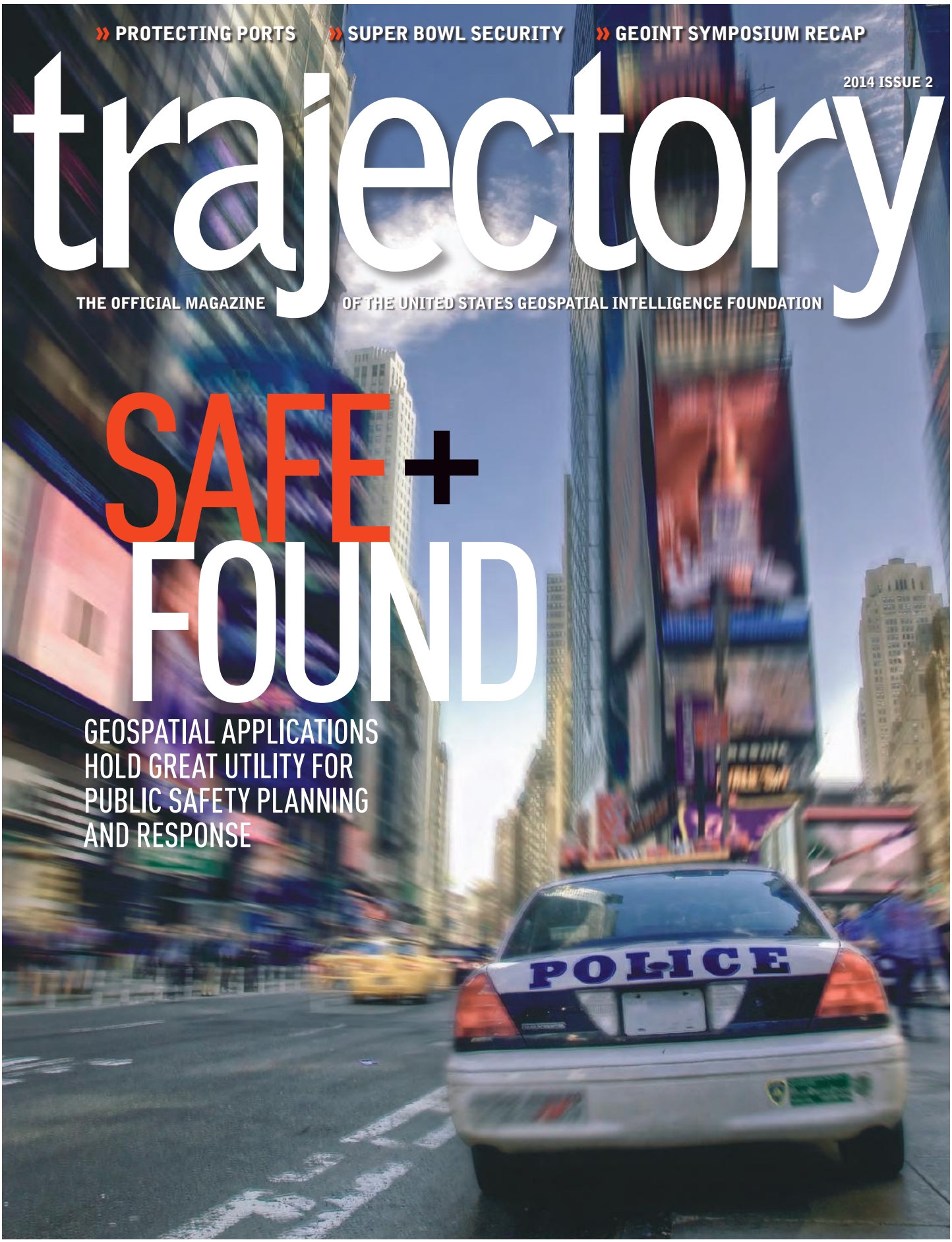

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2014 ISSUE 2

trajectory

THE OFFICIAL MAGAZINE OF THE UNITED STATES GEOSPATIAL INTELLIGENCE FOUNDATION

SAFE + FOUND

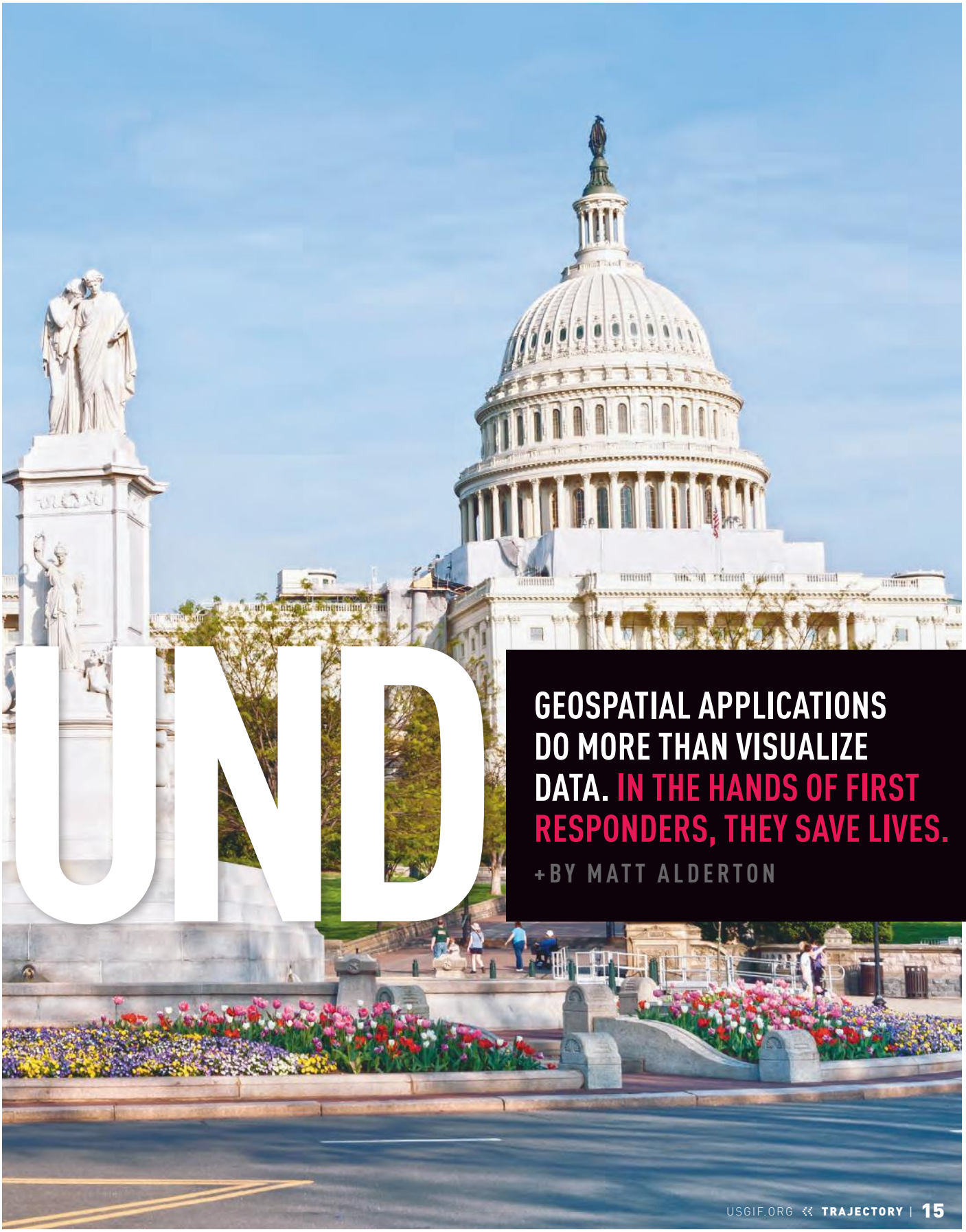
GEOSPATIAL APPLICATIONS HOLD GREAT UTILITY FOR PUBLIC SAFETY PLANNING AND RESPONSE

IN WASHINGTON, D.C., spring is a small miracle. After months of slate-colored skies, frostbitten fingertips, and slushy streets, the nation's capital breathes an exuberant sigh of relief as its denizens exchange parkas for parasols and snow boots for sandals. Cherry blossoms paint the National Mall a bubblegum shade of pink, snow banks give way to sunbeams, and for a moment all seems right with the world.

