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Next generation networks for public safety

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Introduction

They are the events that often prompt the question, "Where were you when it happened?" Tragedies such as the recent Tucson, Ariz., shooting compel the public to stand glued to the T.V. or constantly scan the Internet, searching for updates. But as much of the world stands still, first responders are springing to action, working furiously to save lives and minimize the damage.

The prevention of — and the effective response to — disasters, accidents or acts of violence require emergency personnel to quickly share up-to-the-minute information and collaborate. Unfortunately, they often must communicate using multiple, disparate technologies that lack interoperation with each other and with outside agencies and jurisdictions. First responders lack real-time communication with the ability to share critical data.

These limitations can stifle an orchestrated, harmonious emergency response on local and national levels. Sharing large multi-media evidence, records and reports and accessing information from hospitals, crime units and databases during a crisis or accident can be impossible.

However, new improvements to network capabilities are changing this. Next generation networks allow first responders, agencies and jurisdictions to share relevant data moment-by-moment using data applications enabled by wireless broadband to address local, regional and national events, save lives and improve safety.

This paper will examine some of the current challenges public safety officials and first responders encounter as they work to prevent and respond to calamities. We'll discuss how robust networks — including 4G — can help assuage these issues and equip emergency personnel and public safety officials with the tools to achieve their mission — keeping people safe.

CHALLENGE: Obtaining Real-Time Security Footage

Security cameras give first responders eyes where they cannot be. However, jurisdictions cannot extend fiber and cabling everywhere to support the devices because it is expensive, time-consuming and often physically impossible due to existing structures or infrastructure that presents physical obstacles.

Where jurisdictions cannot run fiber and cabling or there are other deterrents to optical security measures, crimes and disasters go unrecorded. In March 2010, a man stabbed two people to death on a New York subway.[i] There were no security cameras near the site of the act. Police could not identify the killer because he knew to exit the train at a stop without security cameras.

In some implementations where cameras are more plentiful, incompatible camera systems from different vendors implemented across local jurisdictions make it difficult for dispatchers and emergency personnel to see all camera views from a single location where they could better coordinate their efforts.

SOLUTION:
Wireless Cameras on Robust Networks

Making History Happen

Wireless cameras operating on robust networks allow security personnel to monitor people and places without fiber, cables or trenching. They can empower jurisdictions to add temporary installations for events, and then easily take them down and move to other areas where they are needed, such as a neighborhood where crime is becoming more prevalent.

One such event was the 2009 inauguration of President Barack Obama, which created a challenge for officials who needed to ensure the safety of the president-elect and his family and the mass of individuals (a record 1.8 million people) attending the high-profile ceremony. Time lags in video imagery and lapses in coverage were not acceptable.

The district's various public safety agencies already operated 299 video traffic- and pedestrian-monitoring cameras deployed throughout the parade area — most of which were older analog cameras from a variety of vendors. These cameras included some of the hundreds of cameras that the D.C. Department of Transportation uses to monitor intersections, as well as other cameras owned by the Metro Police Department and Homeland Security Emergency Management Agency.

Although the existing cameras provided adequate coverage, they could not be centrally monitored. Feeds from cameras owned by the Homeland Security Emergency Management Agency could only be viewed at the Unified Communications Center, the nerve center for federal and district communications. Similarly, feeds from the Department of Transportation's cameras could only be monitored in that agency's headquarters. Therefore, each agency would only be able to see fragments of the scene instead of the holistic view needed to detect and respond to problematic situations.

"Effective crowd control would require a centralized solution to manage, monitor, and archive all 299 video feeds," said Glen Carter, director of networking and telecom services for the Office of the Chief Technology Officer. The goal was to increase situational awareness for all agencies by making all feeds available on large plasma screens in the Washington D.C. Unified Communications Center, Department of Transportation, and Metro Police headquarters, and on PCs and laptops in other locations.

Video traffic was integrated so that the agencies could monitor views from the entire pool of cameras. Such integration work is complex and can often take months to achieve, but the Washington D.C. public safety agencies needed the technology in place in only a few weeks' time. The agencies worked with Cisco to integrate the separate video-traffic and pedestrian-monitoring networks in time for the historic event over an existing fiber-optic IP network.

