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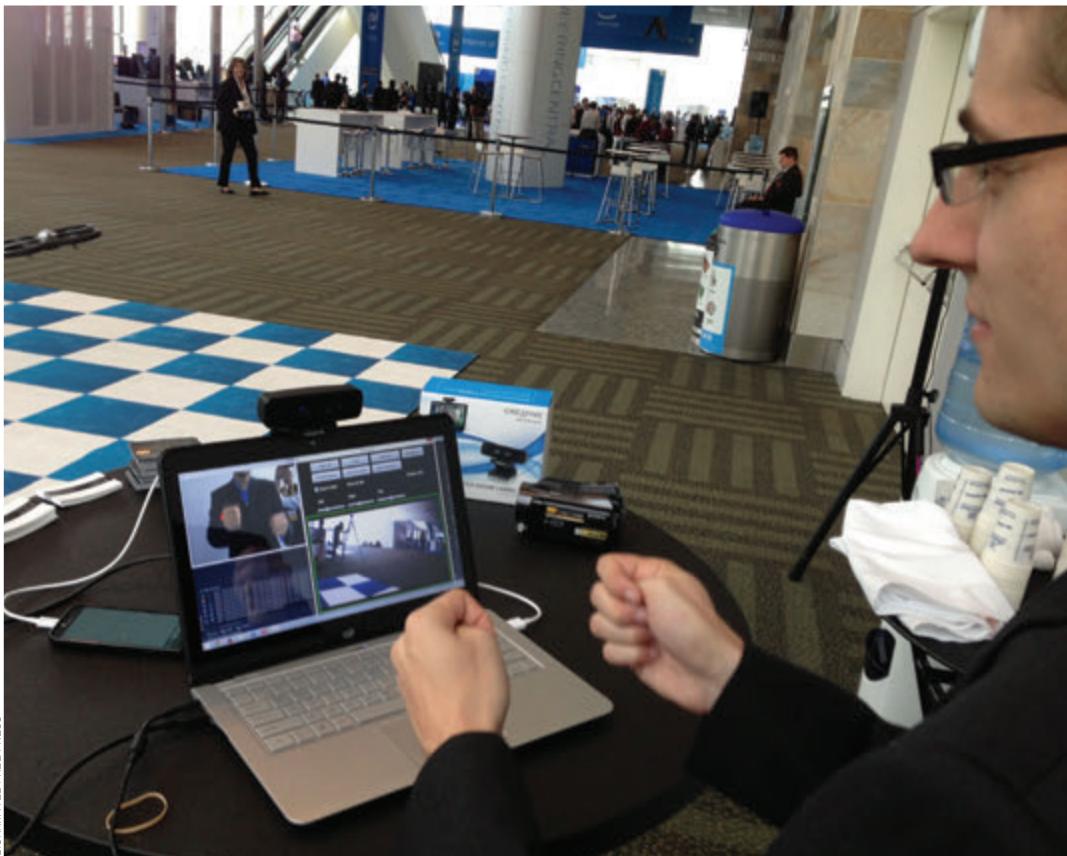


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When Big Data Gets It Wrong

Shouldn't more data always make us smarter?

Caught on Camera

With more video footage than ever, here's how to go about analyzing it.

All the Data Chiefs

Which comes first, the performance officer or the data officer?

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Gov Tech as a Business

Last year at this time, we introduced our inaugural GovTech 100 list — a group representative of the growing number of viable technology businesses pointing their solutions squarely at government. At the time, we assembled an emerging collection of companies that were increasingly challenging traditional public-sector processes and ushering a new wave of innovation into government. The past year bore out that we were onto something in noting a fundamental shift. Government doesn't perform its vital functions nor deliver citizen services the same way anymore, and our coverage should reflect that.

We've started to devote more reporting resources to the gov tech market. You probably learned about Maury Blackman leaving Accela, for example, or the GovDelivery/Granicus merger, on Govtech.com. Expect more stories like that, as we delve deeper into the trends and happenings in the market space, drawing upon our background and expertise with state and local government tech deployments.

We'll talk to established and emerging companies, customers of those companies, investors and analysts with a perspective on what various moves and shifts in direction may signal for the broader marketplace. The most pertinent question our stories will strive

to answer aligns perfectly with the mission of this magazine: How is the cause of innovation in the public sector advanced through the growth and development of the gov tech industry? It's no longer a question of whether it is or isn't. We've moved on to how.

The 2017 GovTech 100 (see page 30), like the initial effort in 2016, is the culmination of months of research and information-gathering, complemented by hours of interactions with opinion leaders and innovators in the trenches. But this year's list, unlike 2016's, is made infinitely richer by an important new partnership that deepens our knowledge base in a significant way.

Government Technology has officially partnered with Crunchbase, TechCrunch's startup database arm that features rich context on hundreds of thousands of global companies. The expansive site includes thousands of pieces of company data on those firms making inroads into gov tech. Crunchbase's team of researchers and tools offers insights into investments, competitors, leadership and employee counts, media coverage, and more. It's a wealth of data that helped inform not just the 2017 GovTech 100, but also will help provide vital, verified context to our reporting going forward. What's more, through our collaboration, gov tech is now officially an industry category in Crunchbase.

Along with Crunchbase and its expansive market knowledge, we are also leaning on the experience of the Nasdaq Entrepreneurial Center and the San Francisco Mayor's Office of Civic Innovation — leaders in engaging startup energy in the public sector through their Startup in Residence program, which has expanded to include smaller municipalities nearby.

Attendees of last October's State of GovTech event got a preview of this new alliance. At the Nasdaq Entrepreneurial Center in San Francisco, we convened public-sector leaders, startup companies interested in working with government, investors and nonprofits to talk about the opportunities represented by the nearly \$1 trillion state and local government technology market.

Pioneering gov tech investor Ron Bouganim, founder of the Govtech Fund, explained at the event that his fund was borne out of the refusal of venture capitalists just a few years ago to engage with companies that were focused on government, failing to see its potential or feeling it wasn't worth the hassle. "Literally, one of the reasons I started the Govtech Fund, I joke to my friends, was out of spite." But things are changing. Those same investors are starting to co-invest with domain experts like Bouganim as a first step. "You cannot ignore this space," Bouganim added. "It's too big." **gt**

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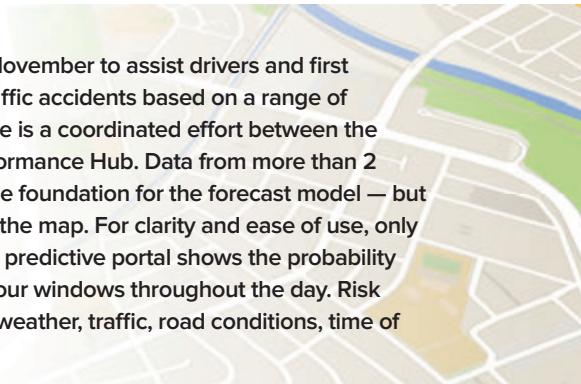


Hitting the Streets

Various reports have surfaced about drones delivering packages to your door — but some options are closer to the ground, literally. Redwood City, Calif., passed a resolution for a nine-month pilot program in which Starship Technologies will use its **autonomous robots to carry out the deliveries** of certain items like groceries. The six-wheeled robots will travel on city sidewalks, obey crosswalk signals and move out of the way of pedestrians. "We saw this as an opportunity to show the tech world ... that we are open to new technologies," said Redwood City Economic Development Manager Catherine Ralston.

Calculated Risk

Indiana unveiled a new online resource in November to assist drivers and first responders with predicting and avoiding traffic accidents based on a range of available data. The Crash Prediction Website is a coordinated effort between the State Police and the Management and Performance Hub. Data from more than 2 million crashes, dating back to 2004, laid the foundation for the forecast model — but not all of those crashes are represented on the map. For clarity and ease of use, only pertinent crash information is included. The predictive portal shows the probability of accidents across the state within three-hour windows throughout the day. Risk decisions are based on the combination of weather, traffic, road conditions, time of day, historical information and census data.



A Cut Above

All around the U.S. civic groups are paying citizens to test-drive government websites and put new apps through their paces. Known as Civic User Testing Groups, or CUTGroups, the phenomenon first appeared in

Chicago in 2013. More recently CUTGroups have been launched in Oakland, Calif.; Chattanooga, Tenn.; Miami; and Detroit. And momentum is building: The Chicago group recently put out a how-to book for other cities looking to participate. Citizens typically get a \$5 gift card just

for signing up to participate. Anyone who comes in to test a website or application gets a \$20 gift card. Organizers say the program offers a force multiplier to city IT departments that may not have the bench strength to perform thorough user testing on every new tool they introduce.

WHO SAYS?

“Technology makes it cool, but data is what makes it smart.”

www.govtech.com/quote-Jan17

TOP VIEWED STORIES ONLINE:

2016 Digital Cities: Winners Focus on Transparency, Security, Infrastructure
4,669 VIEWS

The Trouble with Recounts in the Name of Hacking
3,844 VIEWS

Esri, Waze Partnership: A Growing Trend in Sharing Data for the Benefit of All?
1,955 VIEWS

As Socrata Shifts, OpenGov Competes for Smaller Customers
1,708 VIEWS

Indiana Launches Predictive Crash Tool for Citizens, First Responders
1,417 VIEWS

Cool Cities Rely on Technology; Smart Cities Rely on Data and Partnerships
1,370 VIEWS

tech/byt^es

80+ K

Californians checked their voter registration online in the three days leading up to the November election.

50 MILES

The length of a research corridor New York hopes to see created in the state to aid in the development of an unmanned aerial traffic management system.

\$11 K

The amount a communications professor raised on Kickstarter for the development of a civic tech guidebook, which will eventually be released under a creative commons license.

4

Jurisdictions — Colorado, Idaho, Maryland and Washington, D.C. — plan to pilot a digital driver's license through the use of a mobile app.

GIS PUTS REAL-TIME DATA IN USEFUL CONTEXT

HOW A NEW
GENERATION
OF IMMEDIATE
AND RELEVANT
INFORMATION IS
TRANSFORMING
GOVERNMENT
DECISION-MAKING
AND TRANSPARENCY.

Snowplows in Saginaw County, Mich., are equipped with wireless sensors that report their position in real time as crews clear streets during the region's harsh winters. Location data from the plows feeds GIS maps that show supervisors and foremen where the fleet is deployed and enable them to reroute equipment or make other adjustments on the fly. That information isn't just available to county workers — a public version of the maps, accessible online, shows citizens which roads have been cleared and where the plows will be next.¹

This is just one example of a seismic shift that's underway in how government officials make decisions and explain them to constituents. Advances in mobile, wireless and sensor technologies are providing real-time information that can be used to improve government performance and engage citizens. And the amount of real-time data available to public officials will grow exponentially as the Internet of Things (IoT) takes hold, lending intelligence to more of the objects around us.

This evolution presents both an opportunity and a challenge for public agencies: The IoT will unleash a torrent of potentially useful information, but governments must be prepared to make it actionable.

Roads, bridges, vehicles and buildings will generate a steady stream of information about their location, current conditions and maintenance needs. Citizens themselves already flood social media with alerts about emergency incidents, outbreaks of illness and other issues. All of this, and much more, can be leveraged by governments to better understand and respond to citizens' needs.

The city of Seattle tracks police use of force incidents in real time.



But a mountain of rich, timely information is simply noise without a way to put it into context. GIS platforms and tools – already a staple of government planning and decision support – will become even more important as public agencies strive to act on real-time data.

GIS: A Clearer View

The game-changer is that information is becoming more immediate and more plentiful. Increasingly, government leaders, planners and managers can make decisions based on what's happening at this moment. As this new generation of data-driven decision-making gains momentum, GIS technology will give public officials a primary tool for organizing, visualizing and operationalizing the mountains of real-time data at their disposal.

Esri's ArcGIS® platform has powerful tools like ArcGIS GeoEvent Server that provide new methods for understanding and sharing real-time data – both within government and with the public at large. GIS already plays a fundamental role in helping government agencies make informed decisions, thanks to its ability to organize and present data based on physical location. With improvements in mobility and sensor technology, GIS can be used to understand and visualize issues and events as they unfold.

The World Health Organization, for instance, uses GIS to track the spread of Ebola in real time.² And, in Massachusetts, the state Emergency Management Agency's Boston Marathon Dashboard provides an online map to help keep the public safe from potential threats by tracking every aspect of the annual 26.2-mile race.³

For local emergency responders, real-time GIS can provide a new level of situational awareness. Firefighters in Alameda County, Calif., use maps that show the location of every available response unit across 738 square miles served by the Alameda County Regional Emergency Communications Center. This information is available on tablets, smartphones and wall-mounted monitors, providing incident commanders and others a common operating picture.⁴

Engaging Citizens with Data

The marriage of real-time data and GIS also revolutionizes how citizens understand and participate in the public decision-making process. Consider the previous example of Saginaw County's use of

sensor data from snowplows: Citizens can easily see where and how the plows are being deployed during a storm, providing assurance that roads are being cleared. Depicting this real-time data using online GIS maps gives county leaders a tool to deliver meaningful transparency and accountability to residents.

But information no longer flows just one way. Real-time GIS is becoming a uniquely powerful platform for bringing together government and citizen data to provide shared understanding and context.

When flooding devastated parts of southern Louisiana in 2016, the city of Baton Rouge used both internal and crowd-sourced data – including sensor data, 911 calls, 311 calls, and search and rescue data – to create a multi-layer GIS map that identified areas worst hit by the storm. The map helped provide situational awareness to first responders and predict unforeseen events because of the flooding.^{5,6}

Another innovative use of government and citizen-generated information is happening in Southern California. The city of Los Angeles recently agreed to share data with the Waze navigation app, which uses crowd-sourced traffic reports to help motorists find the best route to their destination. The city provides the app with information on road closures, construction and safety hazards. In return, Waze provides the city with anonymized user data to help traffic planners better understand driver behavior. That data eventually will be integrated into city traffic management and 311 systems to organize events and road closures more intelligently.⁷

In San Diego County, mobile GIS lets community organizations collect information electronically, making it available for analysis almost immediately. The county used Esri's Survey123 for ArcGIS at one of its 2016 Love Your Heart event locations, which provides free blood pressure screenings. Event volunteers have always recorded specific participant data — including age, gender, blood pressure and ZIP code — by hand and then emailed or faxed the data to headquarters where it was rechecked for accuracy. The Survey123 application enabled volunteers to relay the data to the office in real time, which allowed the county to distribute the results the next day and helped community leaders make faster, more informed decisions about the health of San Diego County residents.⁸

Governing in Real Time

Demand for real-time decision-making and transparency data will be magnified as leaders embrace



An Operations Dashboard for ArcGIS helps city employees track utility pole violations and ensure they are being addressed.

"smart community" concepts powered by IoT. Sensors already are everywhere. For instance, smartphones carried by citizens and government employees are equipped with multiple sensors that can measure or detect a range of physical properties. Along with more sensors are a growing number of connected devices, which now include everything from playground slides to vending machines.

The expanding IoT is enabling the next generation of real-time GIS, which will collect, analyze and warehouse millions of daily sensor events. Besides allowing government workers and citizens to quickly visualize, explore and replay data-driven observations, real-time GIS can rapidly perform batch analytics on vast amounts of streaming and stored information, enabling faster decisions.

Meet the Future

Ultimately, merging real-time IoT data with sophisticated GIS will open vast amounts of decision-making data to public officials and citizens. Sometimes it will deliver completely new types of information. In other cases, it will help public agencies obtain data that's historically been costly to acquire and hard to process. For instance, inexpensive drones are now capable of capturing photos or video that can be paired with agency GIS platforms to produce geographically accurate aerial imagery in real time and at a much lower cost than traditional methods.

A recent proof of concept using drones to monitor beach erosion offers a glimpse of the potential. In May 2016, engineering and surveying firm McKim & Creed, Inc. conducted an experimental mapping project on North Carolina's Wrightsville Beach designed to help the U.S. Army Corps of Engineers and other government agencies combat beach erosion in the Carolinas.