At last, summer is on its way.

For District residents, it's a blessing. For District police, however, it's a curse, according to Robert Horne, the District of Columbia's program manager for geospatial intelligence. "Crime seems to spike in D.C. during the summer," he said. "Nobody wants to go outside when it's cold and windy, but when it's warm outside, people go out and commit crimes."

SAFE + FO



UND

GEOSPATIAL APPLICATIONS DO MORE THAN VISUALIZE DATA. IN THE HANDS OF FIRST RESPONDERS, THEY SAVE LIVES.

+BY MATT ALDERTON

Indeed, numerous studies have shown that when temperatures rise so does the crime rate. There are many reasons why, ranging from social—people congregate more in the summer—to physiological: Heat causes increased heart rate, blood pressure, and testosterone, all of which can make people more aggressive in stressful situations. Regardless of the cause, however, the effect is often violence, which is why the D.C. Metropolitan Police Department has organized a Summer Crime Prevention Initiative every year since 2007. Spanning May through August, the annual program mandates increased law enforcement in neighborhoods with the largest concentration of robberies, carjackings, homicides, and shootings.

To make summer streets safer for citizens, police leverage not only violent-crime detectives, who make more arrests, but also analysts such as Horne, who uses the District's geographic information system to extract location-based insights about crime and criminals.

"The police department uses GIS to determine what areas, based on historical crime as well as current activities, it should focus its efforts in," Horne explained. "We certainly aren't the deciding factor in reducing crime—good police work is the deciding factor—but we help point good police work in the right direction."

In fact, GIS and GEOINT are compasses that point all manner of public safety personnel in the right direction, including police, fire, and emergency medical services (EMS), helping first responders plan and execute missions more effectively, efficiently, and safely.

"Whether you're talking about fire safety, crime, or quality of life in your community, public safety agencies are using GIS to get a better handle on it," said retired chief of police Lew Nelson, director of Global Law Enforcement Solutions and Industry Solutions department manager for Esri.

CHARTS OF THE FUTURE

Geospatial technology and law enforcement are perfectly matched, according to David Roberts, senior program manager in charge of the IACP Technology Center, through which the International Association of Chiefs of Police (IACP) provides technology research and support to state and local law enforcement agencies.

"Everything in policing is location-based," Roberts said. "It stems back to the earliest days of policing, when police had pin maps. Using pins on a map, agencies were constantly trying to interpret the contours of crime and criminality in their jurisdiction so they could determine how to best deploy resources."

The New York City Police Department (NYPD) is widely credited as the first law enforcement agency to recognize the power of geospatial information. It was 1990 and Manhattan was a scary, lawless place, more gritty than glamorous. Crack pipes littered the ground like cigarette butts, walls wore graffiti-like tattoo sleeves, and Times Square was better suited to criminals than tourists.

Crime was especially rampant in the subway, which fell under the purview of New York City Transit Police Lt. Jack Maple. Rather than focusing on response to subway crimes, Maple strove to stop them before they occurred. To do so, he famously used 55 feet of wall space to map every train and train station in New York City. In crayon, he marked every violent crime, robbery, and grand larceny that took place in the city. Eventually, he made more maps charting more crimes, utilizing a system of colored pins to help Transit Police visualize patterns and strategically deploy patrols to high-risk areas. Maple called the maps his "Charts of the Future," and between 1990 and 1992, they helped reduce felony crime in the subway by 27 percent and robberies by a third.

