

Law Enforcement Looks to Video Surveillance Networks



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2008 may have been The Year of the Large-Scale Wireless Video Surveillance System, as several cities and their police departments joined the growing market, while others expanded existing systems.

These systems stream high-resolution video to monitoring stations and police squad cars from cameras strategically located throughout downtown areas or other high-priority, high-crime districts. The cameras can prove valuable to police and prosecutors for capturing and convicting criminals and as a crime deterrent.

There are a few factors driving interest in these mostly hybrid fiber/wireless systems: a convergence of technological advances that complement existing infrastructure; the availability of licensed 4.9 GHz spectrum for public safety; and in some cases, the availability of homeland security grants to fund these projects.

Most of the recent deployments combine a fiber infrastructure with a mesh network, utilize multiradios (where a radio accompanies each node on the system) and the 4.9 GHz band - which was allocated for public safety use by the FCC in 2002 to align with U.S. homeland security needs - and capitalize on the shift from analog to Internet protocol (IP). Another key shift in the industry is proprietary hardware systems are being replaced by software-based digital video management systems.

"The good news is that all the new pieces of technology come together in the systems where it's now open, standard, scalable; you can swap out any piece for any other piece," said Jasper Bruinzeel, vice president of marketing and sales for Wi4Net, a wireless broadband and video surveillance provider.

Hybrid Systems Grow Popular

Oklahoma City; Milwaukee; Long Beach, Calif.; Reading, Pa.; and Chicago have dived into the market

in a big way. Milwaukee's system covers 97 square miles and has 15 cameras so far, with more to be added later. The cameras stream real-time, high-resolution video to a centralized monitoring facility, where the video is stored for 120 days with 30 terabytes of storage. The storage is direct-attached solution that can expand as needed. Milwaukee's video system is designed to scale to more than 100 cameras.

The hybrid systems include the benefits of fiber without the costs of building a complete fiber infrastructure. For example, the city of Reading wrote an RFP for a fiber solution but instead opted for the hybrid developed by Wi4Net, according to Bruinzeel.

"In the process, we said, 'Wireless is available and has the ability to give a fiberlike experience if you design it right,'" Bruinzeel said. A 100 percent fiber solution wouldn't have been cost-effective and wouldn't have met expectations for video resolution and frame rate. The hybrid solution can run at 30 frames per second at high resolution.

But there isn't a one-size-fits-all formula.

"It really depends on the city and what their expectations are," Bruinzeel said. "In our Long Beach deployment, we're expanding from 29 to 59 cameras and it all aggregates to a single aggregation point in 4.9 [GHz]; there is no fiber. To bring those 59 cameras all in one location, we're running those streams at six to eight frames per second."

That's still a big improvement over the first-generation dual/single mesh radio approach that has limited capacity, Bruinzeel said. "You would never bring 59 cameras to one location [with dual/single radio]; if you bring 10, you are doing well."

Single- and dual-radio networks are subject to congestion as the number of network users increases. By contrast, multiple-radio networks feature a radio that accompanies each node on the system, which ensures that there's no interference.

Though Reading built its system from scratch, one benefit of the hybrid system is the ability to use existing communications, cameras and other infrastructure. For example, a security system with cameras can become part of a citywide surveillance system. A typical security setup would run 10 cameras to a digital video recorder. That system could easily be transferred to an IP-based system using an encoder and tied into a citywide system.

Suited for Video

Chicago's system was built with \$35 million of Urban Area Security Initiative grant money. The system used 500 miles of fiber and 850 miles of copper that was already in place. The city added 30 miles of fiber and 180 cameras in the central business district, adding to the "hundreds, into the thousands," of cameras installed across the city since 2004, according to Jim Argiropoulos, first deputy chief of staff of Chicago's Office of Emergency Management and Communications.

The city cut costs by using existing infrastructure where available and then adding the wireless nodes. "Of course fiber is expensive," Argiropoulos said. "Depending on where you put it, you could be looking at the high end of \$1 million a mile. When you start hub-and-spoking it for redundancy with a wireless solution, you can propagate that network much cheaper than you can laying fiber."

In the future, Chicago could stream video into the mobile data terminals of 2,500 police squad cars. The city is planning for an aggressive crime analytics model to accompany the system, which makes the video quality critical.

"You need to make sure you do it right the first time," Argiropoulos said. "We're using [mesh network provider] Firetide and finding in the 4.9 [GHz] license spectrum; it's some of the best in the industry in high-aggregate bandwidth."