Collecting imagery with a camera attached to a quadcopter drone, McKim & Creed quickly processed the visual data with Esri's Drone2Map™ for ArcGIS, which streamlines the processing of drone-captured images for visualization and analysis. Within four hours, the first of many high-resolution 2D and 3D image maps was published in ArcGIS® Online, Esri's cloud-based mapping platform, enabling the Corps of Engineers to quickly identify trouble spots and evaluate corrective efforts. McKim & Creed estimates the use of unmanned craft and Drone2Map for this type of survey could reduce costs by 60 percent versus conventional mapping techniques.⁹

These capabilities will unleash new insights for strengthening public safety, transportation and other fundamental government responsibilities. Agencies will be able to capture more data and new types of data – often at lower cost – while simplifying processes for analyzing and sharing this information.

Scenarios like this will become commonplace as governments use more real-time data to inform their decision-making. Citizens increasingly expect their leaders to have timely data-driven insights, and to share that knowledge through transparency initiatives. GIS will be fundamental to unlocking the power of real-time data for public officials and society at large.

How to Get Started

Could your organization benefit from collecting and understanding data in real time? Get started with the following steps:

1 Enable your organization with ArcGIS Online and ArcGIS Desktop Applications.

Maps are essential for adding context to data. Esri's online mapping platform, ArcGIS Online, and Esri's desktop GIS applications, ArcMap and ArcGIS Pro, provide your organization with the mapping capabilities and resources needed

for data management, analytics, field mobility, decision-making and constituent engagement. ArcGIS Online and ArcGIS Desktop give your organization access to hundreds of free applications, like the Operations Dashboard, Survey123 and so many more.

2 Enhance your GIS investment with tools that can process IoT sensor data and real-time photography.

Getting your organization connected to tools like ArcGIS Enterprise and ArcGIS GeoEvent Server gives your organization the ability to connect with virtually any type of streaming sensor feed. Or you can use apps

like Drone2Map for ArcGIS to turn still imagery from drones into stunning 2D and 3D images for monitoring, analysis and inspection.

3 Start taking action!

Esri's ArcGIS platform provides the end-to-end solutions that help your organization visualize data in real-time in order to make more informed decisions. The benefit of using ArcGIS for your real-time decision-making needs is that you never have to leave the ArcGIS system to collect, share or analyze your data, making it easier for your organization to collaborate internally and with the public.

This piece was developed and written by the Government Technology custom media division, with information and input from Esri.

- 1 <https://www.esri.com/~/media/Files/Pdfs/library/casestudies/saginaw-county-road-commission.pdf>
- 2 <http://maps.whoi.int/mapjournal/?ppid=fe93c0af78d34adfa27ea822e32f68db>
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Take a stance

Help people get the services they need

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Challenge my city

To better serve the people

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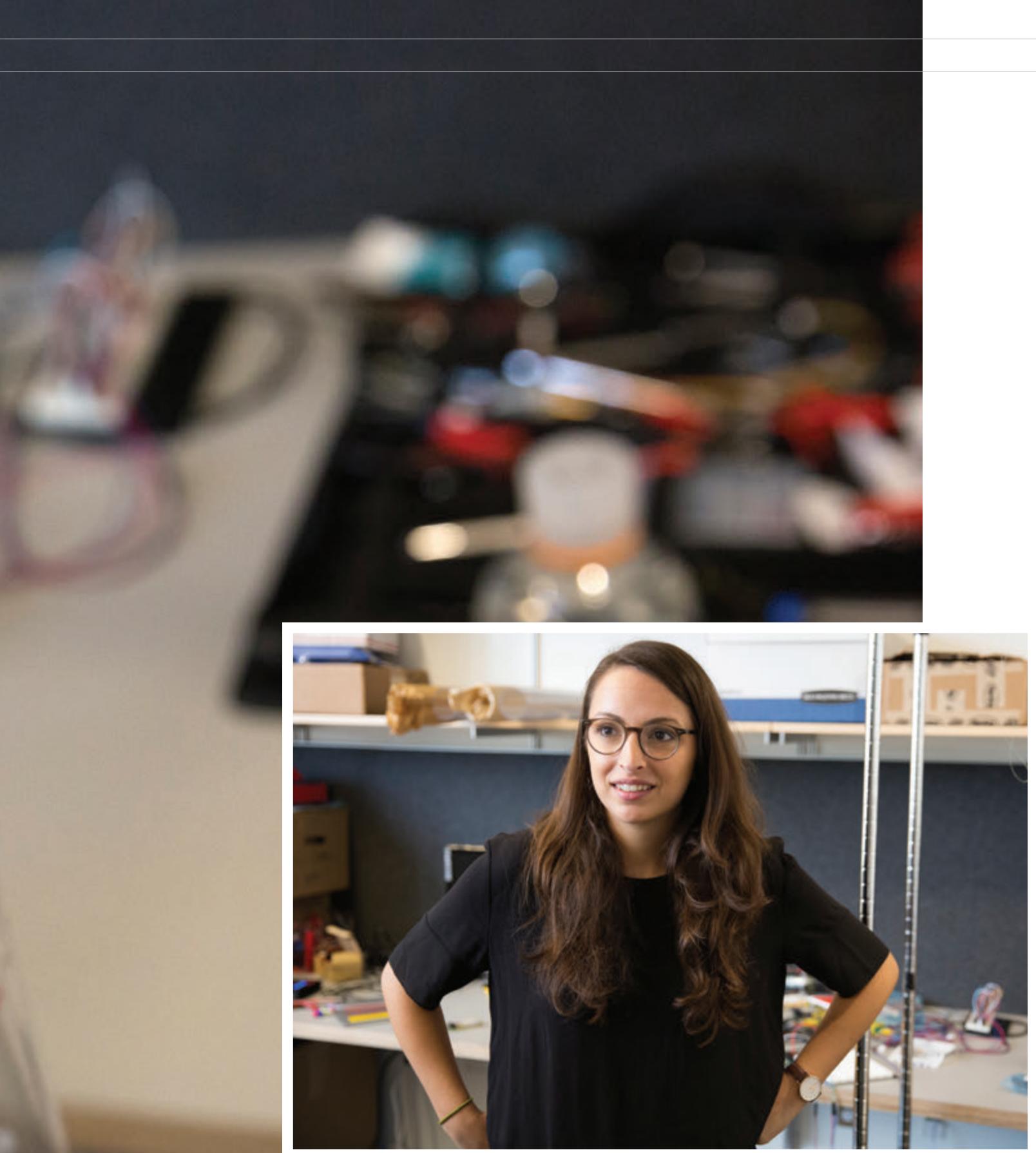
Measuring a City's Health by Testing Its Gut

Can the health of a city be measured through its sewer system? The Senseable City Lab at the Massachusetts Institute of Technology thinks it can and is putting robotic devices into the sewers of Cambridge to find out. The prototype device now undergoing tests measures just a few factors, such as water flow and temperature. But if the robot works as proposed, the next step will be to place more sensors on it to test for specific pathogens, such as viruses and infectious diseases, according to researcher Newsha Ghaeli. "The idea is that if we can look at types of viruses found in the sewers, we can start to understand how diseases are started and how outbreaks move through cities. The robot can be used to act as an early warning system for infectious diseases," she said. In 2013, researchers in southern Israel discovered the polio virus while testing sewage

samples. The government quickly responded with blanket vaccinations for the local population before the virus could spread. While most city governments run tests on what is contained in the water at wastewater treatment plants, Ghaeli said these facilities are disconnected from the cities they serve and that the water often contains runoff from streets and has been traveling for hours, which means important chemical bonds are breaking down, making the testing less accurate. "This robotic device, which is lowered right into the sewer lines, measures what's happening in the heart of the city," she said. The project, which is being funded by a grant from a Kuwaiti-based foundation, is part of the lab's broader effort to understand human behavior within a city. By bringing together bioengineering with Internet

of Things sensor technology and large pools of data, researchers hope to find better ways to link urban life — and health — with public policy.

—Tod Newcombe



MIT Senseable City Lab Project Lead Newsha Ghaeli



“Siri, I’d Like to Report a Pothole”

Artificial intelligence will help create a more responsive government.

When a citizen dials 311, it has been the longstanding preference by mayors to have a city employee on the other end of the line to deliver the ever-valuable personal touch.

But when efficiency is the priority, are we really best served by having city employees at 311 call centers act primarily as switchboard operators, sifting through online scripts or, worse, binders or spreadsheets and responding to information requests with specifically coded responses?

More often than not, citizens will call 311 with an information request — to determine their trash pick-up day, the hours the public pool is open or another simple ask. The North Carolina Innovation Center is now using chatbots for its internal IT help desk hotline, where between 80 and 90 percent of calls are for help changing a password.

Still in its experimental stage, North Carolina uses the bots to free up help center operators to handle more challenging and complex concerns. Instead of spending

the majority of their time unlocking accounts and resetting passwords, the IT center workers can focus their efforts on more time-intensive service requests.

Given the recent private-sector advances with virtual assistants like Siri, Alexa and Cortana, as well as natural language use and

cognitive learning, government should look to broaden the use of artificially intelligent assistants, particularly for the next generation of 311. The implementation of these artificially intelligent “assistants” should be more than an internal experiment; it should be targeted and complemented with deep contextual knowledge.

Because of enhancements in app-driven digital channels, it might be perceived that the Internet is the primary route citizens take to voice concerns to their city, but a 2015 report from the International City/County Management Association suggests that the telephone will remain the most popular citizen-government line of communication.

The next generation of 311 must make the phoning-in process more responsive. In most cities today an interactive voice response system screens and redirects calls to a live operator. Yet those voice response choices are relatively static, and even after fighting through them, the live operator who engages the citizen remains dependent on often dated and difficult-to-find scripts and with little real time for problem-solving.

Responsive government requires using the likes of Siri and Alexa to help answer questions and complete simple tasks and commands. A bot’s ability to quickly digest thousands of pages of documents will both more quickly resolve informational requests and more accurately

A graphic illustration featuring a black smartphone on the left and a large red speech bubble on the right. Inside the speech bubble, the text "How can I help you?" is written in a white, sans-serif font.

"How can I help you?"

find up-to-date information from official documents and other approved sources. The improvements in efficiency will allow 311 center workers to focus on addressing and solving complex citizen complaints — producing a truly personal touch.

Call center operations should rely on chatbots to read the applicable documents, mine the relevant social media (e.g., spot a tweet from a frustrated parent that the swimming pool is not open as it should be) and turn the more difficult problem-solving over to engaged operators. Ironically, a bot will in fact bring forth efficient personalization, in multiple languages and with less frustration. Siri, can you help make my city hall operate better? 

Stephen Goldsmith
is a professor at Harvard Kennedy School and director of the Innovations in Government Program and Data-Smart City Solutions. The former mayor of Indianapolis, his latest book is *The Responsive City: Engaging Communities through Data-Smart Governance*.

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Skyhigh State and Local Customers





Michael Sherwood

CIO, Las Vegas

If CIO Michael Sherwood has his way, what happens in Vegas could very well spill over into the streets of every city in the United States — maybe even the world. He wants new technologies and the companies behind them to flourish in the glitzy jurisdiction.

The idea behind the city's tech tack is simple: create a place to innovate and give citizens new tools to make their lives easier. In one area of the city, an innovation district promises to be a proving ground for autonomous vehicle technology, and a new identity management system could help lay the groundwork for more efficient government. As Sherwood tells it, officials are committed to making Vegas more than just a tourist destination — they want stake in the future as well.

1 What are some of the major initiatives you are working on? We're working on creating partnerships with private entities and other public agencies, and developing a truly innovative downtown area. We have an innovation corridor in our downtown area, so we're looking at autonomous vehicle loops where we would have autonomous vehicles running. We're partnering with several regional as well as national companies that specialize in that field. We're looking at doing an Internet of Things-based deployment downtown as well — temperature sensors and other types — which is consistent with what others are doing, but we're looking at how we can interact that with the community at large, including business partners.

2 How do you see the innovation district developing in the next couple years? It's almost limitless. There are so many ways we can engage our citizenry better, provide better transportation, provide better medical service and provide an overall better experience for the people within our city.

I think this state is all-in on technology. It comes from leadership from all over — from local government to the governor's office. I think this entire state is energized toward really using technology to its fullest extent. On the local level, our mayor, our City Council and city manager, we're out there, we're ready to go and take on projects. We're not afraid of risks, and we're willing to do things we believe will have a high possible yield. If they don't work out, we regroup and we go back at it.

In one highly publicized advancement, the city installed kinetic sidewalks that help store electricity to power city lighting. Sherwood said new technologies like this could one day help to better manage roadways and connect with people on the street.

3 How is Las Vegas focusing on becoming more customer-centric?

What we are doing now is building an identity management system where you log in, we know who you are based on your identity and we will be able to start tailoring the delivery of services to you based on trends. So if you have purchased soccer camps for your children, we will be able to tell you about upcoming classes or soccer camps. Then when new soccer programs come up, if you opt in, we would alert you to those types of the events. It's kind of the single pane of glass.

4 How is the Amazon Echo playing into Las Vegas' strategy? There is more

to it than just that customer interaction experience; it's about how we reach as many different layers of the citizenry as we can. So there are mobile applications, and we just see this as another form of transparency where we can provide services to people in a way that is much more convenient. When you look at technology as a whole, running out to your phone, grabbing it, opening an app and then trying to interact with government is one way of doing it, but there are other ways that are more efficient and can provide instantaneous feedback.

We're trying to take it to the next level. Right now you can ask [Alexa] when the next council meeting is, when the next planning commission meeting is, you can ask which ward you are in ... but we are looking at taking our open data initiative and incorporating it into Alexa. We're hoping this will cut down on public records requests. If we can have this information available, maybe that will help us become more efficient internally. 

— Eyrong Eidam, Assistant News Editor



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MAKING CONNECTIONS

From flood control in Texas to wildlife protection in Florida to earthquake alerts in Los Angeles, practical uses of the IoT in government are everywhere.

By Tam Harbert



ITIONS

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In the Internet of Things, the large, cutting-edge projects usually get the most attention.

In the public sector, headlines are dominated by infrastructure projects like sensors in roads that help manage traffic or smart meters used by utilities to save energy.

Yet it's often the more prosaic use cases and smaller-scale projects that lead to real, long-lasting benefits. These projects are often at the local level. They fly under the radar and have modest goals. But this is where public servants are using the technology of IoT to better serve their constituents.

In fact, the definition of the Internet of Things is nebulous, noted Joshua New, policy analyst at the Center for Data Innovation. A report by the center defines IoT as a set of physical objects embedded with sensors or actuators and connected to a network. That's a broad universe. "It goes from the really benign to the super-futuristic," New said. "You can pretty much 'sensorize' and connect everything."

The technology is in its infancy in the public sector, at both the federal and the local levels. "The Internet of Things is super-promising for local and state governments, but because it's an emerging technology, it can be expensive and it is relatively untested," New explained. "That creates a high level of perceived risk."

The same factors that the center identified in a recent report as holding back IoT projects at the federal level are likely to be even bigger barriers at the state and local levels. These include a lack of strategic leadership on how to use IoT; a lack of skills in using the data generated by IoT; insufficient funding to modernize IT infrastructure to enable IoT projects; procurement policies that make it difficult for governments to quickly and easily adopt the technology; and risk and uncertainty about privacy, security, interoperability and return on investment.

But strip away the label of “IoT” and you’ll find dozens of interesting projects that use connected devices to increase efficiency, lower costs and even save lives. For example, the Lower Colorado River Authority (LCRA) started deploying rudimentary sensors along the Colorado River in Texas decades ago to help track stream levels that could lead to floods. Back then “they didn’t realize they were implementing an IoT system,” said John Miri, chief administrative officer of LCRA. “They were just using the tools that were available.”

The LCRA was created at the height of the Great Depression to help Texas better manage the flood plain along the lower Colorado River basin, as well as to produce and distribute hydroelectric power to the cities in the area. The system uses a network of 275 U.S. Geological Survey gauges, some installed as long ago as 1898. In the 1980s, LCRA began deploying radio telemetry sensors on those gauges. Today the system, called Hydromet, monitors and reports stream flows and other data, including temperature, rainfall and humidity, on a public website in near real time.