In 1994, Mayor Rudolph Giuliani named Maple's boss, William Bratton, NYPD commissioner. Immediately, Bratton deployed an electronic version of Maple's charts of the future, called CompStat, which has been credited with reducing homicide, robbery, burglary, and car theft by 80 percent, 83 percent, 86 percent, and 94 percent, respectively, between 1990 and 2011.

"CompStat reporting is becoming very popular in law enforcement," said Cameron Smith, acting vice president for security solutions at Intergraph Government Solutions. "Essentially, it gives police departments the ability to data mine information by location … so they can not only pinpoint the locations of crimes, but also draw conclusions from those pinpoints to help them address problems."

> **"Everything in policing is location-based. It stems back to the earliest days of policing, when police had pin maps."**
>
> —David Roberts, senior program manager, International Association of Chiefs of Police Technology Center

SERVE, PROTECT, LOCATE

As more police departments implement CompStat tools and methodologies, law enforcement as a discipline is evolving, according to Roberts, who notes a shift toward "place-based policing"— focused on crime "hot spots"—and "predictive policing," which focuses as much on preempting crime as it does on punishing it.

Geospatial technology, including GIS and GEOINT, is facilitating this shift in many ways. One is by helping agencies manage limited resources for maximum effect. "Most police agencies don't have sufficient manpower," Nelson said. "GIS acts as a force extender by helping them put the right people in the right place at the right time."

The Ogden Police Department (OPD) in Ogden, Utah, uses this method, in a slightly different way. Earlier this year, it launched Cyberwatch, a GIS application that utilizes citizens to extend and optimize OPD's police force. The system sends location-based alerts to registered users on a daily basis notifying them of new crimes and suspected criminals within a given radius of their home. It also allows them to submit geotagged anonymous tips to OPD's Real Time Crime Center.

"It's basically a neighborhood watch," said OPD Deputy Director of Support Services John Harvey. "If you think about how cops solve crimes, it's usually because someone calls in with a tip. So, it makes sense to put this information out there."

Once the data reveals a developing crime trend in a particular area, OPD rolls out another force extender—a high-visibility remote video surveillance trailer dubbed Archangel. An effective deterrent, Archangel's deployment reduces crime rates between 24 and 38 percent for areas under its watch.

Law enforcement agencies can also optimize resources by tracking their officers. The Mountain View Police Department (MVPD) in Mountain View, Calif., for example, recently explored "Blue Force Tracking" by piloting Altus, an officer tracking application created by location solutions company Polaris Wireless.

"We're talking about putting mobile tracking devices on our motorcycles [used for traffic enforcement] and breadcrumbing where they go in the course of a day, a week, or a month," said Capt. Chris Hsiung, who leads MVPD's field operations division. "By overlaying that with traffic accident data, we can determine if we're writing tickets in the appropriate places, and whether our patrol patterns match up with where our traffic problems are."

Agencies can use the same Blue Force Tracking devices to enhance officer safety. "When I was in law enforcement, I worked in situations where officers were involved in foot pursuits and ended up dying in an alley with nobody knowing where they were," Nelson said. "There is no need for that now because you can know where people are at any given time. When you hear a gunshot you can locate your officers to make sure they're not victims and send help if they are."

PREDICTIVE POLICING

Resource management is one use case for geospatial tools in law enforcement. Crime fighting—predicting, preventing, and solving crimes—is another.

As IACP's Roberts indicated, law enforcement can implement place-based policing, basing patrols on geospatially relevant incidents and risk factors.

"[Former Police Chief] Tom Casady … pioneered this in Lincoln, Neb.," Roberts said. "He built a location-based policing application … that's linked to the Lincoln Police Department's information management system. Instead of seeing the local Starbucks or Pizza Hut on a map, officers see there's a registered sex offender at this address, or there was a burglary at that address. They see this on their mobile device, which provides situational awareness to officers in the field."

Geospatial intelligence can further enhance place-based policing by overlaying on crime maps information related to environment and demographics.