Chicago's video is streamed to a control room at 30 frames per second of full-motion video from 1.2 megapixel cameras. The control room is staffed with 15 positions, each of them able to talk to police units via a touchscreen radio system and also generate a service call through the computer-aided dispatch system. The cameras are located at specific latitude and longitude coordinates and given a physical address. If there's a disturbance near one of the cameras, staff can get a live look at the area and dispatch the nearest police unit.

"We have a 24/7 command and control room with a 28-foot video wall," Argiropoulos said. "The room is set up like a battleship, with video surveillance specialists sitting around in homeland security desks."

The video is stored for 30 days with more than 90 terabytes of storage at a central location that's replicated at a backup site.

Technological Advances

When a new Oklahoma City police officer arrives for his first day of work, his rank is entered into a computer system that automatically places him into the correct user group, which determines his access level to the citywide video surveillance system. Oklahoma City's surveillance system covers 555 square miles - with nearly 500 cameras - and streams video to laptops in the police force's 700 vehicles. When an event occurs, commanding officers who have the proper authority take control of the cameras that are nearest the incident and provide access to officers who are working the scene, controlling which cameras each officer sees.

Oklahoma City had big ideas when it first entertained the concept of a video-surveillance system about five years ago. City officials wanted a large-scale system that would be used by dozens of agencies and also structured hierarchically, so that the appropriate people would have access to the appropriate cameras.

"Depending on how you do it, you can spend a tremendous amount of resources just in the administration of these things," said Mark Meier, the city's IT director. "The technology that's available now we couldn't find five years ago."

Meier and others began a partnership with General Electric to create software that would administer the system with only little administrative input. Then they teamed with Tropos Networks, a wireless broadband provider, to develop the infrastructure to bring the video into police cars.

"The base system was a half million dollars, and most of that was for fiber," Meier said. "We already had cameras all over the place." The rest of it was getting those cameras licensed and into the system. The city spent about \$5 million on the system overall, but there were tremendous cost savings because of the ground-floor partnership with General Electric.

"The concept [of the] meeting with General Electric [was], 'We will bring local expertise and help you develop this product, and in return you're going to give us discounts on equipment, on the software, on the licensing.' You have to have precise implementation plans," Meier said.

With nearly 500 cameras, it wasn't feasible to put high-resolution cameras everywhere. The city looked for areas where real-time, high-quality video wasn't necessary and used analog cameras in those places.

"A megapixel camera will pump through between 15 to 20 megabytes per second," Meier said. "That's a huge amount of data. We said there are areas where we're going to go with an analog camera and a traditional network connection, and it's going to pump through a fraction of the amount of data. So by structuring it with different choices in different places to make the most effective use of the technologies - and accepting that you can't have this beautiful picture everywhere - you are able to reduce your costs significantly."

Oklahoma City chose to use the 2.4 GHz band instead of the 4.9 GHz band for this project, partly because of the deployment's size, Meier said. "The density of the node placement is significantly lower for 2.4, and 4.9 does not get the penetration that 2.4 [does], so you need more infrastructure for 4.9. For an organization trying to cover almost 600 square miles with Wi-Fi, that is a very key point."

The high cost and high expectations of a large-scale surveillance system - with little or no way to measure return on investment (ROI) - makes it imperative that jurisdictions assess their needs and weigh them against the available options and costs.

"I see a lot of organizations that say, 'We want this and we're going to take one approach to accomplish it,'" Meier said. "Well, you just drove up your costs phenomenally. It's a relatively expensive system and unless you administrate it correctly, I'm concerned the value doesn't meet the expectations."

Measuring Success

These large-scale deployments are relatively new, and it's hard to measure ROI. "How do you put a price on a life?" Argiropoulos asked.

The deployments can be a crime deterrent in some locations, and they can also be used for evidentiary purposes. "We've captured several crimes on video that have assisted in prosecution and also deterred a lot of internal affairs complaints," said officer Eduardo Reyes, video camera administrator for the Long Beach Police Department. "Somebody says, 'The officer punched me in the face.' We look at it on video and nothing happened."

Of course, cameras won't prevent crime, Reyes said. They're just an additional tool for law enforcement. "If the criminal is going to do something, he's going to do it whether the camera is there or not. You need something additional. Yeah, we'll probably catch him next week or next month or next year, but if we have an officer standing there, who's to say he wouldn't have committed that crime?"

Reyes said putting cameras everywhere wouldn't necessarily work. "It has to be in certain spots, like the entertainment district. You have to weigh the benefits versus the costs."