This year, LCRA received a \$650,000 contract from the U.S. Department of Homeland Security to investigate better sensor technologies and software needed to disseminate information and alerts during a flood. The sensors used in the system today are expensive — costing anywhere from \$25,000 to \$50,000 each. One goal is to find or develop a next-generation flood sensor that would take advantage of advances in hardware and consumer sensor technologies yet still be rugged enough to last in harsh outdoor conditions.

Today, LCRA is evaluating sensors that cost \$200 to \$2,500, Miri said. The other goal is to build a better framework so that data can be used more practically. Rather than just post it on a website, LCRA might be able to geo-target the smartphones of citizens in specific areas where flooding is imminent. “If this works, then the cities and counties we serve could use this technology to send



The Lower Colorado River Authority in Texas has installed sensors to track stream levels that could lead to floods.

out better, more targeted warnings to keep their citizens safe,” Miri said.

Alerting residents to danger is the goal of a new project in Los Angeles as well. The city has lots of Internet-connected things, including 145,000 streetlights and 4,500 intersections. And yet IoT was not the goal. “Now we call them IoT devices. We’ve put a name, a label, a concept around it,” said Ted Ross, L.A.’s general manager and CIO. But “three years ago, they were just devices.”

He calls what the city has done so far “Smart City 1.0.” The next step is to gather information from and send data to multiple sources — not just city-installed sensors, but the sensors that people carry around, such as smartphones and watches. Smart City 2.0 is about gathering “streams of data, then laying them atop of each other and getting situational awareness and location intelligence,” he explained.

For example, the city and the California Institute of Technology (Caltech) developed a project called “Quake Alert,” which uses sensors to detect the nearly constant tremors in the area. Today, that data is used to visually depict a quake in



Laying the Groundwork

In Washington, the state's centralized IT department, Washington Technology Solutions (WaTech), is migrating to IPv6. IoT was just one of several factors that prompted the move, according to Daniel Mercer, WaTech chief technology officer. The prime reason was that the state needed to change how it governed Internet protocol (IP) addresses. Under IPv4, each state agency obtained and managed its own IP addresses, which in some cases led to problems. With IPv6, WaTech will manage all IP addresses. Also, the state needs to adopt IPv6 in order to be able to work with the federal government and commercial business partners in the future. IPv6 will enable state employees to move among networks and devices seamlessly, enabling a more efficient mobile workforce. In addition, the state is simply running out of IPv4 addresses.

Although there aren't many IoT projects in the state's agencies yet, the migration to IPv6 and central management by WaTech should enable a smoother transition as more and more things become Internet-enabled. An IPv6-readiness assessment of all network gear and applications should be complete by summer 2017. Then WaTech has to request the funding for the migration. Assuming the funds are available, the actual migration will take at least five years to complete, probably longer, Mercer said. Some vendors have implemented IPv6 in software rather than in hardware, he said, which could strain network processing power. In addition, there are applications and infrastructure-as-a-service providers that are not yet IPv6 compatible. "We'll probably be in a dual-stack world — where we'll have to translate between IPv4 and IPv6 — for 10 years," he said.

progress. To take it to the next level, the city is developing a system of sending alerts to citizens' smartphones to give them 15 to 30 seconds to take cover. The application could save not only lives but also millions of dollars in damage if, for example, alerts went directly to manufacturing equipment, which could shut itself down to avoid ruining product, noted Ross. "That's a classic IoT conversation, but under a very constrained timeline."

Los Angeles is also using sensors to monitor environmental factors, including the health of trees. In its Internet of Trees project, the city is combining data from Google Street View with a machine-learning

algorithm developed by Caltech to inventory its urban forest of some 700,000 trees scattered over 469 square miles. That has saved the city approximately \$3 million, which is what it would have cost to deploy an army of people with clipboards to visually inspect each tree. Now, it is in the process of replacing 200,000 trees (removed when road repairs are made) with new ones that contain sensors to monitor moisture, air quality and the health of the tree itself.

The future value of such projects depends on the city's ability to innovate with the data, which is why it created a federation of 11 local universities where students will do projects with data from various use cases, Ross said. "We think an investment in data science and analysis will have multiple benefits."

Connected devices are also helping small cities save time, money and labor. Tamarac, Fla., population 65,000, uses IP-based controllers in many areas of city infrastructure, including controlling HVAC systems and monitoring data centers for humidity, temperature and flooding, said Levent Sucuoglu, the city's director of IT. Today, Tamarac requires that sensing and IP-based controls be considered in all new city construction. "We make that part of our construction documents, then as we go through the design phase to ... determine how much [technology] will be included based on cost, functionality, availability and reliability," Sucuoglu said.

The city's new fire station, now under construction, will include IP-based building access control, security surveillance, HVAC and lighting control. It will have IP-based sensors to monitor the amount of gas in the facility's pumping station and report how much gas is distributed to each fire engine. A city-run golf clubhouse to be constructed next year will include energy-efficient, IP-based LED lights. Central control will also lower costs by turning the LEDs off when they're not needed. In addition, the city can add some whimsy: The lights can be programmed to change colors to match holidays or seasons — displaying red, white and blue on the Fourth of July, for example.



But network-connected sensors aren't always cost-effective, Sucuoglu noted. "There are a lot of practical applications, but the ones you read about in magazines — all those futuristic IoT devices — they aren't really widely available or affordable."

They also might not be very secure. Phil Bertolini, CIO of Oakland County, Mich., is extremely cautious when it comes to IoT. While central management and control of systems via the Internet can reduce costs and increase efficiency, it can also increase the danger that such systems can be hacked.

"I'm concerned about the Internet of Things from a security perspective," Bertolini said. "It scares the heck out of me that [we could rely on] some of these forward-facing IoT devices." What if a hacker shuts down the air conditioning in a data center, causing millions of dollars' worth of damage to computer equipment? Worse yet, a nefarious actor might take control of all those Internet-connected lights and plunge a city's entire downtown into darkness. "As government, we have to be extra careful," he noted.

Oakland County is installing a new building management system that will be centrally controlled, but the connection will usually be over a secure fiber-optic network connection, not riding over the open Internet, Bertolini said. There will be a way for IT managers to dial in remotely

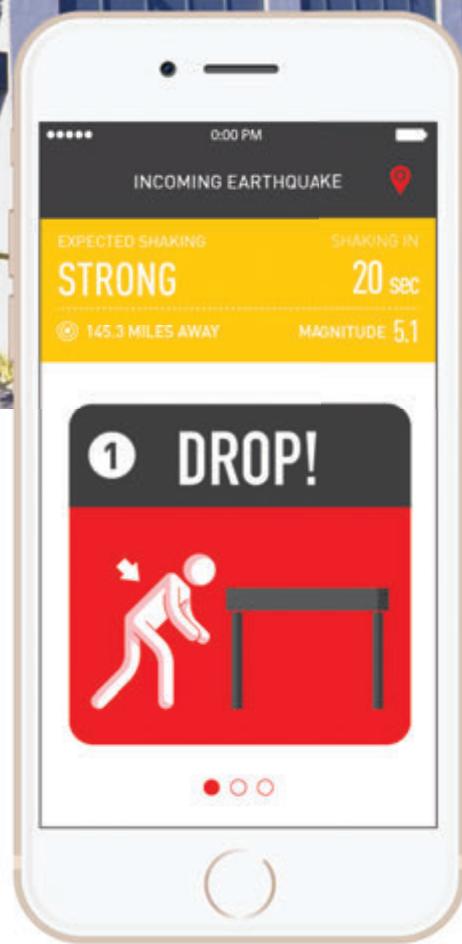
L.A. is working on a sensor-based system to alert smartphone users about an earthquake before the shaking starts.

via the Internet, he added, but it will be through a secured "tunnel" connection requiring two-factor authentication.

At the state level, activity ranges from small, limited departmental projects to statewide initiatives that are laying the groundwork for possible IoT applications in a few years.

Florida's Fish and Wildlife Conservation Commission has been using sensors to track various kinds of wildlife for at least 15 years, said Chip Deutsch, associate research scientist. In one project, researchers attach GPS tags, along with temperature and depth sensors, to manatees to study their movements and habitats. The tags allow researchers to track the animals, documenting where and when the manatees travel in search of food, for example. With the latest sensors, Deutsch said, "we can get incredibly fine-scale on the locations and the time." The project has helped wildlife managers know where to put boating speed limits in order to protect the animals.

Indeed, getting everything to work well together, even in limited pilot proj-



ects, can be challenging. If it finds lower-cost consumer sensors and hardware for its flood alert project, LCRA will have to redesign the entire system, Miri noted. "These sensors won't work exactly the same way, they won't provide data exactly the same way," he said. "So part of what we're doing is changing the whole notification system, the whole business process around it. That's what will help us get to a more cost-effective system."

But don't call what LCRA's doing IoT. "We are not doing this because we want to do an IoT project," Miri said. "We're doing this because we don't want people to die or property to be destroyed in floods." 

MANUAL AND PAPER-BASED?

Nobody (in Government) Has Time for That

Despite the nation's recovery from the recession, state and local governments can still find themselves in financial straits. A March 2015 Rockefeller Institute report notes that tax revenue is slowing and even declining in most states, leading to budget shortfalls. At the same time, many organizations are losing manpower and expertise to retirement. In some state agencies, 40 percent of the workforce will be eligible for retirement by 2017.¹

How are state and local governments addressing these challenges? According to CDG's 2015 Digital Counties Survey, 47 percent of counties are implementing enterprise content management (ECM) systems — it was counties' most popular technology investment after security. It's no surprise government agencies are turning to ECM — automating paper- and labor-intensive processes allows them to cut costs by freeing up valuable staff time and streamlining services for citizens.

Laserfiche can help agencies automate complex, multi-departmental processes, including permitting, case management, contract management, HR onboarding and more. By deploying Laserfiche's ECM system, which acts as a central repository for electronic documents and tools, agencies can automate workflows and manage content throughout its life cycle.

BENEFITS OF AUTOMATED PROCESSES



Savings. Fewer steps and less paperwork translate into lower direct costs. Other savings are reaped through reduced need for document storage and management, and increased productivity.



Efficiency. Reviews and approvals are fast with electronic forms and routing.



Accuracy. Defined workflows and routine business processes reduce errors.



Transparency. Digital documents available through a Web portal serve as a single point of access to information for staff and citizens.

The impact of automation is far reaching. For example, Boca Raton, Fla., implemented Laserfiche's ECM solutions as part of its accounts payable redesign. The city eliminated paper forms for vendor set up, and now routes documents and invoices electronically for approval and processing. Accounts payable can easily access information in the ECM system to print checks.²

As governments implement new technologies to meet citizen demands, the need for automated processes will increase. Laserfiche offers experts to help agencies go paperless, manage digital content, automate business processes and implement ECM.

Endnotes:

1. <http://www.governing.com/topics/mgmt/gov-governments-silver-tsunami.html>

2. The New Answer to "Do More with Less," white paper, published by the Center for Digital Government, underwritten by Laserfiche

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ARE YOU READY

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Tomorrow's
technology
is fast, small and
full of surprises.

BY ADAM STONE



Near-future technologies will change what we do, how we do it, even what we are.

What we do: Why build objects, when 4-D printed materials will build themselves?

How we do it: Drag a mouse, point a cursor and click? Tedious. How much simpler to toss off a gesture in the air, to manipulate computer operations with the wave of a hand or the flick of a finger?

What we are: Gene editing already grows bigger corn and longer-lasting tomatoes. Could it grow a longer-lasting you?

Last decade's sci-fi movie effects become next year's reality. Technology seems limited by nothing anymore save our own creativity and vision. That's an opportunity for government leaders, of course. It heralds the arrival of new tools that can help to enhance citizen services while also improving the elemental functions within government.

But there's a caveat, expressed nicely by American futurist Alex Steffen. "We already have many of the technologies and tools that we need to build a sustainable future," he said. "What we don't have is a new way of thinking, and that's really the hardest part."

In considering the emerging technologies offered here, government leaders face an inherent challenge. They are tasked not only to help bring these bold ideas to fruition, but also to play a role in the ongoing dialog regarding the best and wisest uses for all this grand potential.



Gestural interface

Sometimes life imitates art. Take for example that scene in the 2002 science fiction film *Minority Report*, where Tom Cruise uses specially designed gloves to maneuver content around wall-sized computer screens just by waving his hands.

That is totally doable, said Mike Friedel, director of sales for Oblong Industries. The company's CEO, John Underkoffler, was science adviser to Steven Spielberg for the sci-fi film. While Oblong's product uses a wand rather than gloves, the premise is essentially the same.

Gestural technology seeks to adapt the user interface, to make it more effective, more flexible, more intuitive. The user may interact with a computer monitor, a white board or a big array of screens. Commands may be conveyed through gloves or a wand or simply by waving a pattern in the air.

This creates a new dynamic for presentations. Instead of having to click-and-drag on a screen, "now you can grab something, resize it and bring it into the picture from some other place, with simple gestures," said Friedel.

More than mere convenience, the promise of gestural tech lies in its ability to give people freer access to the vast volumes of data that are growing up in the public realm.

"People carry around massive amounts of data on smartphones and tablets and laptops. But can you really solve big problems on a smartphone? No. You need better access to that information," he said. "Sometimes you need access to multiple streams of information, and the ability to manipulate that data is key. It's not just about having the information. It's about being able to combine that data, to cut and paste it and to share it."

This raises interesting possibilities for government, said Michael Hong, principal at global management consulting firm A.T. Kearney. When combined with virtual or augmented reality, the technology

could open the door to smoother, more effective citizen services. Gestural technology could also help government to better serve those with disabilities.

"These are customized, instantaneous, personalized experiences. If someone can move their fingers or arms and you have sensors that pick up on that, now they can interface and engage with government in ways that they haven't been able to in the past," he said.

Gestural tech could bring new challenges too, as for instance with the auto industry's interest in establishing hand gestures as a way to simplify the control interfaces in a car. "So now I will be able to engage with my music system or my climate control without even having to touch anything? For government, there are going to have to be safety precautions considered with that," Hong said. "There has to be some policy impact."

4-D printing and self-assembly

The video from MIT's Self-Assembly Lab is not astonishing at first glance. A string of plastic-looking material about a foot long is immersed in water. In seconds, the object seizes up, contracts and reshapes itself into a new configuration.

It may not look like much, but the implications are profound. The technology here is known generically as 4-D printing, or self-assembly. Unlike 3-D printing, which has become increasingly common, 4-D printing incorporates the added dimension of time, producing objects that possess the ability to evolve their properties under changing conditions.

Researchers say it is akin to taking a simple flat cloth and programming

it to curve itself into complex three-dimensional shapes. The transformation might be triggered by water, or by heat, light or electrical current. While it isn't commercially available, lab tests have shown it is at least technically feasible.

The process requires specialized materials, many of which are currently being investigated. At Harvard's Wyss Institute for Biologically Inspired Engineering, for example, researchers are working with hydrogel ink, which can cause other objects to change shape when exposed to water or other environmental changes. Such materials could give us "self-evolving structures that transform into a predetermined shape ... which can stretch, fold and bend given environmental stimulus," according to *Nature*.

Government may find a range of uses for this capability, once scientists bring it to the point where it can deliver reliably at scale. What if roads that are subject to extreme temperatures could self-assemble at the molecular level to add new levels of resilience? And if so, could the same approach work in bridges and buildings?

"Imagine a sewer or water line that freezes and breaks or corrodes, something that can self-heal or expand based on increased capacity," said Daniel Castro, vice president at the Information Technology and Innovation Foundation. "You could build these different shapes on a very small scale and then when you bring it all together, you can build anything. That is the idea in principle."