"Many times you can remove today's criminals and crime continues going on because there are other factors in that community that facilitate crime, like a high number of liquor stores, or socioeconomic factors such as high unemployment," Nelson said. "We used to work on sending criminals to jail—and we still work on that—but now we also can see if there is some type of modality we can use to change the behavior in a particular area or community."

PHOTO COURTESY OF OGDEN POLICE DEPT.

OPD'S ARCHANGEL, a high-visibility remote video surveillance trailer, is deployed to various locations determined by analysis of crime data trends.

By plotting everything from streetlights to bars on maps alongside the points where crimes have occurred, law enforcement can take a more holistic approach to crime fighting. Predictive policing evolves this concept further by using location-based analysis of past crimes to prevent future ones.

"Wayne Gretzky said the difference between a good hockey player and a great one is that a good one skates to where the puck is and a great one to where it's going to be," Nelson said. "GIS allows us to skate to where the puck is going to be."

Burglaries are a good example.

"Imagine in front of you a saltshaker," said Robert Austin, manager of enterprise applications integration for the city of Tampa, Fla. "About 3 inches to the right is another saltshaker, and 3 inches to the right of that another saltshaker. What police have found is that if a criminal goes to the location of the first saltshaker and steals salt from that on Monday, when he goes back on

Tuesday he'll go to the saltshaker next to it, and on Wednesday to the saltshaker next to that … odds are the criminal will be back Thursday to steal from the next saltshaker."

According to Austin, Tampa police solve 80 percent of all crimes by waiting at that fourth location. "Criminals are not typically the most brilliant of citizens, so they develop patterns," he continued. "Our chief of police estimates that we've achieved 64 percent crime reduction in the last eight years, and she has attributed a large portion of that to the use of GIS."

Law enforcement can similarly use GEOINT and GIS to predict—and therefore pre-empt—carjackings, traffic fatalities, drug crimes, and gang violence. The Los Angeles Police Department (LAPD) combines predictive policing with crowdsourcing by publicizing its predictive policing targets, called "box areas."

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"We are deploying as many resources as possible to the box areas," LAPD's Pacific Division said in a March alert that was distributed to citizens. "To further increase the effectiveness of predictive policing we are asking the public to spend any free time you may have in these areas, too. Your presence alone can assist in deterring would-be criminals from committing crime in your neighborhood."

Because not all crimes can be prevented, another compelling use case is crime investigation. If a child is abducted, law enforcement can use geospatial modeling to determine where the abductor's car could be based on factors such as maximum vehicle speed, time of day, road conditions, and traffic. With a warrant, law enforcement can access cellphone GPS records to locate people who were in the vicinity when a shooting occurred. And with geo-tagged criminal histories, officers can narrow down a list of burglary suspects.

"If we have a burglary pattern in part of the city, we can map out the burglaries and look at offenders in the area who are on probation or parole for burglary," said Darin Lee, a GIS analyst with the Kansas City Police Department in Kansas City, Mo. "Sometimes, they're right on top of each other."

DOD MEETS PD

Of course, GIS isn't the only geospatial tool in law enforcement's toolbox. Police departments increasingly use a wide swath of geospatial intelligence to execute missions.

In Compton, Calif., the Los Angeles County Sheriff's Department recently tested an unmanned aerial vehicle (UAV) that collects high-resolution full-motion video (FMV). During the yearlong test, the UAV—which has a maximum flight time of six hours—allowed police to zoom in on virtually any area within the city for surveillance purposes, enabling them to track individuals and vehicles. When a crime occurred, officers and analysts could direct the UAV to the scene of the crime to gather geospatially relevant information in real time. They could later rewind the video to perform additional analysis.

"What we essentially do is a live version of Google Earth, only with a full TiVo capability," Ross McNutt, president of Persistent Surveillance Systems—the company that provided the technology—told the Center for Investigative Reporting in a video interview. "It allows us to rewind time and go back and see events that we didn't know occurred at the time they occurred."

