

## Case Study

# Using IP technology to link dispatchers, emergency responders across jurisdictions

By Dean Hairston  
and Jeff Frazier

The suspect speeds westbound along the expressway through Danville, Va., weaving recklessly through traffic. A police cruiser follows, but the suspect continues to accelerate. Now pushing 110 mph, the suspect takes the exit onto Highway 29 southbound into North Carolina. The police officers contact dispatch to report the situation. The Danville dispatcher dials long-distance to the Caswell County, NC, dispatcher, who informs county officers that a fleeing suspect is about to enter their jurisdiction.

Unfortunately, when the suspect crosses the state line, the officers in Virginia have to drop their pursuit, and their counterparts in North Carolina are not notified in time to pick up the chase. The suspect escapes, just as he had anticipated, because he could exploit the incompatibility of inter-agency communications.

This type of scenario repeats itself about 200 times a year in the Danville region, where up to five jurisdictions can be involved in a chase. Each jurisdiction has its own private radio system, so the officers in one jurisdiction cannot directly

contact officers in another. The resulting delays or drops in communication often hamper critical law-enforcement and emergency-response efforts.

Or at least that is how it used to be. Thanks to an IP-based system from Cisco, law enforcement and emergency-response agencies in the Danville area are able to communicate directly with each other across jurisdictional lines, and they do it while preserving their original radio investment, avoiding the enormous expense of upgrading an entire infrastructure to a common radio system or frequency.

### Defining the Problem

Agencies in the Danville region often encountered interoperability problems that they could resolve only with inefficient workarounds. When a brushfire broke out near the Virginia / North Carolina border, for example, one fire truck from each state responded, but the trucks could not talk to one another. Two police cruisers were sent to the site, one for each truck. The firefighters then used the police-car radios to coordinate their efforts.

As a further concern, Norfolk Southern rail lines run through the area, and

toxic materials are frequently transported along them. The region does not have the capacity to hire a full-time expert in hazardous materials (HazMat) cleanup.

As in most other states, each local public safety agency has been charged with purchasing its own communications equipment, and each has deliberately engineered its system to operate independently of systems in neighboring jurisdictions in order to avoid interference. These agencies are also finding that voice is no longer the only mission-critical application. The increasingly complex job of keeping society safe necessitates the interoperability of data and real-time video systems as well.

Land mobile radio (LMR) has been the standard for most law enforcement, emergency response and utility agencies for many decades. Privately owned radio towers transmit voice traffic from handheld radios to the dispatch center, usually over analog landlines. Each agency is assigned a specific frequency and range over which it is allowed to transmit. In some cases, a memorandum of understanding (MOU) permits one agency to switch to the frequency of another—for

example, the fire department can manually switch its radios to the police frequency—but while one department is listening on another frequency, it is cut off from its own.

Some of the Danville-area jurisdictions added gateway patches to the hard consoles in the public safety answering points (PSAPs), which permitted some radio-to-radio interoperability within the agencies of a single jurisdiction. Still, however, there was no way to patch in other jurisdictions or to use other technologies such as Voice over IP (VoIP), cellular and land-based telephony, or data or video transmissions.

### Developing a Solution

In the fall of 2005, the Cisco Internet Business Solutions Group—the global consulting arm of the company—sat down with the city of Danville and the National Institute of Justice (NIJ) to discuss how IP technologies could improve regional information sharing in southern Virginia. The discussions moved quickly into an action phase.

The project's overall goals were to open up communications channels and create seamless collaboration, especially in emergency situations. Ultimately,

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the project created governance models and partnerships that enabled agencies to work together to overcome technological and administrative hurdles. The project also reaffirmed that IP technology could improve government efficiency, officer safety and service to citizens.