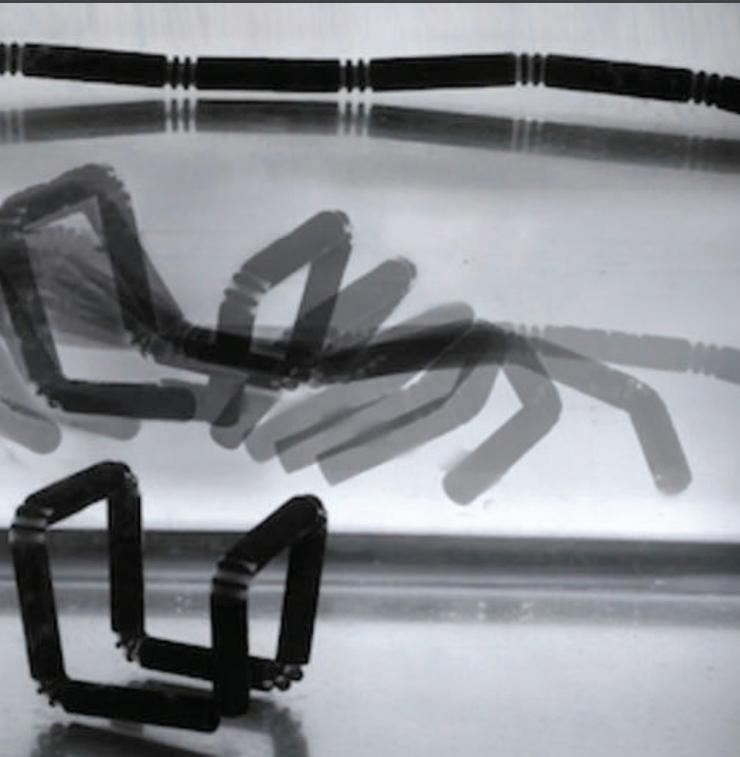
Such implementations may still be a ways down the road. While scientists are beginning to understand the physical parameters of self-assembly, they have not got it going on anything like a commercial scale. "The hardest part of any innovation is scaling it so you can use it in production and get costs down in meaningful ways," Castro said. "I don't think we are close to that yet."

Gene editing

Gene editing can sound like the stuff of sci-fi nightmares. Given the ability to selectively snip into the human genome, will we yield to the temptation to try to generate perfect little versions of ourselves? If we can dip into the genetic code, selectively editing for the traits we do or do not value, is that a Frankenstein scenario in the making?

Probably not. "While scientists are focusing on an array of applications in the areas of health, agriculture and environment, fighting disease and improving health in humans is a top priority for many," said Dr. Catherine Bliss, assistant professor in the University of California, San Francisco, Department of Social and Behavioral Sciences.

As the name suggests, gene editing is the process whereby scientists "cut and paste strands of DNA — actually inserting, removing and replacing them — to modify an organism's genetic code," Bliss said. In a 2015 summit, scientists



MIT

CONTINUED ON PAGE / 28

5 Steps to Secure Your Print Environment

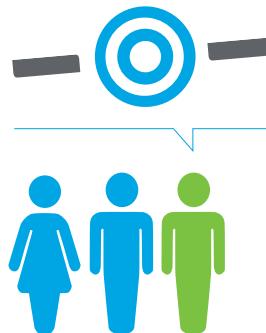
While government agencies work to combat evolving and sophisticated cyber threats to their networks, email systems and databases, they can't forget the risks associated with their print environment. In June 2016, CDG surveyed 178 government decision-makers to better understand threat levels, compliance and decision-making around print security.¹

Step 1: Align goals among key personnel

Having common security goals among decision-makers, including chief information officers (CIOs) and chief information security officers (CISOs), is an important factor in keeping data safe.



2/3
of CISOs say their priorities are **completely aligned** with the priorities of their CIO.



1/3
say they are **somewhat aligned**.

Step 2: Conduct a cybersecurity assessment



Only **35%** of executive-level respondents said they've **conducted a cybersecurity assessment** of their print environment.



37% found that their print environment is **more vulnerable** than other endpoints on the network.

Consider potential vulnerabilities such as printer configuration, data encryption and authentication.

1. The Center for Digital Government surveyed 178 state and local government IT officials in June 2016. The survey instrument was constructed in conjunction with HP, Inc. Responses were gathered from members of the *Government Technology* exchange community. All percentages noted are reflective of the survey results.

Step 3: Establish clear rules – and help staff follow them



51% of agencies have regulations around print security, but only



37% say staff are completely compliant.



The **No. 1** reason for non-compliance was **lack of awareness and training** around those regulations.

Top 3 consequences of non-compliance:

- | | | |
|----------|---------------------|-----|
| 1 | Disciplinary action | 51% |
| 2 | Legal ramifications | 45% |
| 3 | Negative publicity | 37% |

Step 4: Plan for the future



Only **47%** of agencies that have a cybersecurity plan include print security in their plans.

As technology evolves, so should the approach to print security.
Establish a long-term cybersecurity plan that considers the print environment.

Step 5: Turn to experts for help



63% of decision-makers say **vendors need to play an active role** in explaining risks and offering support.

Lean on vendors to provide expertise and innovative options to secure your print environment.

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from around the globe agreed to channel their efforts toward fighting disease.

With gene editing, scientists have been able to switch off the DNA that cause certain diseases. This kind of gene modification has been used to tackle leukemia in blood cells. Another emerging specialty, known as gene therapy, uses certain cells that can attack and kill unhealthy cancer cells. Research has shown that by enhancing what are known as T cells, they can reverse the effects of certain cancers. The T cells act as a drug and have proven effective in treating lymphoma and hemophilia in trials.

Gene editing still is largely a research project, but one with potential practical applications. The U.S. government funds research into medical uses, but how far will other nations go? "Will we create a race of smarter, faster, stronger people? Will some of us live substantially longer than others? Will [genetically modified] humans come to rule over non-GMOs, forcing them into a subservient under-class? These are but a few of the questions we must ask ourselves as we watch this technology develop," Bliss said.

For state and local governments, the more immediate impact of genetic tinkering will likely come on the economic front. As research support builds for gene editing, government labs, state universities and other public institutions may be uniquely poised to reap a financial benefit. As Bliss noted, San Francisco area authorities have fought hard to keep the region on the cutting edge of R&D investments, and it has proved a lucrative path. "So this is as much an economic matter for state and local governments as one of public health," she said.

In the longer term, state and local authorities may find themselves grappling with a host of ethical issues. Genetic editing in the food chain already is raising public concerns, and those voices will only amplify as practical implementations related to human health arise. "In the future, state and local governments may find themselves deliberating over policy regarding specific applications," Bliss said. "There isn't any policy — federal, state or local — thus far."



5G telecommunications

With 4G wireless communications less than 10 years old, it seems odd to be talking about replacing it. But it's happening with 5G, the emerging standard in voice and data telecommunications. "1G was analog, 2G was digital for higher-quality voice, 3G started to provide higher rates allowing for more data-oriented applications, 4G has allowed for the ongoing growth in mobile applications and video over mobile," said Bhaskar Krishnamachari, professor of Electrical Engineering and Computer Science and director of the Center for Cyber-Physical Systems and the Internet of Things at the USC Viterbi School of Engineering.

The 5G specs aim squarely at IoT, with an eye toward supporting the millions of sensors that scientists expect to see deployed in support of smart homes, smart buildings and smart cities. To do this, 5G will have to support far greater density of connected devices. "5G will also have to provide much lower end-to-end latencies than today's cellular networks," Krishnamachari said.

Krishnamachari's team is exploring the likely interactions of 5G-supported sensors in urban settings, where networks will need to handle data on

such diverse phenomena as traffic flows, air quality and noise pollution, disasters, security incidents, and crowds.

"5G will enable much greater capabilities across a wide range of problems," said Darrell M. West, vice president and director of governance studies at the Brookings Institution. "It will be faster, and there will also be more intelligent management of the network. You can have millions of sensors but you also need the means to deal with the flood of information that comes out of that. 5G includes much more advanced data analytics and network management."

While scientists understand the technology driving 5G, actual implementation remains a few years off, with likely rollouts beginning in the 2020 time frame. There are questions of spectrum allocation that need to be resolved, among other issues.

Local government will likely be called upon to play a part in any eventual deployment.

"5G will require many more antennas, and those antennas have to be hooked up to power and the rest of the Internet," said Doug Brake, telecom policy analyst at the Information Technology and Innovation Foundation. "Building out all the 5G equipment and connectivity will have to be a cooperative endeavor with local governments if it is to truly flourish."

Nanotechnology

One nanometer is one-billionth of a meter. How small is that? Well, a sheet of paper is about 100,000 nanometers thick. It can be hard to conceptualize on that scale, and yet engineering is happening there.

The United States National Nanotechnology Initiative cites examples, including nanotechnology-enabled catalysts that improve the combustion of methane to decrease greenhouse gas emissions, and nanosensors to detect things like moisture levels and diseases in food crops. Such sensors could help firefighters and soldiers by detecting toxins in the air.

Using sophisticated tools such as the scanning tunneling microscope and the atomic force microscope, nano-tech scientists are making inroads on a number of fronts. In health care, for instance, nanoparticles can seek

out tumors and deliver drugs. They can push the boundaries of DNA sequencing and perhaps enable tissue regeneration or advanced wound treatment.

In one recent article published on Phys.org, a science news service, scientists describe using a microscopic mechanical decoy to lure and destroy the influenza A virus. In a study on immune-compromised mice, the treatment cut the reduced influenza A mortality from 100 percent to 25 percent over 14 days. "Instead of blocking the virus, we mimicked its target — it's a completely novel approach," according to the lead researcher. "It is effective with influenza and we have reason to believe it will function with many other viruses. This could be therapeutic in cases where vaccine is not an option, such as exposure to an unanticipated strain, or with immune-compromised patients."

The implications of nanoscale technology go far beyond the medical realm.

Such products could bolster infrastructure, for example, by enhancing the performance, resiliency and longevity of steel, concrete, asphalt and other materials. Nanodevices could be embedded in the pavement to help drivers keep in their lanes, avoid collisions and adjust travel routes.

Some have raised concerns that nanorobots could be weaponized, deployed as an avenue of biomechanical error. But informed observers say the benefits will far outweigh the potential downsides. "By manipulating matter at the smallest elemental level you can impact its properties, changing its melting point, its permeability, its magnetic or chemical properties," said A.T. Kearney's Hong. In doing so, scientists may find new and better ways to attack disease, scrub the air of pollution or convert sunlight into usable energy. "All these can have profound implications." **gt**



Further toward the edge

The scholar Warren Bennis said: "The factory of the future will have only two employees, a man and a dog. The man will be there to feed the dog. The dog will be there to keep the man from touching the equipment."

The joke is that technology has outstripped even our own comprehension. Perhaps not yet, but it's easy to feel that way when one looks to the very furthest cutting edge of technology. Here are three examples of the amazing-made-real and what it will mean to us all.

Smartdust: A system of microscopic, interconnected devices rigged up with computing power,

sensing equipment, wireless radios and batteries, these clouds of dust particles could act as sensors to carry out simple tasks. The idea dates back several decades, but has moved closer to reality. In a recent paper published in *Nature Photonics*, scientists describe taking sharp images with a lens 120-millionths of a meter in diameter, the size of a grain of salt. This takes smartdust over a critical threshold, proving it is mechanically feasible to manufacture usable items on such a microscopic scale.

Passive Wi-Fi: Researchers at the University of Washington think they have hit on a solution to pow-

er drain in Wi-Fi equipment. Their passive Wi-Fi hardware can drive routers, mobile phones and tablets using only 10-50 microwatts, or 10,000 times less power than today's best technologies. To achieve its energy savings, passive Wi-Fi reflects signal through a process called "backscatter." While it won't fix all our charging woes — screens still suck electricity greedily — it could at least help to trim the battery drain of devices, a boon in terms of both convenience and cost.

Neuromorphic computing: Computers don't think like we do. Where they conduct their calculations in a linear sequence,

the brain is "fully interconnected, with each neuron connected to thousands of others," Nayef Al-Rodhan, a scholar of technology and geopolitics, wrote in the journal *Global Policy*. Neuromorphic computing seeks to apply that same architecture to computers. Resulting systems might be faster and more intuitive; they might learn and remember in new ways. "Some applications will include neuromorphic sensors in smartphones, smart cars and robots, or olfactory detection," Al-Rodhan wrote. "Neuromorphic technology could impact anything from consumer electronics to warfare."

Act Two:

GovTech

100

**Increased venture capital attention,
success stories and a viable exit lend
credence to the forward momentum
of the gov tech marketplace.**

A large, blurry black and white photograph occupies the left two-thirds of the page. It depicts a person sitting at a desk, facing away from the camera, looking at several computer monitors. The scene is out of focus, creating a sense of depth and activity.

By Paul W. Taylor, Chief Content Officer

#govtech is trending. Strongly.

It is an overnight success 30 years in the making. As our mast-head suggests, we have been covering the intersection of government and technology for more than three decades. So why the GovTech 100, and why now?

As we see it, technology in government has reached an inflection point. With states and localities themselves spending nearly \$100 billion annually on IT, the public sector has always been a massive consumer of technology and a major market for the companies serving them. But over the last several years there has been a fundamental shift in what was a surprisingly staid market. In fact, 2013 and the ignominy of HealthCare.gov will likely go down as the tipping point between the traditional government technology industrial complex and something entirely new.

Much of this shift is driven by developments in technology — from ubiquitous connectivity, mobility and the cloud to powerful data analytics. But importantly, these technologies have combined not only to create game-changing platforms like Google, Facebook and Uber, but have also fostered a generational renaissance in public activism under the label of civic

tech that's harnessed open data to hack the way government works.

The 2017 GovTech 100 stands on the shoulders of all of this. If civic tech is a movement, gov tech is a market; a growing portfolio of truly scalable, digital solutions addressing the tough, complicated problems that governments face, from health care and public finance to urban planning and public safety. It combines public-sector mission and private-sector entrepreneurship and innovation, bringing with it engineering prowess and financial resources otherwise unavailable to government. Gov tech companies differ from incumbent industry players in that their products and services are designed to solve problems specific to government, rather than treating government as a secondary market for products developed with the private sector in mind.

We launched the GovTech 100 to mark a uniquely disruptive moment in the evolution of technology and the relationship between public and private sectors. In his 2016 book *The Third Wave*, Steve Case, AOL co-founder and CEO turned investor sees government as the co-creator of a future as both regulator and customer. Case contends that what matters is not hardware and software but relationships as central to

What is a GovTech company?

A firm focused on providing solutions for state, local or federal governments, deriving the majority of their revenues from the public sector. GovTech companies can be categorized among four domains: Administration, Service Delivery, Civic Tech and Smart Infrastructure.

State and Local Government by the Numbers

confronting “all kinds of ... especially complicated ... new and novel challenges” rooted in the increasing ubiquity of the Internet in every part of our lives.

This evolving relationship between government, industry and technology holds the promise to change the way whole sectors — health care, education, human services, finance and agriculture — work, opening a first-of-its-kind opportunity for governments both small and large to harness powerful new tools that can dramatically improve public-sector outcomes, build more livable places, and let citizens engage more meaningfully in the governance of their communities.

Last year marked the inaugural GovTech 100 list, a foundational group of companies we felt embodied the essence of the space and a good starting place to understand a market lacking in the attention it deserves.

The list is meant to be representative, not comprehensive. These are not all the companies in the government technology market space, nor do they necessarily represent the biggest players. You won’t find companies like Microsoft here because government is only one of many market segments it serves and represents less than half of its annual revenues.

These players run the gamut of government technology, from the energy sector to data analytics to back-end administrative solutions to citizen engagement tools.

What is happening in the market?

2016 was a year of steady growth in the gov tech market. This included the merger of Granicus and GovDelivery and speculation of a possible future IPO for Accela. This year’s cohort attracted more than \$185 million in fresh investment with a growing number of new venture and private equity firms active in the space, evidenced by Warburg Pincus’ investment in NeoGov. Other recent entrants to the market include Vista Equity Partners, Ekistic Ventures and the Urban Innovation Fund, to name a few.

