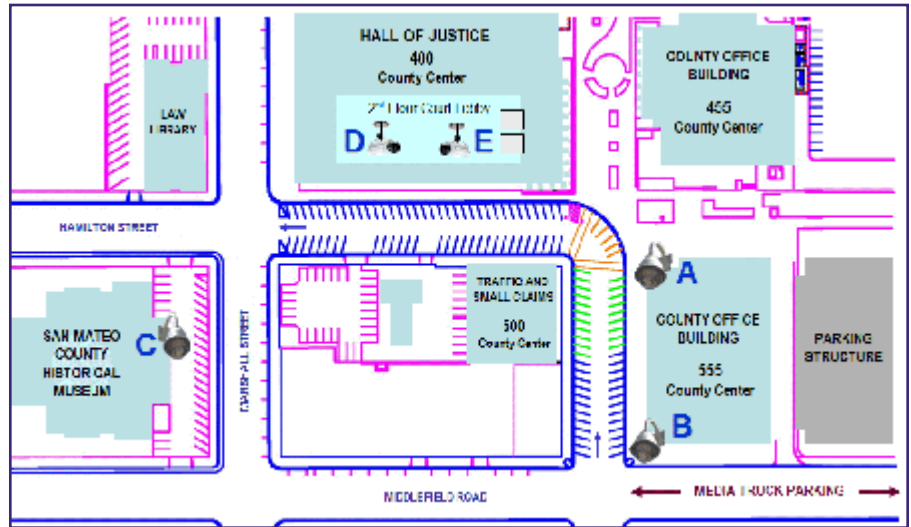


Figure 1: Camera locations throughout the San Mateo County Campus



Figure 2: Camera A, Hall of Justice Plaza



Figure 3: Camera A, Hall of Justice Public Entrance

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Camera B covered the side of the 555 Building where the media trucks were parked, and also completed surveillance coverage of the streets on that side of the campus.

Camera C's vantage point was the roof of the Old County Courthouse, now the County Museum. The photograph from this location shows the other two cameras on the 555 Building about one half mile away.

All three of the PTZ cameras have a 200-1 zoom capability (25-1 optical, 8-1 digital), and could easily read vehicle registration tags, for example, from their rooftop locations.

Two additional cameras (D and E) were located inside the Hall of Justice on the second floor to provide surveillance over the court lobby. This is the public access area outside the courtroomss, accessible via escalators from the ground floor entrance. Surveillance over this area was particularly important to prevent illicit photography in or around the courtroom.



Figure 4: Camera B, Television Van Parking

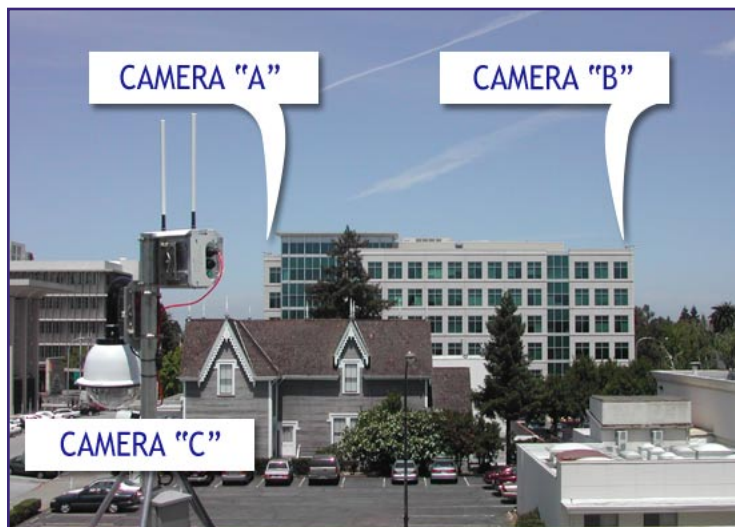


Figure 5: View from Camera C



Figure 6: Images from Cameras D & E, Courtroom Public Lobby Area

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Metro-Scale Video Surveillance Technology

The Peterson trial surveillance system would not have been feasible using conventional video surveillance technology. Until recently it has been virtually impossible to deploy a system such as this due to the requirement to run video cabling over the large distances involved. It certainly would not have been feasible to deploy a temporary system for the duration of an event such as a trial.

The total retail cost of the equipment used for the Peterson trial surveillance project was around \$30,000 and the entire system was installed in three days.

Metro-scale video surveillance has been enabled by the convergence of three complimentary technologies:

- Digital IP cameras that generate high quality MJPEG digital images internally and make them available to other devices on a standard IP network.
- Software-based digital video recorders (DVRs) running on standard PC hardware to simultaneously monitor and record video data from multiple cameras.
- Metro-scale 802.11 wireless networks that can be used to transport these video data streams over large distances without the need for expensive cable runs.

The following components were used to build the Peterson trial system. Each represents the current state of the art for metro-scale video surveillance technology.

IP Cameras:

Sony SNC-RZ30N PTZ cameras with Sony Outdoor Pressurized Dome Housing were used for the rooftop locations. Indoors, fixed mount Sony SNC-20N cameras with zoom capability were used due to their ability to be powered over standard Ethernet cabling (PoE). Both types of camera produce very high quality digital images at 640x480 pixel resolution (four times the resolution of conventional analog cameras).