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Travis Hudnall, the chief technology officer for the District of Columbia Metropolitan Police Department, said it was the first time federal and local law enforcement officials working together in a coordinated action could instantly share video feeds.[ii]

Now that the Cisco solution is in place, Washington D.C. agencies can easily extend its scope and use, including integrating video surveillance with gunshot location and detection systems where the camera will automatically turn to the geographic positioning system (GPS) coordinates to capture images of potential suspects, injured people and witnesses. Agencies can also use the cameras to monitor more areas of the city, including lots for abandoned cars.

Reducing Crime and Violence

Not only for special events, wireless cameras can also serve jurisdictions looking to reduce crime and violence by ensuring incidents are actually recorded. According to Honolulu Chief Information Officer Gordon Bruce, security cameras create a significant deterrence on crime in his city. Traditionally, the city installed cameras where they could wire them back to a central location for monitoring. In some cases, trenching and other expensive and disruptive work would be necessary to reach potential sites of crime and disaster with fiber optics and cabling for the cameras. These cameras also had lapses in coverage.

Using 3G/4G wireless, the city can avoid trenching and long cable runs and their associated costs and put the cameras in any public place.

The city of Honolulu is addressing its blind spots with mobile, wireless 3G/4G IP broadband cameras that they can position temporarily or permanently wherever crime is increasing or disaster is imminent. “The system switches between 3G and 4G depending on signal strength,” says Bruce. The 4G bandwidth increases the number of clearly visible frames of action that a camera can relay, offering approximately 20 frames per second. The 3G technologies are slow and can create lapses in footage. “You don’t have that with 4G,” says Bruce.

Using 3G/4G wireless, the city can avoid trenching and long cable runs and their associated costs and put the cameras in any public place. Increasing law enforcement’s eye on crime, the city is considering mounting the devices in vehicles and assigning them to officers. The city has already deployed some 300-plus cameras (mostly wired), and could install the new mobile cameras in many of the public safety vehicles that are already equipped with 3G/4G modems.

The cameras easily synch up with existing wireless IP networks. Because the devices are mobile, they can be deployed quickly to assist officers in the field as events unfold. As new officers come on the scene at a crime event, those already at the scene can share video they are taking or have already taken.

4G capabilities can also enable responders to better view video from a 4G enabled mobile or portable device because the higher throughput allows for higher frame rates (smoother video) and reduced latency (less lag).

This is all possible without the need for speciality, high-cost equipment — a simple smart phone using a commercial 4G network will suffice.

As in the case of the Obama inauguration, Honolulu will use new technology to ensure safety at a high-profile event. The city will use wired, wireless and mobile IP cameras for security when it hosts the APEC (Asia Pacific Economic Coopera-

tion) conference in November 2011, which will draw leaders from all over the world. At one time, the city would have struggled providing the safety measures needed for such an event, but the mobile cameras will provide the increased level of surveillance that the conference will require.

Existing camera systems around the city from China Town to Waikiki are divergent and incompatible, making it difficult to see all camera views from any one location. As a solution, Honolulu has identified an enterprise-wide access control and monitoring system that it plans to test over the next few months, which it hopes to use during APEC.

Initially, Honolulu is bringing the Department of Transportation services up on this system. The city will move older systems — such as those in China Town and Waikiki — over to the newly installed systems as they break down and possibly integrate them into the single monitoring system that the city plans to study. "With multiple vendors and camera systems, it is difficult to see all the camera views from one central location because they do not interoperate," says Bruce.

The security cameras not only increase public safety, but also can provide additional cost savings for the city. For example, if a suspect says an officer did something inappropriate, the city will have the camera footage to defend the officer's position. This can save the city money that would have been spent defending lawsuits. The city also plans to add cameras using newer technologies in cellblocks and staging areas where individuals suspected of crimes are processed.

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>
> — Captain John Newton, Greenfield Police Department, Franklin County, Mass.

CHALLENGE:
Sharing Information When Seconds Count

When an incident occurs, many local governments may enlist help from agencies in neighboring cities or counties to address fleeing felons who cross jurisdictional lines, fires that rage out of control or natural disasters that result in massive property damage and loss of life. But this resource of additional help is often not fully leveraged because legacy technologies do not enable dispatchers and first responders to see all available police, fire and EMS resources in real time. When dispatchers and first responders have little or no visibility of alternate resources, help may be 'too little, too late', too much or the wrong kind.