Stony Baptiste, co-founder of the venture capital firm Urban.us, is upbeat

in his assessment. “Certainly 2016 has been a great year for government technology, from the ... opportunity side, which is cities that are willing and wanting to adopt innovation — a few signals there, including the number of cities that have pursued or deployed open data strategies as one indicator, the number of cities that have shaped out innovation officer roles, and more broadly and maybe even more tellingly the number of customers and the size of deals that government technology companies have been able to pick up in the course of this last year.”

Baptiste said he saw plenty of reason this year to think that cities are increasingly eager to explore new technology as a means to solve problems. And there are new technologies to explore. More than 40 businesses are new to the list in 2017, representing a mix of the mature — like Cityworks, founded in 1986 — and the new — like ProudCity, which launched in 2016.

On the volatility side, one of the inaugural 100, SnapSense, failed and another, MySidewalk, lost its founder in early December. The publicly traded companies that have been serving the gov tech market for years produced mixed results in 2016. As we went to press, NIC (Nasdaq: EGOV), best known for self-funded state portals, ended the year up 29 percent while Taser (Nasdaq: TASR) slipped by about 5 percent and Tyler Technologies (NYSE: TYL) fell 17 percent for the year.

The 2017 list comes at a time of political transition after eight years of an activist Obama administration, the legacy of which includes financial and other supports for government modernization, including the General Services Administration’s 18F and the United States Digital Service, a startup at the White House. Both groups extended their reach to states and localities, which may have to look elsewhere for assistance on such matters under the new administration.

Things are looking less certain for 2017 on other fronts too. Some market-watchers have been speaking for years about the influx of cash into Silicon

24
states would rank
in the Fortune 100

Annual spending in state and local government:
\$3 Trillion

19M
employees
in state
and local
government

10k
IT vendors
doing
business
with
government

33k
IT-related
opportunities
in 2016

15,000
Statewide IT contracts
across the U.S.





Valley tech ventures and wondering whether it might be too much.

"People are cautious," said Julie Lein, managing partner of the Urban Innovation Fund. "There are a lot of people talking about the fact that there are so many growth-stage startups that haven't had liquidity."

Still, Lein remains bullish on the still-nascent gov tech space as the technology becomes ever more sophisticated, the challenges facing the public sector more complex, and the intention of government to address vexing problems for themselves — but not by themselves.

"I do think that for a long time when people saw challenges in their cities and communities, they expected cities or nonprofits to have solutions to those challenges," Lein said. "I think more and more, and especially over the last decade, people are starting to create solutions for themselves."

Her fund's first gov tech investment was in Valor Water Analytics, which earned a place on this year's list.

2017 brings a great deal of pent-up demand to gov tech. There are macro trends to be exploited in transportation and the electrical grid with continuing advancements in autonomous vehicles and

distributed energy generation. There are also the non-trivial challenges of implementing and managing body camera programs for law enforcement in the many cities that have promised them. At the micro level, voters worked their way through 162 statewide ballot measures in 2016, authorizing significant changes in, among other areas, marijuana, gun control, health care and the minimum wage.

Regulatory changes in these and other areas will create the need for software to handle things such as licensing, permitting, reporting and tracking.

There has also been persistent interest among investors and government in data services. The movement to open up government data — including a wave of data Web portals and publishing platforms from companies such as Socrata and OpenGov — has laid the foundation, many believe, for the commercial sector to unlock new value. Some of that data might be useful for improving performance, for example. Some of it might be useful for budgeting.

And some of the value might be unseen right now. Baptiste sees potential

Crunchbase Helps Power GovTech 100

New for the 2017 GovTech 100 is a partnership with Crunchbase, the startup database from TechCrunch that offers thousands of data points on gov tech firms through a channel dedicated to the industry. See "Gov Tech as a Business" on page 6 for more details on the alliance.

in machine learning, which involves crafting algorithms that become "smarter" over time as they handle more and more tasks, to draw new insights from government data.

"I think governments will be looking for opportunities to get some help for all of the data that they've opened up and collected and now they're scratching their heads and going,

'What was the point, beyond looking innovative?'" he said.

As chief innovation officer at e.Republic, the parent organization of *Government Technology*, Dustin Haisler is the creator and lead researcher of the GovTech 100. He shares Baptiste's enthusiasm for machine learning in government and sees a growing role for artificial intelligence as public services morph to meet public demand and fundamentally change the underlying cost structure.

"The abundance of open and closed data in government has led us to this pivotal moment, where a new technology, like artificial intelligence, can finally unlock new value that we can only begin to imagine," Haisler said. "AI just might be the killer app that government agencies have been looking to use on their data. The fraud detection firm Pondera's technology begins to hint at the exciting possibilities here."

As gov tech continues to mature, it will inevitably come to terms with other market dynamics. The early acquisition of market share, mergers, IPOs and (as importantly) business failures, represent both growth and some measure of correction as startups find their footing, or don't. And incumbent industry players may become the elephants in the room. The incumbents have a few options — compete from a position of financial strength, acquire to capture government-specific expertise and products, or adapt the Steve Case strategy and partner. 

Who's Investing?

Here are some of the investment groups working in the gov tech space.

- 1 / Andreessen Horowitz
- 2 / GovTech Fund
- 3 / Greylock Partners
- 4 / Motorola Solutions
- 5 / Omidyar Network

- 6 / O'Reilly AlphaTech Ventures
- 7 / Urban Innovation Fund
- 8 / UrbanUs
- 9 / Vista Equity Partners
- 10 / Warburg Pincus

Staff writer Ben Miller contributed to this story.

Category Key



Smart Infrastructure companies represent the infrastructure layer of government agencies, helping to maximize the operational capacity of physical assets and systems.



Service Delivery companies are the transaction layer of government and enable the processing of transactions, payments and logistics.



Civic Tech companies are the engagement layer of government agencies and support citizen self-services and engagement processes using technology.



Administration companies are the record layer or ledger of government, managing the flow of permissions, data and money.

2017 GovTech 100

Companies listed in orange type are making their first appearance on the GovTech 100.

Company Name	Category	Description	Website
Accela		Accela software helps government agencies automate transactions and service delivery in land management, asset management, licensing, and public health and safety.	accela.com
Aclara		Aclara supplies automated meter and smart grid infrastructure to water, gas and electric utilities.	aclara.com
AmigoCloud		AmigoCloud provides mobile GIS solutions to government.	amigocloud.com
Appallicious		Appallicious creates open data visualization products for government agencies on its proprietary platform.	appallicious.com
APPCityLife		APPCityLife provides an end-to-end platform for developing city- and agency-specific mobile apps.	appcitylife.com
ArchiveSocial		ArchiveSocial provides cloud-based social media archiving for records management, regulatory compliance and e-discovery. (Disclosure: The parent company of <i>Government Technology</i> is an investor in ArchiveSocial through e.Republic Ventures.)	archivesocial.com
Aunt Bertha		Aunt Bertha helps people find social services and education programs in their neighborhood by ZIP code.	aunthertha.com
Bidgely		Bidgely helps governments monitor and manage energy use.	bidgely.com
BlueLine Grid		BlueLine Grid helps first responders find each other and collaborate in the field.	bluelinegrid.com
Buildingeye		Buildingeye maps planning application data in cities, allowing planners, businesses and the public to see what is being planned in their area.	buildingeye.com
Cartegraph		Cartegraph offers mobile-enabled asset and operations management software to cities and counties.	cartegraph.com

Citizinvestor



citizinvestor.com

Citizinvestor is a **Civic Tech** platform used by government agencies to solicit investments directly from citizens for community projects. Civic Tech companies are the engagement layer of government agencies and support citizen self-services and engagement processes using technology. Historically, funding community projects would require government agencies to budget for them at least a year in advance, but Citizinvestor's online portal allows government agencies to create projects that can be easily funded mid-budget year, directly from citizens. It's the Kickstarter for Government.

Source: *Government Technology* & Crunchbase (2016)

Company Name	Category	Description	Website
CityBase		CityBase is a cloud platform that integrates data from multiple sources to develop citizen-facing portals and apps and optimize government operations.	the citybase.com
CityGrows		CityGrows offers collaboration and transparency software to help streamline government processes.	citygro.ws
Citymart		Citymart helps cities solve problems by connecting them with new ideas through open challenges that engage entrepreneurs and citizens.	citymart.com
CitySourced		CitySourced helps cities and utilities manage their assets, ensure regulatory compliance, improve safety and respond to customer requests.	citysourced.com

2017 GovTech 100 companies have raised **\$949,906,000** in venture capital

CityView		CityView's software helps drive efficiencies in local government business processes in departments including building, licensing, inspections and public works.	municipalsoftware.com
Cityworks (Azteca Systems)		Cityworks uses GIS data to help public-sector agencies manage physical and land-based assets.	cityworks.com
Cityzen		Cityzen works with government on targeted audience outreach.	cityzenpolls.com
Cityzenith		Cityzenith allows cities to see, manage and use the disparate data they hold through its proprietary platform.	cityzenith.com
CivicPlus		CivicPlus builds custom websites for city and county governments.	civicplus.com
Civic Resource Group (CRG)		CRG offers an augmented reality platform that governments use to help connect citizens to their communities.	civicresource.com
CivicActions		CivicActions uses open source tools and agile methodologies to help government develop digital platforms and large-scale software deployments.	civicactions.com
CivicSmart		CivicSmart provides smart city parking systems around the world.	civicsmart.com
ClearGov		ClearGov aggregates financial data on cities to help citizens and local officials understand and visualize how tax dollars are being spent compared to other jurisdictions.	cleargov.com
COBAN Technologies		COBAN Technologies manufactures and develops digital video systems for public safety agencies.	cobantech.com

2017 GovTech 100 companies have **332 investors**

Comcate		Comcate enables cross-agency information-sharing to help streamline processes and improve customer service.	comcate.com
Compology		Compology builds WasteOS, a dynamic routing system built around the unique needs of the waste industry.	compology.com
coUrbanize		coUrbanize provides an online marketplace for undervalued and abandoned urban real estate.	courbanize.com

Source: Government Technology & Crunchbase (2016)



Company Name	Category	Description	Website
Court Innovations Inc.		Court Innovations' Matterhorn platform enables self-service for resolving disputes and minor criminal cases entirely online.	courtinnovations.com
CrimeWatch		CrimeWatch is data-sharing software that law enforcement agencies use to access cross-jurisdictional information as well as simplify citizen communication efforts.	crimewatchus.com
CyPhy Works		CyPhy Works develops unmanned aerial vehicles for search-and-rescue missions and bridge inspections.	cyphworks.com
Department of Better Technology		The Department of Better Technology is a forms software platform to foster greater engagement and operational efficiency.	dobt.co
DigitalTown		DigitalTown's cloud-based smart city platform aims to boost local economic development efforts, improve government efficiency and drive citizen engagement.	digitaltown.com

2017 GovTech 100 companies that are publicly traded: **7**

EagleEye Intelligence		EagleEye Intelligence is a unified intelligence platform that combines and analyzes multiple data sources in complex public safety and security environments.	eagleeyeintelligence.com
ElectSolve		ElectSolve's uCentra platform integrates and manages utility meter data across multiple vendors.	electsolve.com
Engaged-Public		Engaged Public uses technology to distill complex public issues to engage the community, foster collaboration and elicit actionable feedback.	engagedpublic.com
Enigma		Enigma software allows governments to discover, surface, manage and analyze public data sources.	enigma.io
Esri		Esri provides a geospatial platform and related tools for public agencies.	esri.com
EvoGov		EvoGov provides CMS, e-government software and custom Web development to municipalities.	evogov.com
Fast Enterprises		Fast Enterprises provides off-the-shelf integrated tax processing software to government agencies.	fastenterprises.com
FiscalNote		FiscalNote applies artificial intelligence, big data and predictive analytics to help public agencies with decision-making.	fiscalnote.com

Average age of companies on the 2017 GovTech 100: **12.4**

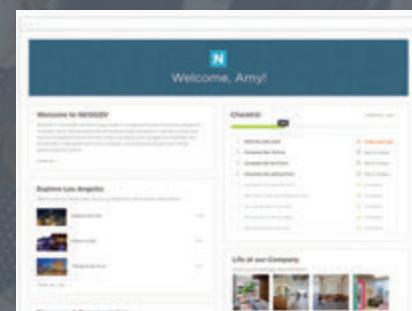
GovDelivery		GovDelivery manages email and other communications for public agencies. Its recent merger with Granicus suggests core services will expand to include agenda management and legislative transparency tools.	govdelivery.com
Govlist		Govlist helps local governments make better procurement decisions using automation, analytics, management and collaboration tools.	govlist.us
GovSense		GovSense is cloud-based permitting, licensing and financial software for state and local government.	govsense.com

Company Name	Category	Description	Website
Itron		Ittron offers technology and services focused on measuring and controlling energy and water use.	itron.com
Junar		Junar is a cloud-based open data platform used by government agencies to share the public data they hold.	junar.com
Mark43		Mark43 software allows police to collect, manage, analyze and share information.	mark43.com
Maximus		Maximus software and services help governments administer health, child, family and community development programs.	maximus.com
Meter Feeder		Meter Feeder allows people to pay parking meters from their smartphones and provides a platform for parking enforcement.	meterfeeder.com
MetroTech		MetroTech helps municipalities use data from video cameras and sensors to manage traffic.	metrotech-net.com
Munetrix		Munetrix provides tools for visualizing and using financial information from municipal governments.	munetrix.com
Municode		Municode provides legal, editorial and publishing services for managing city codes.	municode.com
mySidewalk		MySidewalk's platform allows cities to use aggregated demographic and socio-economic data in planning and operations.	mysidewalk.com
Neighborly		Neighborly curates opportunities for direct individual investments in public projects and civic infrastructures.	neighborly.com

NEOGOV

NeoGov is an **Administration** company that provides on-demand human resources software to automate the entire hiring, onboarding and performance evaluation process for government agencies. Administration companies are the record layer or ledger of government, managing the flow of permissions, data and money. NeoGov is cloud-based, making it simple for government agencies to set up, deploy and securely manage their human resources without the need for infrastructure and data safeguards.

neogov.com



Nextdoor		Nextdoor is a neighborhood-specific private social network.	nextdoor.com
NextRequest		NextRequest provides user-friendly FOIA and public records processing software for governments.	nextrequest.com

Source: Government Technology & Crunchbase (2016)

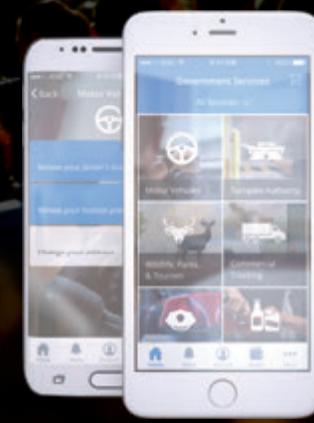


Company Name	Category	Description	Website
NIC		NIC develops and operates official government websites, mobile apps and secure payment processing for public-sector clients.	egov.com
One Concern		One Concern uses artificial intelligence to complete risk assessments and damage and loss estimations.	oneconcern.com
OpenCounter		OpenCounter helps new businesses obtain permits from city hall.	opencounter.com
OpenGov		OpenGov software allows interested parties to access, explore and share finance and budget information held by government.	opengov.com
Paladin Data Systems		Paladin Data Systems delivers hosted solutions that help agencies streamline community development, project management and employee development.	paladindata.com
Passport		Passport specializes in enterprise business applications and payments for parking and transportation.	passportinc.com

PayIt

mobilgov.com

PayIt is a company in the **Service Delivery** category that uses cloud-based technology to help government agencies take electronic payments through a Web or mobile interface. Service Delivery companies are the transaction layer of government and enable the processing of transactions, payments and logistics. PayIt is free for government and has built a business model around cost recovery using transaction fees, similar to what Square does for small businesses.