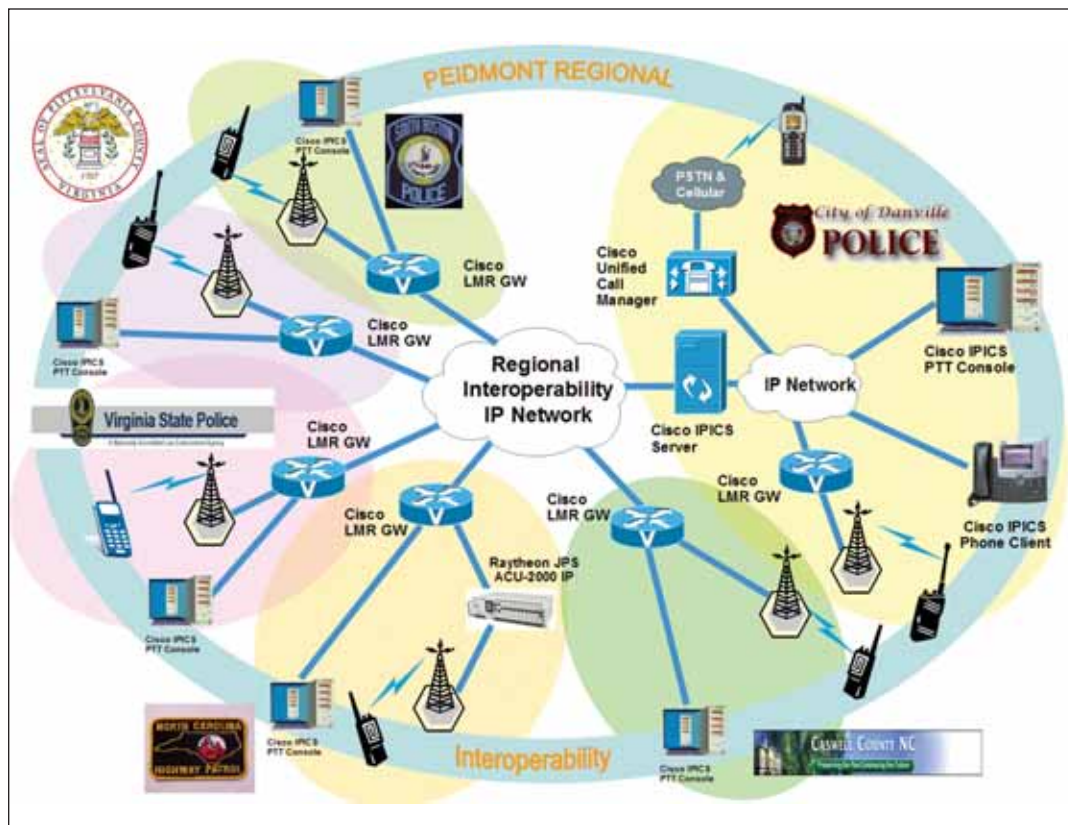
Cisco had developed an integrated radio-over-IP solution, tested within smaller, single-agency venues, and entered into an agreement with Danville to test its product in a multi-jurisdictional project.

The project involved a collaborative effort between Cisco, Sprint Nextel, the NIJ Communications Technology Program, and a multi-agency consortium comprising agencies from Virginia and North Carolina. Virginia Tech University assessed the project for future applicability.

The effort was named the Piedmont Regional Voice over IP Pilot (RVIP) project, encompassing these jurisdictions:

- City of Danville, VA. (consultation by NIJ Communications Technology)
- Caswell County, NC: emergency responders
- Pittsylvania County, VA: emergency responders
- State of North Carolina: state highway patrol
- State of Virginia: state police

The first phase of the project involved the city of



Danville only. The police department took the lead in implementing the solution, and the police and fire departments, emergency medical services, public works department, and city utilities were all integrated into the Cisco IP Interoperability and Collaboration System (IPICS). Phase two expanded the system to the fire departments, emergency medical services, and sheriff's offices of Caswell and Pittsylvania counties. Phase three, now in its final stages, encompasses the state police and highway patrols of Virginia and North Carolina.

## IP Networks and IPICS

A common approach to solving interagency interoperability problems is to upgrade every agency to the same LMR technology—usually P25, a digital radio standard—and migrate to a common frequency such as 700 MHz. This type of upgrade, however, can be prohibitively expensive. The new radio towers alone can run into the tens of millions of dollars, and the handheld units cost a couple thousand apiece. Moreover, such a drastic upgrade manages to solve only some interoperability problems. Not every agency can migrate

overnight. Also, a neighboring jurisdiction may not have upgraded to P25, so the cross-jurisdictional interoperability problems remain the same. There is also no way to extend the system to cellular telephones, VoIP, or wireless local area networks, which can provide data and video interoperability.

IPICS, however, can convert disparate signals into IP format and route them over an ordinary IP network. This solution costs a fraction of a radio upgrade while extending interoperability among radio, VoIP, data and video information streams.

IPICS permits agencies to do the following:

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- Link voice technologies—including cellular, VoIP, and analog telephones; and LMR, P25, and other push-to-talk radios;

- Enhance existing PSAP solutions by providing integrated, preset talk groups tied to alerts and mutual aid agreements, MOUs and standard operating procedures (SOPs);

- Create virtual talking groups (VTGs) into which two or more “channels” can be combined—for example, a police department channel (on LMR frequencies), a fire department channel, and an EMS channel—so that all the users can talk to each other as if they were using the same radio network;

- Establish user accounts for individuals (specialists, consultants, commanders) so that they can join a VTG over their personal cell phones;

- Create notification procedures and alerts that automatically push information such as invitations (via e-mail, text messaging, a pager, or a telephone call) to individuals to join a VTG;

- Activate multiple VTGs so that a participant can listen to more than one VTG but the VTGs cannot hear each other;

- Implement a cost-effective migration strategy if the agency is converting in stages to a 700 MHz platform.

## Piedmont Regional Voice over IP Pilot Program



## Implementing the Solution

Central to the security and reliability of any IP-based LMR system is the network platform. Danville had an existing fiber network infrastructure that it installed in 2004 for a wireless local area network in city government and school buildings. This IP backbone provided an ideal foundation for the IPICS solution. After the addition of a few T1 lines, the LMR signals were converted to IP format with a router that had an LMR gateway built into it. An IPICS server was installed in the Danville Emergency Operations Center to test the solution

against the tough mission requirements of complex interoperability.