Too little, too late is a typical occurrence in rural areas such as Franklin County, Mass. "We are a large rural area with fire and police departments that are mostly staffed by volunteers and part-time personnel. It is easy for events to overwhelm our resources very quickly. People get into very dangerous situations in the blink of an eye," said Captain John Newton of the Greenfield Police Department in Franklin County.

When help does arrive, most police,

fire and EMS personnel use multiple disparate data communications technologies such as mobile data terminals (MDTs) to communicate with dispatch and receive critical information. The technologies are not interoperable, negating any hope of real-time, interagency communication and cooperation during events and disasters and limiting or excluding data exchanges between first responders.

First responders need access to external data resources as well as to each other. Firefighter access to pertinent weather information affecting the fire is limited in quality and scope and never available in real time on legacy devices. Firefighters need to determine how much time they have on the ground to do their jobs safely before weather conditions make it impossible. Unfortunately, legacy systems are inadequate for retrieving this information with the visual quality required.

The same is true for law enforcement. Mobility is limited when MDTs are mounted and only available in a law enforcement official's vehicle. Police officers do not have direct, real-time mobile access to records management systems (RMS), their state's Criminal Justice Information System (CJIS), or the National Crime Information Center (NCIC) database at the FBI. Speed and quality limit their access to warrant data and mug shots. If officers cannot retrieve data and confirm suspicions within a certain amount of time, they must release unidentified persons.

An appropriate solution set would enable both first responders and dispatchers to see all available resources and call directly on those they need. With this, they can deploy the right agencies in suitable numbers, as the situation requires. This solution set could also enable all first responders across agencies and jurisdictions to communicate with each other with full mobility. Emergency personnel could retrieve the data they need directly from external sources in real time.

SOLUTION:
Integrated First Responder Communications

Resolving "Too Little, Too Late"

To support mobile devices, data and applications for first responders, Franklin County has assembled infrastructure for a microwave network to extend 4G wireless broadband from fiber optic cable. Across that network, police, firefighters and EMS workers will use mobile devices to view all the data the dispatcher sees including available resources that are en route or at their disposal.

When dispatchers can see available resources, they can call the appropriate departments directly for the aid needed. "You can put some of that responsibility on the dispatcher when they can see who is available to help via computer-aided dispatch," says Newton; "and when firefighters (or other emergency personnel) are looking for a particular resource, they can see whether it is available, ask for it directly and watch it coming to them in real time."

First responders from different agencies and jurisdictions will communicate with each other on a single, interoperable 4G network using mobile devices such as ruggedized handheld devices and laptops. The networks and devices

will enable real-time, inter-agency data communication and cooperation in the field because standardized 4G interfaces and specifications will allow agencies to work with multiple device vendors with the confidence that they will interoperate. This will save time and increase the accuracy of cooperative response during emergency events and disasters. For example, fire, EMS and police could share multi-media representations of traffic patterns and building schematics to navigate routes to fires, rescue trapped victims and cordon off restricted areas in a concerted effort.

First responders in Franklin County will also be able to use mobile devices to retrieve data from external resources such as mug shots from the NCIC database or the Criminal Justice Information System (CJIS) in Massachusetts. Franklin County bought a regional, county-level server and configured it to serve participating agencies throughout the county with a single, consolidated suite of public safety software. The software supports computer-aided dispatch, records management for police and fire, and mobile data in police and fire vehicles.

Law enforcement officials will be able to search criminal data first hand, saving time and increasing the accuracy of the information with which the officer has to work. Officers can immediately check identities and search warrants on the spot when addressing detained persons who are resisting identification.

Instead of burdening an overworked dispatcher with the task, officers can search the databases and scroll through their own screens, seeing exactly what they need, including images that may contain distinctive tattoos, scars and other characteristics.

Advanced broadband capabilities are essential for firefighters who have to be on a fire ground for any length of time. They need to see streaming weather depictions that inform them as to how the weather will affect the fire and how long they have to fight it successfully. Using 4G video capabilities in mobile devices, firefighters can send videos of the fire and its environment out of the area to other agencies and personnel who they need to inform.

CHALLENGE:
Handling Emergencies with an Outdated 911 System

Technological devices continue to connect people more every day, but the system architecture for emergency communication has essentially not changed since the first 911 call was made in 1968. Most emergency 911 systems are outdated, legacy analog systems that are voice-only and out of touch with the modern data technologies citizens would use to call for help.