Periscope Holdings		Periscope provides procurement services to government.	periscopeholdings.com
PermitZone		PermitZone informs contractors if they need a permit and provides the ability to pull permits online from anywhere.	permitzone.com
PingThings		PingThings uses real-time big data tech and machine learning for physical systems to manage the electric utility grid and industrial assets.	pingthings.io
Pondera Solutions		Pondera helps public agencies use analytics to identify and remediate fraud, waste and abuse in large government programs.	ponderasolutions.com
PredPol		PredPol identifies the highest risk times and places for criminal activity in near real time.	predpol.com
ProudCity		ProudCity is a software company providing cities with websites and online government services.	proudcity.com

Source: Government Technology & Crunchbase (2016)

Company Name	Category	Description	Website
QScend Technologies		QScend Technologies provides Web-based services for municipalities, including CRM and website content management.	qscend.com
RapidSOS		RapidSOS uses technology to rethink emergency communications and is working on a platform to predict emergencies before they occur.	rapidsos.com
Recovers		Recovers provides a website for community-by-community disaster relief.	recovers.org
Remix		Remix allows city transit planners to see the cost, demographic and fiscal impact of proposed route changes.	remix.com
SceneDoc		SceneDoc is a mobile software solution for public safety data collection and retrieval.	scenedoc.com
Seabourne		Seabourne provides data integration, consolidation and visualization tools for the public sector.	seabourneinc.com
SeamlessDocs		SeamlessDocs converts PDFs and paper forms into fillable, e-signable, secure online digital forms.	seamlessdocs.com
SeeClickFix		SeeClickFix allows residents to report nonemergency neighborhood issues through its Web tool, which are then communicated to local governments.	seeclickfix.com
Seneca Systems		Seneca Systems' CRM for local government manages citizen requests and case work.	seneca.systems
Sidewalk Labs		Sidewalk Labs works with cities to build products that address urban problems.	sidewalkinc.com
SmartProcure		SmartProcure aggregates the purchase histories of public agencies.	smartprocure.us
Socrata		Socrata provides data discovery services for government.	socrata.com
SPIDR Tech		SPIDR Tech offers a community engagement platform that helps police departments serve their communities.	spidrtech.com
SpotCrime		SpotCrime makes public crime data available through a public-facing crime map and alerting service.	spotcrime.com

Number of companies formed after 2012: **28**

SST Inc.		SST develops gunshot detection and location technology to help reduce gun violence in cities.	shotspotter.com
StreetLight Data		StreetLight Data delivers geospatial business intelligence to support critical decisions and improve return on investment.	streetlightdata.com
TASER International		Taser provides electronic control devices to law enforcement and corrections agencies.	taser.com
TriTech Software Systems		TriTech provides computer assisted dispatch, records management and EMS billing.	tritech.com

Source: Government Technology & Crunchbase (2016)

Company Name	Category	Description	Website
Twenty First Century Utilities		Twenty First Century Utilities provides integrated energy management solutions through a model that aims to optimize the grid.	tfcutilities.com
Tyler Technologies		Tyler is a provider of end-to-end information management solutions and services for state and local governments, as well as school districts.	tylertech.com
Utilidata		Utilidata works with utilities to save energy, increase reliability and better detect grid anomalies.	utilidata.com



Valor Water Analytics

valorwater.com



Valor Water Analytics is a **Smart Infrastructure** company that uses a water utility's existing data to increase revenue, efficiency and customer satisfaction. Smart Infrastructure companies represent the infrastructure layer of government agencies, helping to maximize the operational capacity of physical assets and systems. Valor helps water utilities increase revenue using advanced data analytics to eliminate meter reading errors. Valor also helps utilities personalize conservation outreach campaigns using individualized targets.

VaultRMS



VaultRMS is a cloud-based technology platform for public safety agencies.

vaulrexposuretracker.com

Viewpoint



ViewPoint provides online permitting, licensing, inspections and code enforcement for local governments.

viewpoint.com

Vision Internet



Vision Internet builds custom websites for city and county governments.

visioninternet.com

Vizalytics Technology



Vizalytics creates insights from open data to provide customized intelligence for municipalities and government agencies.

vizalytics.com

WebQA



WebQA provides customer service systems and work management tools for municipalities.

webqa.com

WiredBlue



WiredBlue helps police departments connect with their communities and lets residents communicate with them securely.

wiredblue.co

Xcential Legislative Technologies



Xcential's software replaces paper-based rulemaking processes in legislatures and government regulatory agencies.

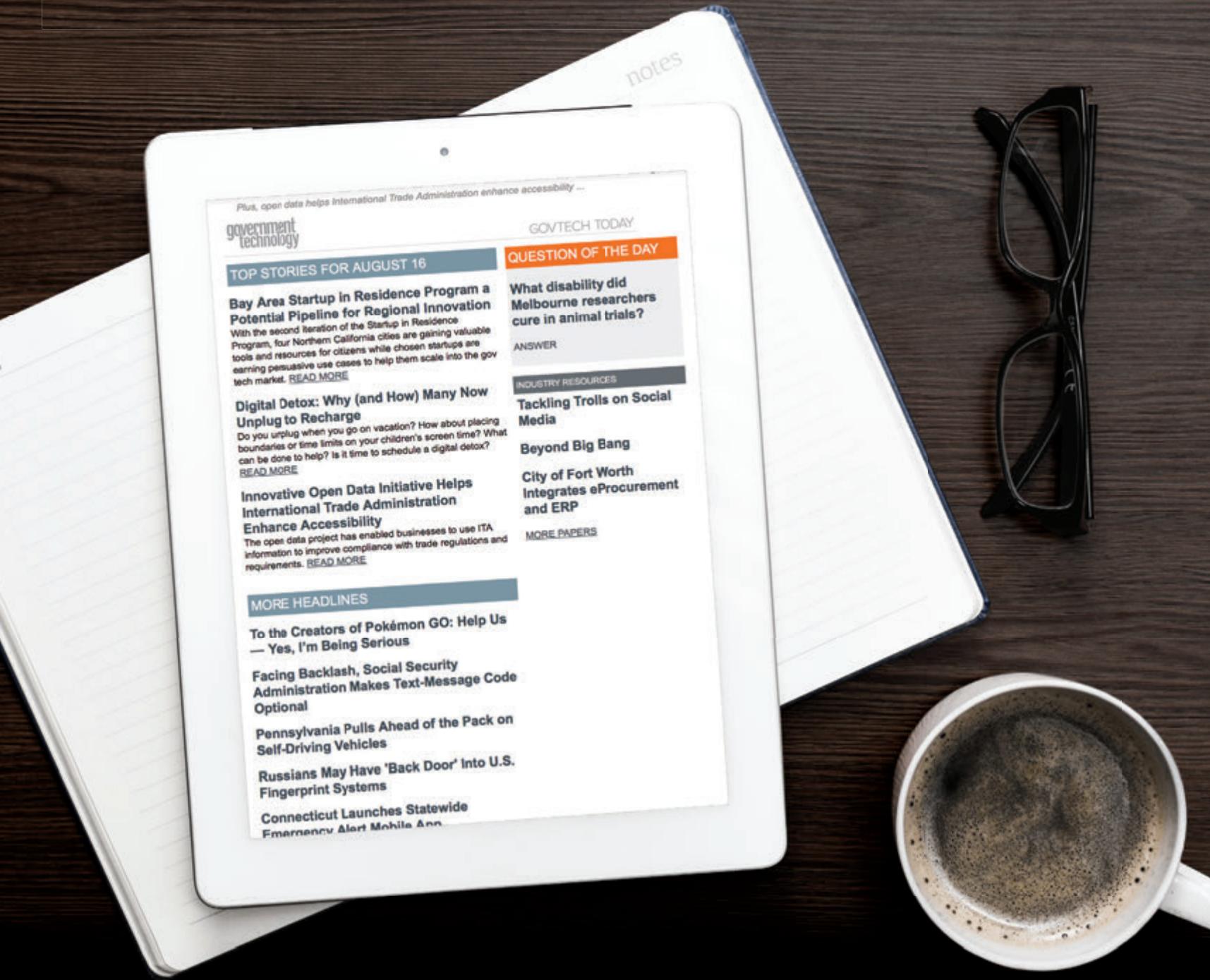
xcential.com

Source: Government Technology & Crunchbase (2016)

Take a closer look at the GovTech 100 companies at GovTech.com/100, now powered by Crunchbase.

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Platform Partner

Governments benefit from crowdsourcing platforms that let them consume as well as contribute data.

By Justine Brown // Contributing Writer

Esri and Waze announced recently that they're partnering to help local governments alleviate traffic congestion and analyze congestion patterns. Called the Connected Citizens Program, the program — which enables local governments that use the Esri ArcGIS platform to exchange publicly available traffic data with Waze — may represent a growing

trend in which citizens and government share data for the benefit of all.

Connecting Esri and Waze data will allow cities to easily share information about the conditions of their roads with drivers, while drivers anonymously report accidents, potholes and other road condition information back to the cities. Local governments can then merge that data into

their existing emergency dispatch and street maintenance systems.

Paige Fitzgerald, head of new business development and data acquisition for Waze, said the partnership was a natural evolution of work the company was already doing and a way to scale the arrangement given that so many governments around the world already use the Esri ArcGIS platform. According to Esri, about 40,000 clients currently use the company's database and mapping software, including ArcGIS, to manage a wide collection of city assets, ranging from sewers and electricity infrastructure to locations for planting trees. Waze currently has more than 65 million monthly active users worldwide.



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"The two-way data exchange was a model that had a lot of interest and a lot of demand from the public sector," said Fitzgerald. "Governments also wanted to use Waze as a platform to disseminate information about road closures because Waze reroutes drivers around those closures, so it reduces the associated congestion. We thought this partnership made a ton of sense for both parties."

Jams and Alerts

Through the Connected Citizens Program, Waze shares two main data sets with its government partners: jams and alerts.

"If a traffic jam report comes in via Waze, we send that data to our government partners," Fitzgerald said. "If they're

already signed up with Esri, that jam data goes directly into their ArcGIS platform and shows up on their existing maps."

If there's a major traffic jam in an unusual area, a traffic management center operator might be triggered to examine that area further. For example, Boston recently used Waze jam data to identify a couple of traffic-prone intersections in the Seaport District.

"In doing so, they recognized that they could adjust the signal timing at those particular intersections and then used our jam data to measure an 18 percent reduction in month-over-month congestion because of the signal timing adjustment," said Fitzgerald.

Similarly if a Waze user reports a crash, that information shows up on the city's existing ArcGIS map. City personnel can assess the crash and combine the Waze data with its existing data sets, if desired. The city can then notify emergency response, for example, to address the accident and send out emergency vehicles if necessary.

The partnership also has the potential to enable long-term traffic and congestion improvements by helping governments understand where crash-prone intersections and congested areas exist. Governments get more comprehensive data sets so that they can figure out exactly when, where and how to make infrastructure planning changes to alleviate those problems.

An IoT Alternative?

The Connected Citizens Program could also provide local governments an alternative to IoT investments, because a city can utilize real-time reports from the road rather than investing in sensors and infrastructure. The Kentucky Transportation Cabinet, for instance, uses data from the Connected Citizens Program in several ways, including to monitor and detect automobile accidents on its roadways.

"The Kentucky Transportation Cabinet likes to think of Waze data as millions of sensors within vehicles," Fitzgerald said. "Instead of investing in road sensors or embedded sensors, they get access to the data provided by Waze users who are out there contributing information whenever they open the application and are navigating with the app. So it's moving from a fixed infrastructure to a dynamic, crowd-sourced data infrastructure. It's an opportunity for government to utilize the data that users are already generating through Waze."

Johns Creek, Ga., is an early adopter of the Connected Citizens Program, whose alerts feed lets the city see what's happening on the roads before small problems become big problems, said GIS Manager Nick O'Day, adding that jam data provides his city a longer-term history of where traffic jams are occurring.

"It provides our engineers with better ideas of where we need to improve roadways," he said. "It also helps us provide a better level of citizen service with limited resources so we can have the most impact. It's data we could not have afforded to hire someone to go out and get for us."

Chris Lambert, systems consultant for the Kentucky Transportation Cabinet, said combining Waze data about accidents with his agency's own real-time traffic data enables them to detect incidents with much higher accuracy than if they depended on one data feed alone.

"We're also using Waze data during snow and ice events to create better situational awareness, as well as using it as an index of how well we're clearing the roadways," Lambert said. "As we see storms moving through the state, we're able to monitor Waze reports of 'ice on roadway,' which helps us deploy trucks sooner than we otherwise could have."

Last year, Kentucky also leveraged the Waze partnership to push out shelter locations to motorists stranded during a storm and worked with local Waze map editors when they had short notice on road closures.

"I've been able to contact the Waze community about a major event and they have responded within the hour saying the closures have been entered," he said, "so motorists get that data much more quickly."

Lambert said that overall, the relationship his agency has with both Esri and Waze through the Connected Citizens Program allows them to think differently about data, and he believes this type of data sharing between commuters and city/state government will be a growing trend.

"It's a new direction for our cabinet," Lambert said. "We're moving toward being data facilitators, not simply data creators or originators. Instead of spending tax dollars trying to reproduce apps and platforms, we want to partner with those apps/platforms and publish our data to them. We want to meet the public where they are, on the platforms of their choosing." 

cio central

This new feature will highlight career changes across tech-driven roles in government, showcasing who goes where and what impacts it may have for the public sector. See full reports and breaking news at govtech.com/people.

Longtime San Antonio CIO Heads to the Private Sector

It was announced in early October that longtime San Antonio Chief Information and Technology Officer **Hugh Miller** would be leaving city service for a job in the private sector. In an interdepartmental memo, City Manager Sheryl Sculley announced that Miller, who has been with the city since 2004, had accepted a position with a technology startup. Until a permanent replacement is found, Applications Division Assistant Director Kevin Goodwin will fill in as interim CTO.



JESSICA MULHOLLAND



San Francisco's CIO Moves to the Big Apple. In New York City's search for a new chief technology officer, it found a perfect match in San Francisco. The New York City Department of Information Technology and Telecommunications announced on Oct. 24 that **Miguel Gamiño Jr.** accepted its chief technology officer post, which was left vacant in August when Minerva Tantoco departed. Gamiño, who previously served as chief information and innovation officer for the city of El Paso, Texas, was named one of *Government Technology's* Top 25 Doers, Dreamers and Drivers in 2016.

CLARK COUNTY, NEV., CONFIRMS PERMANENT CIO

The board of commissioners in Clark County, Nev., ratified the permanent appointment of interim CIO **Michael Lane** on Dec. 6. Lane was first tapped to lead the county's IT department by County Manager Yolanda King on Nov. 18, just a week after the departure of former CIO Louis Carr Jr., who accepted a position with the Los Angeles Department of Water and Power.



Phoenix Names Digital Leader Its New CIO

After months of searching for retired CIO Debbie Cotton's replacement, Phoenix has made its selection, someone who has taken the city of Virginia Beach, Va., to new technological heights — including taking the top spot for its population category in the 2016 Digital Cities Survey.

The city announced Nov. 9 that **Matthew Arvay** will take over as its CIO the first week of January. During his time with Virginia Beach, Arvay worked to map the municipal government's five-year master plan and the six-year infrastructure modernization and life cycle master plan.

ARKANSAS CIO RESIGNS

Arkansas Department of Information Systems (DIS) Director and Chief Technology Officer **Mark Myers** submitted his resignation letter to the governor's office in November, signaling the beginning of a shift in the administration's IT approach. Myers, who was initially tapped to lead DIS by Gov. Asa Hutchinson in January 2015, was reportedly asked by the governor to resign on Nov. 23.

The agency's deputy director, Yessica Jones, is filling in as its interim director. Jones, who was appointed to the DIS deputy post in January 2016, formerly served as the governor's outreach liaison.

Colorado Appoints a Digital Transformation Officer

Several states now employ innovation officers or digital officers, but Colorado may be the first to bring on a digital transformation officer (DTO). On Nov. 2 the Colorado Governor's Office of Information Technology announced that **Brandon Williams** will become the state's first DTO. Williams led the state's Google Services team for the last four years. In his new role, Williams will work with state agencies to align user and customer experience with strategic business plans and ensure Colorado's public-facing websites and other digital touch points are efficient and easy to use.



Philly's Civic Tech Director Moves On.