At the PSAPs, the computer-based consoles needed only an IPICS client installed, whereas those PSAPs with hard consoles needed only a desktop computer to reside near the console. During normal operation, the dispatchers can use their consoles the same as before. Then when an interstate or multi-agency situation arises, they can use IPICS to create instant interoperability.

Some emergency responders were issued Nextel handsets, which have both cellular and push-to-talk capabilities, the latter of

which use the same LMR frequencies as before. In other cases, the existing LMRs were retained.

The various agencies used existing procedures and MOUs to create policy templates on IPICS. For example, one SOP might hold that when a suspect is in a high-speed chase from Pittsylvania County headed toward Danville, the adjoining agencies are authorized to cooperate. They, therefore, could create a template called “PD\_Pitts\_Dan,” which would automatically combine the Pittsylvania Sheriff’s Office and Danville Police Department radio channels.

After a review, the city

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administrators realized the SOPs and MOUs were outdated, having been developed under the old paradigm of radio incompatibility. When the participating agencies realized they could freely interoperate with other jurisdictions, they negotiated new MOUs and created policy templates to reflect them. For example, if a chase that originates in Pittsylvania County proceeds southbound on Interstate 29, the suspect encounters an interchange that allows him to head west toward Danville or south into Caswell County. A policy template called “PD\_Pitts\_Dan\_Cas” could combine the radio channels from all three jurisdictions so that the suspect could be intercepted regardless of which road he chose.

The new IPICS capabilities also permit the agencies to include individual users in the VTGs. For example, if a train derails and spills hazardous chemicals, dispatchers can activate a policy template to page a remotely located HazMat cleanup expert and invite him to call in to the VTG from his cell phone so that he can speak directly to the emergency responders over their radios.

Because these policy templates are created ahead of time, dispatchers can activate any policy with a mouse click. The dispatcher can also add more channels or users in real time as the situation requires. Additionally, an intercom channel was created to link the PSAPs. This permits the

dispatchers in each jurisdiction to communicate directly with each other, thereby better coordinating their efforts.

## New Capabilities

With IPICS in place, the following scenarios are now possible:

**Scenario 1:** A hostage situation arises in Danville. The dispatcher activates a policy template that notifies a hostage-crisis expert in Roanoke, VA, who calls in on her cell phone to advise the on-site officers over their radios. The suspect manages to drive away with the hostage toward North Carolina. The dispatcher adds the Caswell County Sheriff’s Office channel to the VTG and alerts the Caswell County dispatcher, who can also activate preset VTGs, add new users or continue direct communication with neighboring dispatch operators.

**Scenario 2:** A citizen calls 9-1-1 to report a 10-car pileup on Highway 58. The dispatcher activates a policy template to combine the Pittsylvania County Sheriff’s Office, emergency medical services, and tow-truck channels. When the officers arrive on the scene, they tell the PSAP that a car struck a utility pole and a live line is lying across the road. The dispatcher adds the utility company operations center manager, who uses a different radio frequency. The operations manager is able to integrate crews in the field who are on yet another radio frequency, thereby creating

interoperability between government agencies and the private sector.

**Scenario 3:** A hurricane moves into the region, causing extensive flooding along the Dan River. Each PSAP activates several VTGs—one for the rescuers who are retrieving victims from rooftops, one for the police department that is attending to flooded roads and swamped cars, and one for the National Guard unit that is sandbagging riverbanks. The VTGs are kept separate to minimize the number of people talking at the same time, and the dispatchers listen to multiple VTGs simultaneously so that they can respond to additional requirements as situations arise or relay information from one VTG to another. A disaster coordinator listens to some or all of the VTGs from a cell phone in a remote location and gives direction as needed. In addition, the PSAP receives live video feeds from the state highway patrol helicopter crews, who are participating in a VTG for the incident. The PSAP then distributes video feeds to police officers on their mobile computers, providing them with a bird’s-eye view of the situation and enabling them to make critical decisions faster.

## Conclusion

Because IPICS uses the existing IP network and allows the agencies to retain much of their equipment, the participants in the Piedmont RVIP project were able to

achieve interoperability for roughly one-tenth of the cost of upgrading every agency to a P25 or similar system. The IPICS system will also be able to support future communications innovations that use IP technology. The Danville region has already started work on regional data sharing, which will operate over the IPICS network. After a time, the region hopes to add graphics and video capabilities to its system as well.

The Piedmont RVIP project validates an exceptional model to improve local and state public safety response effectiveness through the use of IP technology. For the first time ever, these organizations are able to communicate in ways that they never thought possible. We recommend that all sovereignties look into taking full advantage of their existing IP network infrastructure to improve both inter- and intra-jurisdictional communications. ■

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For more information about Cisco IPICS please visit: [www.cisco.com/go/ipicssolution](http://www.cisco.com/go/ipicssolution)