Although UAVs are still experimental, many police departments already use video surveillance on the ground. The Boston Police Department famously used surveillance video in 2013 to locate the Boston Marathon bombing suspects. In Washington, D.C., police can readily tap into closed-circuit television (CCTV) maintained by other local agencies.

"The Housing Authority, for example, has CCTV in all of its housing units," Horne said. "The Department of Transportation likewise has cameras that monitor intersections for signal timing and whatnot. We can pull video from all of those cameras and display them on maps … to see any intersection in D.C. that has a camera pointed on it."

In Ogden, OPD has cameras locked on hiking areas, its downtown entertainment district, and public schools. "Right now we have about 230 cameras that the city owns that we can monitor," Harvey said. "We also have access to 1,000 cameras that the Weber County School District has put in schools."

But it doesn't stop at video. Federal authorities have also used helicopters equipped with infrared imaging to identify where marijuana is being grown. And in Montana, law enforcement agencies were part of a recent Montana State University project that tested the use of LiDAR to locate meth labs.

"More and more, you're starting to see the public safety realm [adopt] some of the [GEOINT] tools from the military and intelligence world," Smith said.

RAPID RESPONSE

As powerful as it is for policing, geospatial technology has public safety applications far beyond enforcing laws. In the hands of 911 dispatchers—who locate the response teams nearest an incident, then optimize a route based on traffic, weather, street closures, and other factors—these tools can save lives.

"The value of having a map as part of the dispatching process is self-evident because a major focus of public safety is response time," Smith said. "The quicker you can get to the scene, the better the outcome is."

In Charlotte, N.C., the city uses GIS to manage ambulance response. "There are times of day, days of the month, or months of the year that, for whatever reason, you have more medical emergencies, so you risk running out of ambulances," Nelson said. "Let's say you have 12 ambulances and 10 are

busy; in Charlotte they use an application to determine where they should place their last one or two ambulances so they have the best chance of getting to the next emergency, based on a historical analysis of emergencies at the same time of day, the same day of the week, at the same time of year. They've found that this is very effective at saving lives without the need for more ambulances."

Response time is so important in Delaware County, Ohio, that the Delaware County Emergency Management Agency (EMA) recently completed a two-year project to map and photograph the county's six public high schools in advance of a potential school shooting. The county's GIS department took 360-degree photos of school interiors; highlighted areas of interest and risk, such as potential hiding places or science labs containing volatile materials; and uploaded them to a secure geospatial application for access by first responders.

"Now, if there's an incident at one of the schools—a protracted standoff scenario, for example, or a building collapse—first responders can get a very good layout of the school before they enter the premises," said EMA Director Sean Miller.

Other cities and counties are executing similar projects with malls and other public areas. "If you have a huge mall, you can have all this information—floor plans, pictures, exits—to assist first responders," Smith said.