Philadelphia Civic Tech Director

Aaron Ogle left his position with the city for a new opportunity, taking over a role with an organization that holds similar goals. Ogle now serves as director of product for the OpenGov Foundation, a civic tech group working to further transparency in state and local legislatures, and narrow the void between governments and their citizens.

In a tweet, Ogle expressed skepticism as to whether the city would replace him: "It's disappointing that I may be the last Director of #CivicTech."

CISO NAMED FOR CALIFORNIA

California appointed FireEye executive **Peter Liebert** as the state's chief information security officer, the governor's office announced in November. In the position, Liebert also will serve as director of the Office of Information Security within the California Department of Technology. The state had been without a

permanent CISO for about eight months, since Michele Robinson left the post in March.

Liebert will be leading an information security office in California that's changing and in transition. An unflattering statewide audit completed in 2015 found that many agencies and departments self-reported that they aren't fully compliant with existing cybersecurity procedures.

Transformation Officer to Boost Efficiency in Arkansas

Arkansas' first-ever chief transformation officer will work with agencies statewide to boost efficiency and improve the use of technology. **Amy Fecher** was appointed to the position Dec. 5 by Gov. Asa Hutchinson and will work concurrently as executive vice president of operations for the Arkansas Economic Development Commission. Fecher heads a department of one: a move aimed at dispelling notions of shrinking other areas of bureaucracy while simultaneously creating more of the same. "The governor felt it was important and shows ... if he's asking state agencies to find efficiencies, he wants to do the same and lead from the top down in that regard," she said.

FINITE FUNDING LEADS TO CHANGES IN INNOVATION OFFICES

Both of Long Beach, Calif.'s innovation leaders are moving on. The changes underscore a fluid innovation environment at the city predicated on a finite amount of funding: The \$3 million Bloomberg grant that established the i-team will run out at the end of 2017. After that, what happens at the city is uncertain — mostly, it will come down to what the City Council and mayor decide.

John Keisler, director of Long Beach's Bloomberg Philanthropies-funded i-team, is now head of the city's economic development department, while **Ryan Murray**, the mayor's innovation deputy, took a job with New York City, where he'll be working on procurement innovation.

The drying up of Bloomberg Philanthropies funding will be an issue for several cities in the next year. Long Beach was one of 12 that joined the program at the end of 2014, and all of them — from big cities like Los Angeles to smaller ones like Peoria, Ill. — signed onto the same three-year limit.

The New Silo Breaker

APIs are at the center of one county's e-government revitalization.

By David Raths / Contributing Writer

In Douglas County, Colo., an effort is underway, led by the elected county treasurer and assessor, to find better ways of sharing data both with the public and between government offices.

Beyond the transparency and open data efforts that many government entities are undertaking, the county, which sits between Denver and Colorado Springs, is putting an emphasis on application programming interfaces (APIs) between previously siloed software. In fact, it may be a good example of what *Government Technology* Chief Content Officer Paul Taylor identified as "government as an API" in his December 2015 column.

"Governments regularly consume public APIs, including those for mapping and payments," Taylor wrote. "They also provide private APIs to connect applications within the government ecosystem. Looking forward, government-provided public APIs play a key role in helping to complete the e-government experiment."

John Thompson, Douglas County's data services manager, said the county is looking at how to make its data more accessible and enable constituents to help the county build apps and software, and its IT leaders realized that APIs are a key building block. "One of the compelling reasons we decided to go with Socrata for an open data platform in the first place was because it had a role-level API for any piece of data we make available," he explained. "We approached it not from a transparency standpoint, but more as an



Douglas County, Colo.

IT entity. We want to make data machine-readable and as widely available as possible."

In terms of software procurement going forward, the API has surfaced as a top requirement, Thompson said. "We are looking at how we make government data available so a person can read it but also a machine can read it. Then it becomes more powerful," he explained. "Once we had that as our guiding principle, we started looking around. Open data made sense for us. Obviously it isn't going to work for everything we do in the county, but we still had that mindset."

In working with its legacy systems, the county has had to reverse-engineer databases and build its own extract, transform and load processes to create a data store. "Moving forward we don't want to go through the three layers of databases before we make data available,"

Thompson said. "We want to ask the vendor to just design it into their product."

Silos Within Silos

Lisa Frizzell, county assessor, said it's not unusual for somebody to contact her office but actually need to talk to County Treasurer Diane Holbert's office or vice versa. "It feels wrong and like we are providing poor customer service when we bounce people around," she said, "and that is just two offices. You can multiply that times 100, because we have the county offices and the municipalities within the county — they are their own silos and they have silos within their organizations."

Constituents don't know when they are crossing from unincorporated Douglas County into a municipality or into a water and sanitation district or a fire protection district. "Those invisible



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lines exist, and they impact constituents very heavily in their ability to get information,” she said. “We thought, wouldn’t it be great if we didn’t have to do this? If we can minimize how much they have to drill down to get the information they want, that is better for everybody.”

Frizell said that although the assessor’s office has always taken pride in making information readily available on its website, layering data from several sources holds more potential. “The real benefit is that you are not just looking at assessor information,” she said. “You can layer building permits on top of assessor information. You can layer demographic information on top of that.” Frizell referenced a project in Seattle that is combining demographic, real-estate sales and property valuation information to create affordability indexes so

“We approached it not from a transparency standpoint, but more as an IT entity. We want to make data machine-readable and as widely available as possible.”

the city can be more strategic about where it invests in affordable housing.

Traffic and Construction Notification

Traffic and road construction have been identified as major complaints of Douglas County citizens. “We were presented with the problem of surfacing road construction news for the public in a way that makes it easy for them to get to and understand,” Thompson said.

The first step was looking at how the county traditionally gathered and made this data available. “We found it was put in a spreadsheet, and then people were making a map and posting online a PDF of the map,” he added. They automated that process to allow the individuals working on those projects to enter it with a mapping component built in and populate NearMeDC (a free online tool) and Socrata Open Data.

The county also entered into a two-way data-sharing partnership with the real-time navigation app Waze. It provides the fastest routes based on current driving conditions and data from users. It also provides Douglas County residents with details about current traffic impacts and construction projects.

“If we have a road closure, Waze will dynamically route users around that issue,” Thompson said, adding that Douglas County is building the infrastructure to capture Waze information for tactical use. The Waze reports often happen faster than a 911 call or a report to agencies. “We are incorporating them into our emergency operations center feed so that we can respond faster,” he said. “We are looking at how to make the data available in case we have a natural disaster, such

as a forest fire. We can have this super-salient information in real time.”

By working to include data from the cities of Castle Rock, Parker and Lone Tree, the county now can make available a comprehensive set of data on current and upcoming construction. “We have this data set that is API-accessible,” Thompson said, “and South Metro Fire Rescue Department is looking to plug that data into its routing software to avoid sending a fire truck through a construction zone, because that takes extra time. Pre-emptively rerouting a truck during a fire incident could save time and save lives.”

Additionally the county and cities sometimes do construction work in adjoining neighborhoods. The county is working on a prototype of a visualization tool using the APIs to show the planned and current projects and the entry and exit points of all the neighborhoods. If a community is going to be disproportionately impacted by construction, projects can be rescheduled.

Holbert said efforts such as the one in Douglas County involve nurturing relationships with partners in the municipalities. She said it also requires leadership, and not just from IT. “We don’t want to be patting ourselves on the back. We recognize this is a journey. We need to continually look at how to make our products better and make ourselves more relevant to the citizens of Douglas County.”

“You hear the buzzword ‘smart city,’” Thompson said. “We see this as making that vision a reality. We are using data in a smart manner to do the things we need to do as a government, but in a way that is not disproportionately impacting citizens.” **gt**

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Rethinking the Back End

Serverless computing is a growing trend. Here's what you need to know.

Cloud computing is about to hit its tween years, but spinning up virtual machines to install MySQL, Oracle or SQL Server to launch a new application is starting to seem a bit like yesterday's technology.

What's the problem?

From the beginning, public, private and hybrid clouds offered scalability on demand and the quick setup of virtual servers that may be physically a continent away. Nevertheless, maintaining the software stack on those virtual servers has become a complex, time-consuming and expensive chore that developers and system administrators must (painfully) manage.

Enter "serverless computing." While we will likely have servers for decades to come, serverless computing adds another layer of abstraction on top of existing cloud infrastructure.

Why now? Serverless computing allows developers to upload snippets of code, maintained independently, that are called into action at runtime. This setup allows

a true platform-as-a-service environment, letting developers focus on coding rather than back-end operations.

This relatively new terminology, which some call "back end as a service," may seem like a subtle data center architecture change that only geeks really care about, but the benefits are real. By using serverless architectures, cloud

platforms may finally reach the original goal of becoming abstracted and automated enough to deliver on the promise of reducing data center operations staff.

Examples, Please

Amazon is generally credited with starting the serverless compute trend with its AWS Lambda offering. "AWS Lambda lets you run code without provisioning or managing servers," according to the company. "You pay only for the compute time you consume — there is no charge when your code is not running."

Google, meanwhile, launched an AWS competitor called Cloud Functions. Google describes Cloud Functions as "a fully managed, serverless environment in which we handle the servers, operating systems and runtime environments, and you focus on building great solutions."

Not to be outdone, IBM developed OpenWhisk, which is described this way on the company's website: "OpenWhisk is a cloud-first distributed event-based programming service. It represents an event-action platform that allows you to execute code in response to an event. OpenWhisk provides you with a serverless deployment and operations model hiding infrastructural complexity and allowing you to simply provide the code you want us to execute."

Benefits and Problems

The overall goal of doing more with less with cloud computing has always been just a bit behind the "hands-free" promises. Like

our current journey toward autonomous cars, the reality of administering cloud resources continues to bring an array of issues and pragmatic surprises.

While far from our final cloud utopian destination, serverless computing can provide the next generation of tools and support to enable enterprises to do more with less operational staff.

What are the tradeoffs? Serverless computing does bring vendor dependencies and a further loss of control for your internal teams. You will be relying more on your vendor partners for administrative functions, security and more. This reality can be a good thing or irritate some staff. The immaturity of supporting services can also raise concerns for some technology professionals.

Nevertheless, with more data being moved into the cloud every day, I expect to see a growing number of governments migrate to serverless architectures in 2017. I also expect the leading industry partners to further develop their cloud offerings to provide more options and better performance.

Just as the clouds in the sky change shape, most government cloud infrastructures continue to evolve to arrive at the "bleeding edge" over time.

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AN ALTERNATIVE APPROACH TO MODERNIZATION:

IT APPLIANCES OFFER
A VIABLE PATH TO
CONSOLIDATION AND
COST SAVINGS

HIGH-PERFORMANCE BUNDLES OF HARDWARE AND SOFTWARE OFFER A MODERN ALTERNATIVE TO LEGACY SYSTEMS WHILE ADDRESSING PUBLIC SECTOR CONCERNS ABOUT MOVING SENSITIVE DATA OFFSITE.

More than one million metropolitan Boston-area residents rely on the Massachusetts Bay Transportation Authority (MBTA) to get to work, school or leisure activities each day. Coordinating all the buses, subways and trains requires a Herculean behind-the-scenes effort, supported by a wide range of technologies. Unfortunately, one of the MBTA's most important assets — a proprietary software and database used to track ridership, account for fare payments and generate reports for regulators — was showing signs of age.

"Regulatory reporting is one of the most critical activities — the reports have to be submitted on time and accurate," says Gary Foster, CIO for the Massachusetts Department of Transportation and the MBTA.

The legacy software and outdated hardware that supported it was keeping the MBTA from efficiently meeting this essential reporting requirement, let alone addressing a growing list of new demands.

"We were in a bind," Foster recalls. "The reports were taking days to run. We'd kick off a report, go home for the weekend, and we hoped when we came back on Monday the job had finished."

The answer was an IT "state of good repair" project, and some organizations facing this prospect might naturally look to the cloud for a relatively easy solution. After all, this trendy approach minimizes upfront capital investments for hardware and software and lets service providers handle much of the heavy lifting associated with implementation and ongoing maintenance.

But the cloud wasn't an option for the MBTA. For one, the legacy application wasn't designed to run in an offsite delivery model. And due to security

and compliance concerns, MBTA officials wanted to keep the sensitive data associated with the system safely within the agency's private network.

Fortunately, Foster and the team found another, equally modern alternative — an IT appliance that offered high performance and flexibility similar to cloud platforms. These integrated systems are packed with high-end computing power and management software, plus all the necessary storage and networking resources to serve large-scale enterprise needs. The option Foster chose also includes the latest version of a leading database program.

The choice paid off. Reports that used to take 2 days with the old system are completed in 15 minutes or less. "The project has been a success," Foster says.

MBTA's legacy challenge isn't unusual. CIOs across state and local governments are being pressured to add new services and modernize IT operations — all without seeing significant increases in their budgets. This requires them to find new ways to increase efficiency and reduce costs. Similar pressures are impacting CIOs in commercial industry, who often respond by increasing their commitment to clouds. But that option isn't always available in the public sector. Regulatory hurdles and other issues unique to state and local government keep sensitive data and many core applications tucked within onsite data centers.

Integrated systems, such as the database appliance the MBTA chose,

promise plug-and-play access to high-performing resources that help agencies reap the benefits of data center consolidation, along with associated savings in capital and operating budgets. And initially, at least, that's accurate. A skilled IT staff can typically get the boxes running successfully in a day or less. But from there, implementation challenges may arise, if, for example, the organization uses an appliance to replace legacy hardware and must reformat and transfer large volumes of data from the old system. In those cases, public sector CIOs often must tap the expertise of system integrators with a track record in government IT projects.



This paper explains database appliances in detail, discusses how they address the biggest IT imperatives in state and local government, and offers the insights of public sector officials who have reengineered their IT operations with the help of these innovative systems.



INTEGRATED SYSTEMS GAIN STEAM

In a recent report, the analyst firm Gartner noted that integrated systems are gaining traction in many types of industries. “As organizations seek to modernize and consolidate legacy data center infrastructure, the appeal of integrated systems is high, as these technologies are able to coexist with existing systems and integrate increasingly with the use of external cloud services,” the authors noted.¹

The report added that the integrated system market is outgrowing other data center segments, with sales in 2015 rising to \$9.6 billion, or 11.2 percent higher than in the previous year.

One subset of the integrated systems market is what Gartner calls integrated stack systems (ISSs), which add application software to the mix of hardware and software capabilities found in other designs. ISSs such as MBTA’s choice – the Oracle Database Appliance (ODA) – address many key challenges that CIOs in state and local government face.

CHALLENGE:

CIOs must find ways to reduce existing costs and manage available funding to pay for upgrades and modernization projects.

How appliances help: Because integrated systems arrive already optimized and tested by the vendor, a minimum of internal IT resources are required to deploy, maintain and support the platforms. In addition, the systems can help reduce capital and operational expenses by enabling CIOs to consolidate databases running on separate systems within a single or smaller number of appliances.

These cost savings can be significant, according to the consulting firm Wikibon. It compared the cost of an ODA to a more traditional approach where an IT department buys all the hardware and software components separately and performs all the integration work. It estimated that the three-year cost of the roll-out-your-own approach would be 260 percent higher than using a solution such as ODA.² The savings were tied in part to lower database license and maintenance costs from consolidating the number of processor cores.

“Customers evaluating the business case for ODA should view the degree to which the CAPEX costs can be offset by lower administration costs and reduced ongoing operating expenses,” the Wikibon analysts noted. “The so-called ‘soft dollar’ benefits of using an appliance like ODA include faster time to deploy applications which, depending on application value, can be significant.”

CHALLENGE:

New and additional service demands by business users.

How appliances help: CIOs can get more computing power and efficiency by running the latest versions of hardware and software provided by integrated systems. Also, by consolidating multiple databases within the same platform, IT managers can create a large pool of resources that end users can draw on as their demands grow.

CHALLENGE:

Implementation and maintenance of legacy systems strain internal IT resources.

How appliances help: The management software included in leading database appliances automates many of the management duties that can sap the time of database administrators. Relieving personnel of these routine tasks means they can devote their skills to more strategic projects, such as designing new applications for expanding citizen services.