Current systems are not designed to accommodate emergency calls from laptops, IP wireless devices or other devices that deliver audio, data, video message, picture message and live video. Public Safety Answering Points (PSAPs) have limited capability to identify the location of calls from mobile devices or to recognize the technology generating the call to route the

call to the appropriate responder.[iii]

The inability for emergency personnel to locate where a mobile call is originating can have disastrous results, especially given that approximately 70 percent of all 911 calls in the U.S. are now made from mobile phones.[iv] In January 2008, a woman from Tampa, Fla., called the local analog 911 system from her GPS-enabled phone after she was kidnapped. Without the location data that the system did not register, she was doomed. Police discovered the woman's body later in a vacated home in a neighboring town.[v]

Texting — ubiquitous in the everyday life of the public — is not available to people when they need it most as PSAPs are currently unable to receive text messages.

"The current 911 system is efficient and reliable — handling more than 650,000 calls a day," said FCC Chairman Julius Genachowski at an event in Arlington, Va., in November 2010. "Well, 450,000 of those calls are made from mobile phones. … Even though mobile phones are the device of choice for most 911 callers, and we primarily use our phones to text, right now, you can't text 911. Let me reiterate that point. If you find yourself in an emergency situation and want to send a text for help, you can pretty much text *anyone except a 911 call center.*"[vi]

This can have tragic consequences. In the midst of the Virginia Tech massacre, students attempted to text 911 for help. They had likely used this everyday capability only hours before to meet up with friends or discuss their plans for the night. But in this emergency situation, their messages dropped off in cyberspace and help arrived too late for many.[vii]

An adequate solution would enable all 911 PSAPs to receive and field text, images and multi-media calls in real time and locate GPS-enabled phones just as quickly.

SOLUTION: Next Generation 911

As part of its plan to improve broadband Internet access in America, the Federal Communications Commission took the first steps in December 2010 to address how Next Generation 911 (NG911) can enable the public to obtain emergency assistance through advanced communications.

The Research and Innovative Technology Administration at the U.S. Department of Transportation has produced a study on the future vision of a NG911 system, validated through proof of concept tests, including seven laboratory test scenarios and eight PSAP test scenarios. Within these testing scenarios, the facilities were able to identify the test caller's location through wireline, wireless and IP-based calls; and receive voice, video, data and text.[viii]

Laying the Foundation

Palm Beach County is laying the technical foundation for Next Generation

911. “We are building the infrastructure that would allow for technologies such as texting and video to communicate with 911,” says Everett Vaughan, senior operations manager, Palm Beach County Emergency Management.

Clearly, though it is not currently available anywhere in the nation, the capability to text 911 could save lives like those lost in the Virginia Tech tragedy and countless other horrific events. Victims fearful of being overheard by perpetrators or captors could text 911 more quickly, subtly and quietly than ringing the number and staying on the line with the dispatcher.

The end game is for the system to be able to receive communications in any digital format including digital photos and multi-media. Citizens could report crimes and call for help wherever they are, using the technologies they carry everywhere, everyday. This will speed emergency response and save lives. It will provide irrefutable evidence of crime and identification of criminals and license plate numbers captured on the spot using phone-based photos and video. The system will also have the capacity to receive mobile phone calls with GPS locations. Victims and people in distress will be able to provide accurate location information with every call, ensuring swift responses.

The infrastructure consists of a broadband network from the network provider, a fiber optic cable ring that covers the region, a call routing system and customer premise equipment. Calls come in from the network to the county’s two computer-aided dispatch (CAD) systems. The county will protect these systems inside hardened buildings that can withstand up to a Category Five hurricane. From there, the system will route calls to the appropriate PSAPs.

“We are building the infrastructure that would allow for technologies such as texting and video to communicate with 911.”

— Everett Vaughan, Senior Operations Manager, Palm Beach County Emergency Management

Network architecture would connect the PSAPs to each other making them resilient and redundant so that if call traffic overloads a PSAP, the system re-routes the traffic, shifting it automatically to the next PSAP in line. This all happens very quickly. “The customer would never sense any delay,” says Vaughan. And in such an event, staff from one PSAP can relocate and bring up their desktops on remote systems directly from the virtual computer-aided dispatch systems.

That entire infrastructure is also redundant, failing over to an identical system more than 150-miles away in Orlando, Fla. “If a wide area storm hits us, the possibility of that taking out systems in both locations is extremely low,” says Vaughan. And, if the local system was lost and the traffic did have to bounce to Orlando, it would make the trip in a millisecond. Again, the customer would never know the difference.