DVR Software:

NetDVR-64 software was provided by On-Net Surveillance Systems (ONSSI) for image monitoring and recording. This was installed on a standard PC located in the court security area. This PC monitors all five cameras in real time while simultaneously allowing access to historical recordings from those cameras. Key functionality of this software is its ability to perform sophisticated motion detection on the camera images, recording only when changes occur. NetDVR-64 delivers or exceeds the functionality of dedicated DVRs, and is able to utilize the power of today's PCs at a fraction of the cost of dedicated and proprietary traditional video surveillance equipment.

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Additionally, utilizing both wired and wireless network infrastructure, images viewed and recorded using this software can simultaneously be made available to browser-equipped PCs on the IP network. This feature was used to set up a second viewing station at the front entrance to the Hall of Justice, as well as allowing other Sheriff's Office personnel secure, real time access to the video images on their desktop computers. Because the images are available to any authorized, Wi-Fi equipped PC in the coverage area, they also provide invaluable extra eyes to officers attending an incident by allowing them to monitor live camera images on their portable PCs and PDAs.

Metro-Scale Wi-Fi Network:

Tropos Networks provides the wireless communications medium for metro-scale video surveillance solutions. Tropos uses standard 802.11b wireless networking over a patented mesh routing architecture to minimize the number of wired backhaul connections required when deploying Wi-Fi across large areas. Tropos 5110 outdoor MetroMesh routers typically require only power, and can be mounted in minutes using an adapter for the photocell sensor found on many lampposts. For the Peterson trial system, two Tropos 5110 wired gateways were connected to the Sheriff Office's network at each end of the Hall of Justice building, and three Tropos 5110 MetroMesh routers were mounted adjacent to the cameras and powered from 110V outlets available on the rooftops.

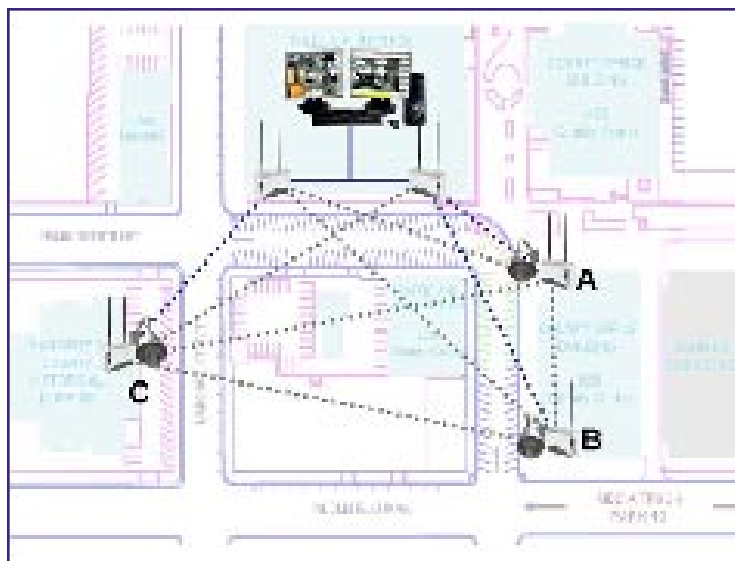


Figure 7: Tropos Metro-Scale Wi-Fi Network

The Tropos 5110 MetroMesh routers, once connected to power, are self-discovering and self-configuring, instantly extending the network range upon power-up. And, because of the Tropos Networks patented Predictive Wireless Routing Protocol (PWRP), the majority of traditional wired backhaul is eliminated, replaced with the world's first truly wireless metro-scale Wi-Fi mesh network.

Using PWRP, Tropos MetroMesh routers self-organize when deployed, and continually monitor the quality of wireless transmissions to provide a performance-optimized, self-healing network.

This factor proved to be invaluable in the Peterson trial project because of the large amount of radio frequency interference encountered from TV and microwave transmissions. These transmissions are transitory and unpredictable, but PWRP routed around the interference using the alternative routes available to the network, as shown in Figure 7.

Tropos enables video surveillance applications, on an unprecedented scale, that are both reliable and economical to deploy and manage.

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Summary

When the Scott Peterson trial was moved to San Mateo County, the San Mateo County Sheriff's Office faced the significant challenge of maintaining a high level of public safety for the five to six month duration of this very high profile event, while controlling police manpower costs. Part of the solution was to use new, affordable technology to deliver video surveillance coverage around the entire County Center campus and in the public access areas of the Hall of Justice adjacent to the courtrooms.

Video surveillance provides extra 24x7 eyes for officers and deputies, allowing more efficient use of available manpower resource. The converging technologies of networked video cameras, broadband wireless networks, and video recording software have finally made video surveillance technology affordable and rapidly deployable on an unprecedented scale. Sony IP video cameras were installed on high-vantage rooftops allowing maximum use of their full panoramic coverage and built-in 200-to-1 zoom capabilities. These cameras were linked to On-Net Surveillance System's (ONSSI) sophisticated PC-based digital video recording software using a Tropos metro-scale Wi-Fi network. The patented wireless mesh architecture forming the communications backbone of the system enabled secure and reliable wireless connectivity from rooftop locations over several blocks in a particularly RF-unfriendly environment.

The entire system was deployed in three days for a capital equipment cost of around \$30,000, proving that video surveillance is now affordable and readily deployable on a true metro-scale.



555 Del Rey Avenue • Sunnyvale, Ca 94085
phone 408.331.6800 • fax 408.331.6801
www.tropos.com • sales@tropos.com

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