CHALLENGE:

Agencies need a path to hybrid clouds in case that becomes a viable option in the future.

How appliances help: While some government organizations choose IT appliances over cloud for specific use cases, many agencies still want to keep the cloud option open for the future. Appliances offer a stepping stone to cloud, especially for CIOs who choose a hybrid approach that pairs their data centers with public cloud resources. Leading vendors use the same software in their appliances and their cloud services, so CIOs can easily transfer data between on-premises and offsite locations.

INSIDE A DATABASE APPLIANCE

The hardware and software included within integrated systems are pre-tested and optimized for high performance. For example, the Oracle Database Appliance X6-2L offers:



Database software:
Oracle Database Enterprise Edition
or Standard Edition

High-performance computing power:
two 10-core Intel Xeon processors

Network connectivity:
10GBase-T and 10GbE SFP+fabric

Solid-state storage:
9 TB of high-bandwidth NVMe flash-drive capacity, expandable to 29 TB

Management software:
Oracle Appliance Manager for provisioning,
patching and system diagnostics



TIME TO ACT

Foster says the MBTA's legacy system experienced significant performance problems caused by proprietary software. The only option MBTA had was to leverage hardware to improve the application performance. The database application supported a variety of activities, including producing various reports that had to be filed with the U.S. Federal Transportation Authority (FTA).

"We couldn't add any more CPU or memory to the legacy system," he says. "So we really didn't have a lot of choice in terms of solving the problem."

The question was, should the agency upgrade to a newer version of the same dated hardware platform at a higher cost or look at other options? "We chose the ODA option," Foster says.

Foster and his staff considered other integrated system options, but settled on ODAs because they were tuned to run the MBTA's database of choice, also from Oracle. "Now, with 72 CPUs and significant throughput capability, the system provides the database performance required," he says.

The task of moving over 5 terabytes of data and integrating with the application services took months and the expertise of Mythics, a systems integrator that specializes in Oracle solutions.

"We didn't have much trouble with the physical infrastructure or getting the technology stack running. On a complex, technical, performance-oriented project like this, we certainly needed to have a team with the specific skills required to get it right," Foster adds.

The project launched in February 2016 and the bulk of the migration work was completed by June. “Then the team focused on testing the performance, quality, data accuracy and systems integration required to enable a production launch in mid-August,” says Casey Miles, MBTA’s project manager.

One of the more complex aspects of the project was moving the data from the older Oracle database the MBTA had been running to the latest edition — a jump of about five versions. An added challenge was addressing the impact of running the application on the newer server platform with the latest generation of processors. “We had to do data conversion and data migration at the same time, which was a challenge considering the amount of information we were dealing with,” Miles says.

In addition to the technical hurdles, Foster and his staff faced some practical considerations, namely how to avoid any production downtime when switching to the new platform. “This is a mission-critical system that has to run 24/7,” Foster says. “MBTA’s fare collection system allows people to pay

their fares and purchase our fare products. One of the biggest challenges was coming up with a solution that allowed us to migrate in a short amount of time to not impact the customer experience of a million-plus riders. Mythics was front and center on that data conversion and helping us create and execute the migration plan.”

The switchover came as scheduled last August and thanks to extensive upfront planning, in-depth testing of the application and software, and a deep bench of third-party technical expertise, the transition was glitch free. In the months since the go-live date, MBTA has seen a number of improvements.

The ability to run more reports and finish them faster provides better service for internal department heads and compliance officers. “We’ve resolved a lot of angst around our former struggles to get information out of the system,” Foster says. The agency is more confident about maintaining service levels thanks to new primary and secondary appliances and the speed with which it can move to the backup system if a disruption occurs. “We dramatically reduced the time it takes to make the transition from primary to secondary resources,” Miles says.

The new platform also ensures the department fully meets the stringent security requirements spelled out by the payment card industry, an important point for riders who don’t use cash.

Finally, the IT department spends less time maintaining and supporting an end-of-useful-life legacy system.

HOW TO KNOW IF YOU NEED AN IT APPLIANCE

If the following checklist accurately describes problems in your data center, an integrated system may be the right solution.

-  Are you under pressure to reduce IT spend while maintaining or increasing service level agreements?
-  Do you run multiple instances of the same database in your environment? If so, will consolidating them save on licensing and other expenses?
-  Do you lack the IT staff and specialization to build and manage the existing data management infrastructure?
-  Are you looking to speed time to deployment for your database solutions?
-  Do you feel you have a data security risk due to delays in patching database servers?
-  Do you desire a more cost-effective disaster recovery solution?



APPLIANCES PROVIDE A BRIDGE TO THE FUTURE

Database appliances deliver on their promise to provide CIOs with high-end hardware, software and applications without the installation hassles of traditional systems. But when they are a foundation for migrations away from legacy platforms, IT departments face an array of complex data conversion and transformation challenges. However, with a comprehensive transition plan in place, along with the technical expertise of a seasoned systems integrator, agencies can shrug off the problems of the past and deliver modern government services.

IMPLEMENTATION BEST PRACTICES

IT appliances offer a solid foundation for data center modernization, but a range of related challenges mean government CIOs need an implementation strategy that will help them get the most out of the appliance as quickly as possible. These five steps can get you started in the right direction.

- 1 Assess your current environment for upgrade and consolidation opportunities.** Identify core applications and hardware that are nearing the end of their useful life or whose licenses are approaching expiration. Evaluate potential savings and efficiencies available from IT appliances versus simply upgrading to newer versions of existing resources. Assessments should weigh whether application consolidation is an option. Reducing the number of discrete servers and software licenses by moving them to an appliance can save in both capital and operations expenses.
- 2 Partner with a systems integrator with a solid track record in IT appliances and integrated systems.** Moving legacy systems and large volumes of data to a new platform requires sophisticated technical skills. Internal IT personnel may not have sufficient expertise or the time to devote their full attention to a complex upgrade project. For these reasons, IT leaders advise using an experienced systems integrator to help with large-scale efforts. “Moving from one platform to another requires a solid team of systems engineers who can really drill into the details,” Foster says. “In the public sector, these skills aren’t always available in house.”
- 3 Take advantage of cooperative purchasing agreements.** For example, the National Intergovernmental Purchasing Alliance’s The Cooperative Purchasing Network (TCPN)³ consolidates the buying power of governmental and educational entities for commonly purchased products and services. Systems integrators, among others, can offer reduced costs and require less paperwork for IT solutions, including integrated appliances.⁴
- 4 Pre-implementation testing helps ensure success.** To ensure all data migration and upgrades were carried out successfully, the team of specialists created an extensive test lab at MBTA to simulate the production environment and help staff identify problems before going live. For accuracy, the lab mirrored the relevant MBTA operations as closely as possible, from software, servers and network switches to the backend equipment and fare vending machines found in MBTA stations. The team tested all the disaster scenarios it could think of, and took steps to thwart them. “This gave us a safe environment where we could test and perform dry runs to not only find problems but to also see how we could make things run more efficiently,” Miles says. “The test lab enabled us to assure the quality and accuracy of the new platform.”
- 5 Be alert to cultural issues.** People problems can arise when longtime staff members resist change and grapple with new technology. In addition to bringing in a systems integrator for help, Foster hired what he calls “database performance gurus” and dedicated Miles to lead the project. “We built an all-star team that made sure everything lined up properly,” Foster says. Post-implementation, CIOs should also pay particular attention to the operations team, which is responsible for supporting the appliances. This may require them to hone their technical skills. Keeping systems integrators and vendors involved after implementation will smooth the transition and augment any skill gaps that arise before internal team members become comfortable with the new platform.

This piece was developed by the Center for Digital Government custom media division, with information and input from Mythics.

Endnotes

1. "Magic Quadrant for Integrated Systems," November 2016
<https://www.gartner.com/doc/reprints?id=1-3E3UTV&ct=160804&st=sb>
2. <http://www.oracle.com/us/products/database/database-appliance/wikibon-database-appliance-wp-2866503.pdf>
3. <http://www.nationalipa.org/Pages/default.aspx>
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Moving Beyond Intuition

States need to embrace data-driven education.

When it comes to education, we are living in the dark ages. Even as the technology-driven march of progress continues to reshape industries from automakers to financial service providers, the forces of innovation come to a screeching halt at the doors of most schools. Instead of using data to personalize instruction, most educators adopt a one-size-fits-all strategy that fails all but the most “average” child. Instead of using analytics to make schools more efficient, school administrators rely on intuition. And instead of implementing evidenced-based education policy, school boards merely follow tradition. As the Center for Data Innovation has written in a recent report, this needs to change, and making this change will require states to bring a new level of technological sophistication to their school systems.

Many parents, educators and policymakers have adopted an instinctual aversion to attempts to create a more data-driven education system. Much of this opposition is fueled by the assumption that increased reliance on data will simply drive

educators to focus on helping students succeed at testing rather than at learning. In reality, data-driven education might be the very cure that schools need to avoid teaching to the test by eliminating high-stakes annual testing in favor of routine assessments of whether students have mastered specific concepts.

Daniel Castro is the vice president of the Information Technology and Innovation Foundation (ITIF) and director of the Center for Data Innovation. Before joining ITIF, he worked at the Government Accountability Office where he audited IT security and management controls.

But in a world where data-driven education is falsely equated with politically fraught programs like No Child Left Behind or Common Core, it is no surprise that all but the most courageous policymakers steer clear of these important initiatives. Instead, they are more likely to propose additional student data privacy rules, a typically meaningless gesture given existing rules, but one that erects additional barriers to collecting and using data in the classroom.

This should not be the case. After all, measuring a student’s academic progress with valid, reliable data should go hand-in-hand with providing that child an education. How can educators help students succeed if they do not know where they are struggling, where they are thriving and how they learn? While there is growing awareness that health care needs to be moving into a world of personalized medicine, where doctors treat patients based on how their individual genetics, lifestyle and environment shape their disease risk factors, few recognize the importance of creating an education system similarly designed to meet the unique needs of every child. And beyond personalized instruction, an increased used of data would enable schools to become more efficient and accountable.

Achieving this type of transformation will require schools to integrate new technologies, processes and training. Given that it has taken tens of billions of dollars in funds to incentivize doctors to adopt electronic health records and train them in how to use the technology, we

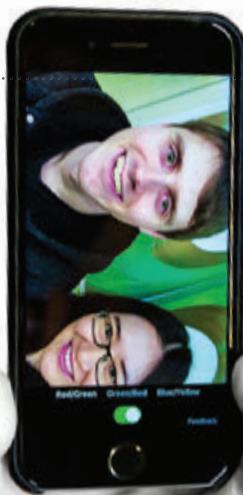
should not expect to see a similar change in schools without a serious commitment of funding. While the federal government has provided grants for the development of statewide longitudinal data systems for student information, schools still need to adopt learning management systems to facilitate student instruction and assessment; backend databases to store the massive volume of data produced by these digital learning tools; and the front-end systems necessary to provide students, teachers, parents and administrators access to the relevant information.

Some states have been more ambitious than others about transforming their education system to better use data, but no state can do this alone. While states are going to be responsible for creating the tech infrastructure for data-driven education, it is the private sector that will ultimately develop many of the analytical tools that will make use of all the data. But these markets will only thrive with scale, which means states need to coordinate their efforts so that data collected in one state is compatible with data collected in another.

Education is due for a renaissance. If the future of education requires data, then state technology leaders will need to play a greater role in improving education. While this transition will not occur overnight, states should begin to look closely at how they can lay the foundation for greater use of data in education by modernizing their information systems, establishing national education data standards and changing the culture around data in the classroom. **gt**

DIGITAL PRESERVATION ▶

To ensure that detailed information is available about all of Earth's creatures, scientists are using the Beastcam to capture high-resolution, full-color 3-D models of living organisms. Based out of the University of Massachusetts at Amherst, the Digital Life nonprofit initiative is partnering with scientists, zoos and nongovernmental organizations to access a wide variety of animals, with the end goal of documenting every living thing on the planet. The 3-D models are available for free online, with a handful already posted including the blacktip shark, emperor scorpion and birch fungus. SOURCE: TREEHUGGER.COM



SCOTT EKLUND/RED BOX PICTURES



DIGITALIFE3D.COM

◀ **Color Corrector.** The colorblind have a new and easily accessible tech tool to help them see the contrast in different colors. Developed during a hackathon by two Microsoft engineers, the Color Binoculars app uses an iPhone's camera to apply a filter to live images to increase the contrast between colors or adjust the image, making the colors easier to distinguish. One of the developers, who struggles with red and green, said the app helps him determine when food is cooked based on the changing colors.

SOURCE: FAST COMPANY

Taking Flight

The future of streetlights may be less static. A new concept by UK insurer Direct Line would use drones to provide lighting on demand. Similar to ride-hailing services like Uber, users make a request for lighting via a mobile app and the Fleetlights travel to the needed location. The concept could help search-and-rescue teams or people who walk home from work in the dark.

While Fleetlights isn't planned for commercial development, the drones have been tested in Petworth, which has one of the most dangerous (and dark) roads in the United Kingdom. The tech was built on an open source platform so developers can continue to build on the concept.

SOURCE: NEW ATLAS

8 YARDS

The length of a new outdoor vacuum that aims to clean the air. Dutch inventors unveiled the device in October, saying it can suck in air from over four miles and treat 800,000 cubic meters of air per hour, filtering out 100 percent of fine particles and 95 percent of ultrafine particles. Classified as carcinogenic by the World Health Organization, fine particles are caused by emissions and industrial combustion. The system, made by the Envinity Group, could be installed on top of buildings to help purify the air in large cities.

SOURCE: PHYS.ORG



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Setting Social Precedent

Why most government social media policies suck.

I have read hundreds of city and county government social media policies, and it amazes me how common two major problems are: The policy is either way too sparse and skimps on some of the bases it should cover, or it's too convoluted and incomprehensible for the average employee or citizen.

As someone who has been in the government social media space since cities started creating profiles on social platforms a decade ago, I've seen up close what works and what can go terribly wrong.

Many government agencies want to get a policy in place quickly, but are not particularly confident that it is comprehensive enough. We ran a competition last year at the Government Social Media Conference to find the top government social media policies in the nation. Despite dozens of entries in our other competition categories related to social media content, can you guess how many agencies were confident enough to enter their social policy? Only three in the entire country. We actually had

to eliminate that category due to the lack of entries.

When I review my clients' policies, I look for language related to employee use of social media. I have seen many agencies afraid to cover employee use in their policy because they are worried about getting in trouble for restricting the wrong things.

Kristy is known as "GovGirl" in the government technology industry. A former city government Web manager with a passion for social media, technology and the lighter side of government life, Kristy is the CEO of Government Social Media.



The reality is that there is very little case law to guide us in the area of government social media policies.

Your agency's elected officials or administrators must make decisions on what is allowed by employees on work time, and that guidance should be written in your policy. You might say that staff members officially designated as social media administrators are allowed to manage social media profiles on work time, but all other staff may not use the agency's network for personal social media during those hours. Or you may allow a minimal-use policy where a small amount of social media use on work time is acceptable.

Be crystal clear about privacy in your policy. You might caution employees that they have no expectation of privacy while using the Internet on employer equipment. If employees will be monitored, the policy should inform them of such monitoring. Also make sure to clearly state that employees should never post legally protected personal information that they have access to on the job.

The reality is that there is very little case law to guide us in the area of government social media policies. Don't get me wrong, agencies get sued all the time for their actions regarding social media. But cases are usually dismissed or settled out of court, so we don't have legal precedent in many areas.

You will need to make several tough decisions about employee use of social media, usage on work time and comment moderation. Decide based on best practices, then codify the rules in your policy. Do not avoid establishing policy, because I promise you it's much harder to react to a situation when there were never clear rules and expectations set forth in the first place.

One final thought, and it's an important one: Please, remember to take this approach using plain language. Your agency isn't just implementing a social media policy to legally cover your butt — it is important that employees and citizens actually understand it. Make it readable, searchable, publish it everywhere and constantly offer employee training. 

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