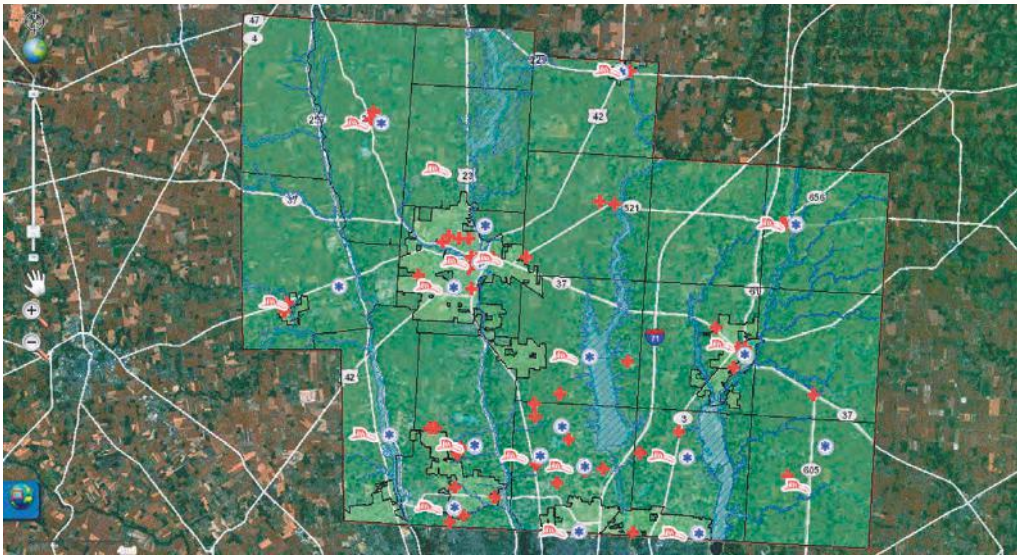

PHOTO COURTESY OF DELEWARE COUNTY, OHIO

DELAWARE COUNTY'S public safety application is extremely helpful as a planning and response tool, displaying critical infrastructure and performing analyses of hazard zones.

WHERE THERE'S SMOKE ...

Fire departments also use GIS to improve response times. In addition to responding faster, however, they can leverage geospatial intelligence to respond better.

"[GIS] allows us to do work before an incident occurs to be more effective when it does," says Dustin Morrow, deputy chief of the Tualatin Valley Fire Department in Tigard, Ore.

The wildfire community has used GIS for decades, according to Sean Triplett, group leader within the U.S. Forest Service's Fire and Aviation IT Group. When a wildfire starts, he said, the U.S. Forest Service uses GIS to analyze a multitude of geo-tagged data, including:

- The locations of the fire, populations, burned areas, watersheds, structures, wildlife, and safety hazards such as power lines in the flight path of water bombers, which help determine threats;
- Weather, wind, and terrain, which help predict the fire's spread;
- The positions of firefighters, fire lines, dozer lines, and water sources, which help manage resources.

"We also use GIS in prevention," explained Triplett, who said the Forest Service continually maps the presence of volatile vegetation in forests so it can mitigate potential blazes. "Based on our analyses, communities and recreation areas can develop action plans to reduce fuels in their area so that when we do have a wildfire, its severity and impact will be significantly altered and decreased."

A 2013 wildfire in southwestern Colorado shows geospatial intelligence in action. "It was a very hot, fast-moving fire in a large continuous stand of dead spruce trees that were victims of beetle kill," Triplett said. "What we noticed using remote sensing and satellite imagery was that when the fire ran into areas of mixed aspen and deciduous trees—fuels that weren't impacted by bug kill—it would lay over so we could suppress it."

Municipal fire departments are similarly deploying GIS. Instead of vegetation and watersheds, however, their maps include information about fire hydrants, structures, and building occupants. Philadelphia firefighters use a mobile GIS terminal to locate the nearest hydrant, view gas lines and water mains, and access vital building information, including size, building material, whether it's vacant or occupied, and whether it houses any hazardous materials.

Philadelphia Fire Department IT Director Peter Della Porta said firefighters also have access to aerial and oblique imagery.

"Last year, a firefighter died because he was fighting a fire on a row house that had three different levels of roof. He was walking backwards through the smoke and fell. If he had intelligence about what the structure looked like, that might have been avoided."

BIG BROTHER AND BIG DATA

Despite its myriad public safety applications, first responders face a slurry of financial, cultural, and legal obstacles in their quest to utilize geospatial technology to its full potential.

Across the public safety sector, budget is a principal concern.

"We drop $500,000 on an engine without any problem, but as soon as somebody says, 'I need $12,000 for an Esri data set,' everybody freaks out,"

THE NEXT GENERATION OF POLICING

In his 1956 short story "Minority Report," adapted for film by Steven Spielberg in 2002, science fiction author Philip K. Dick describes a dystopian world in which law enforcement is based on the precognition of crime by three persons known as "precogs." By punishing citizens before they commit crimes, not after, authorities reduce felonies by 99.8 percent and homicides by 100 percent.

PHOTO COURTESY OF COPTRAX

Despite the rise of "predictive policing," modern-day geospatial tools are far from clairvoyant, but they facilitate police work that's intelligent—not omniscient.