Dispatchers can also route calls originating from a particular event directly to a command center established at the location of the event. This capability speeds up response times and the dispatcher does not have to call in resources from long distances. “With an event such as the county fair, we can draw a circle on a map inside the system around that event, and any 911 call that comes from that event is automatically routed to the command center inside that event,” says Vaughan. This also prevents those calls from flooding the overall system by routing them only within the geographical limitations of the event.

Funding Considerations

Government leaders should strongly consider investing in projects that emphasize centralization and consolidation when funding next generation applications. Dollars go further when governments adopt one system where multiple agencies and communities can share both the costs and the benefits.

Consolidating and Centralizing

Franklin County is installing a centralized system of technologies to enable participating agencies in the region to share key emergency event data. Agencies received funding from their regional homeland security council to fund this endeavor.

The system will enable central dispatching to see a real-time snapshot of events and resources and coordinate the efforts of multiple departments. "They will have the ability to move to chat communications to free up other communications modalities for other staff and first responders and to send requested data," says Newton

Diverse Uses of the Network

Robust next generation public safety networks become more affordable and cost effective when jurisdictions find multiple uses for them. Video technologies are useful for training, remote testimony and video arraignment — which addresses prisoner transport issues. Cross-jurisdictional communication negates the necessity for travel as well as securing large events.

The city of San Antonio, Texas, uses a Tandberg video implementation to decrease travel and communications costs[ix] within and outside the city. Public servants can communicate with each other across jurisdictions, and the city can create accounts to communicate with people not on their video system. The Tandberg system is also compatible with the city's Cisco videophones.

The city also uses the video implementation for public safety. The public safety applications of the Tandberg system include up-linking with DEAFLINK so that the city can provide an interpreter for deaf victims and suspects. Suspects can plead their cases remotely via video without the city having to transport them.

The new system will not only enable computer-aided dispatch, but also police records management, incident recording, arrest documentation, fire records management including access to building blueprints and pre-planning documents, mobile data and field reporting data, data about available personnel and resources, location software including mapping and GIS, and many other shared features.

Franklin County is installing the software on one server, covering 20 jurisdictions. By avoiding the cost of 19 additional servers and software to cover all jurisdictions independently, the county will save 95 percent of the original anticipated cost. The software vendor will only need to support one machine, lowering support costs as well.

"The money we are spending enables the smaller communities and emergency service providers to access $800,000 in hardware and software that each community by itself could never hope to afford otherwise," said Newton.

The county will gain additional efficiencies and cost savings once it consolidates multiple dispatch centers into one center for the region. There will be a savings in hardware and physical building sites.

"Everything will be dispatched out of one location. Dispatchers will see a real-time picture of what is going on in the county, the resources that are available, and the incidents agencies are handling," says Newton.

Because the new architecture is centralized and virtual and the vendor will install the software on a central server, dispatchers will work from much less expensive remote desktops that will not require cumbersome software installations. "Unless they need other programs that are resident on those desktop computers, they can make do with a low-end workstation to gain access across the network to the public safety software," says Newton.

In Palm Beach County, the system will record calls centrally on two recorders, eliminating the need for 20 additional recorders (one for each PSAP). The recorders cost $150,000 each plus annual maintenance and support costs. As the county must replace the recorders every five years, it will save upwards of $3 million every five years.

Conclusion

The ideal scene for public safety officials and first responders would be to share real-time information, communicate seamlessly and coordinate effectively. This ideal scene is becoming more of a reality with robust next generation networks. As seen through the various local government examples, robust networks enable wireless camera systems, integrated first responder communications and next generation 911, which all help emergency responders overcome the challenges that have plagued public safety agencies in the past. By building the infrastructure from the ground up, investing in new technology, sharing the costs and implementing best practices, public safety can obtain the next generation capabilities needed for a safer nation.

Endnotes

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The Center for Digital Government and *Emergency Management* would like to thank the *Digital Communities* Law Enforcement Information Technology Task Force members for their support and assistance in the creation of this report and would like to give special recognition to the following people for their contributions.

Gordon Bruce — Chief Information Officer, City of Honolulu, Hawaii

Captain John Newton — Greenfield Police Department, Franklin County, Mass.

Everett Vaughan — Senior Operations Manager, Palm Beach County Emergency Management