And yet, in a world of location-enabled law enforcement, science fiction is increasingly more science than fiction, according to retired Chief of Police Lew Nelson, director of Global Law Enforcement Solutions and Industry Solutions Department manager at Esri.

"The future has started to arrive," he said. "The Dick Tracy tools I read about when I was a kid? Those exist now."

The following geospatial technologies are coming soon to a police department near you:

- **Mobile GIS:** "Where technology is going is more and more mobile," said policing technology expert David Roberts, senior program manager at the International Association of Chiefs of Police. "We're going to see considerable development in equipping and empowering officers [with geospatial tools] in the field."
- **Unmanned aerial vehicles (UAVs):** "It's really hard not to [acknowledge] the value of [UAVs]," said Mike King, national law enforcement manager at Esri. "If we can use technology to … improve law enforcement's ability to really be where the problems are, why would we not embrace that?"
- **Augmented reality:** "Within the next five years, I think Google Glass will be standard issue," said John Harvey, deputy director of support services at the Ogden Police Department in Ogden, Utah, who envisions augmented reality applications that officers can use to read license plates, search active warrants, and establish or verify identities.
- **Indoor GPS:** "I see GIS moving inside buildings so we can track, for example, firefighters and first responders inside a burning building," said Robert Austin, manager of Enterprise Applications Integration for the city of Tampa, Fla., who also predicts an increase in 3D mapping that incorporates building heights and subsurface materials.
- **ISR sensors:** "They're already using sensor devices in the forensics world," said Cameron Smith, acting vice president for security solutions at Intergraph Government Solutions. "In fact, one of [our sister] companies, Leica Geosystems, has the ability to take a laser scanner and create a point cloud of a crime scene; you can actually plot the locations of everything at the crime scene … to help you determine what happened there."

Morrow said. "Spending that $500,000 on another analyst, more data sets, and GIS training for our staff would probably do more to mitigate incidents in the community than buying another truck, but it's a big challenge to shift that mindset."

It's a challenge that holds not only small agencies back but also the biggest, according to Daniel O'Donnell, a former GIS analyst in the FBI's Atlanta field office. Although the potential for GEOINT and GIS in federal law enforcement is enormous, he said, it isn't routine at the FBI and doesn't yet exist at the enterprise level. Instead, passionate individuals engaged in boutique production within local field offices typically utilize it.

"There are amazing and innovative things being done in a variety of pockets throughout the [FBI]," O'Donnell said. "But it's going to take time, energy, effort, and resources to demonstrate the value of GIS and secure the political will and executive sponsorship to drive demand for it to the point that it becomes a core corporate line of business."

Legal challenges are yet another significant impediment. As agencies adopt new and emerging technologies such as UAVs and augmented reality, citizens, legislators, and judges will have to weigh the benefits of geospatial tools against perceived risks to privacy and civil liberties, according to Kevin Pomfret, executive director of the Centre for Spatial Law and Policy.

"What generally would have been considered sophisticated geospatial analytical tools and technology even four or five years ago is being pushed down into law enforcement at the state and big-city level, and to increasingly smaller law enforcement agencies," he observed. "That's a good thing because of the power of the tools involved, but it also raises some challenges, as those people don't necessarily have geospatial training or understanding, which increases the risk that they'll use the technology in ways that violate civil liberties or even break certain laws. When you add on top of that the lack of a consistent and transparent legal and policy framework with regard to location information and geospatial technology, you increase that risk at the local level all the way up."

Potential solutions exist—requiring warrants to obtain personal data, restricting access to it, and establishing limits on retention of it—but whether citizens and regulators can agree remains to be seen.

"Given the nature and power of geospatial technology, it can be used for good or it can be used in ways that suppress civil liberties," Pomfret continued. "Where that line is drawn for any particular use is going to be a real challenge."

But also a real opportunity.

"There's a lot of policy that needs to be put in place to govern how we're going to use all this data," Roberts said. "But I believe if we enforce those policies effectively, we can achieve a substantial amount of business value and have a huge positive impact on communities."