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July/August 2015

C O N T E N T S

Vol 28 , | Issue 5

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Atlanta IT Commissioner
and CIO **Samir Saini**

DAVID KIDD

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Looking for What's Next

I remember the first time I browsed the Web. It was probably 1996, and I was managing editor for a magazine that covered laser vision correction and other technology for eye doctors. I had interviewed a noted ophthalmologist from the Tulane University School of Medicine, and after finishing my questions, I hung up the phone before getting a couple of basic pieces of information: the proper spelling of her name and her official title.

This doesn't sound like a problem now, but it was to me back then. It usually meant calling back the interviewee to verify — in this case a busy eye surgeon who I'd spent several weeks chasing with repeated voicemails. I was about to start dialing again when my boss pointed to the Netscape icon on the screen of my trusty IBM 486 and said, "Try this."

I opened the browser, typed in a mysterious string of w's, colons, slashes, etc., and actually reached the university's Web page. Once I got there, I clicked on the phonebook icon and there was her info — name, title, everything I needed. It took me less than five minutes.

In the history of Internet-powered transformation, my first experience falls toward the minor side of the scale. But in a very real way, it reshaped how I and others in the publishing business worked. Lots of basic research no longer required a phone call or trip to the library or courthouse. The Web made it possible to work faster and include a level of depth in our daily reporting that would have been nearly impossible before.

Ultimately, of course, the Web made most of the world's knowledge available with just a few keystrokes. And through e-commerce, streaming video, social networks and hundreds of other advances, the Internet changed our lives forever.

This issue is dedicated to what's next.

Will a new generation of high-bandwidth Web applications being developed by the Global Environment for Network Innovations be just as revolutionary someday?

What about the blockchain? Will the decentralized ledger that's the backbone for bitcoin transactions eventually be the key that unlocks secure electronic voting, simplified tax collection and safer contracting?

In this issue, we look at these and other emerging technologies and try to get a sense of how they might impact the mission of government and the communities where we live. Twenty years ago, I had no idea how game-changing that fuzzy icon on my clunky CRT screen would be. And something new is always around the corner. GT

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The number of states that looked at approximately 100 bills related to body-worn cameras for police officers during the 2015 legislative session.

A Data Set a Day ...

Data-minded startups rejoiced in June over new and unprecedented access to the nation's largest repository of health data: the Centers for Medicare and Medicaid Services (CMS) digital archive. Acting CMS Administrator Andy Slavitt made the announcement at Health Datapalooza, saying the purpose of the policy shift, to start Sept. 1, is to inspire entrepreneurs and forward-thinking companies to create new apps and tech for better health and decision-making. Suggested possibilities included platforms for care management, analytic analysis and predictive modeling. To further accelerate health data consumption, innovators and private-sector researchers can now request updated data quarterly rather than annually.

Project Portal: Riverside, Calif., has developed an innovative, low-cost management solution to improve the way officials manage and track IT projects. The city developed the portal to increase efficiency, reduce capital expenditures and enable real-time access to the status of IT projects. "We wanted to improve IT governance within the city and to do a better job managing projects," said Chief Innovation Officer Lea Deesing. The new in-house portal, called The Hive, uses Microsoft SharePoint to help validate project management process framework compliance and improve communication among project stakeholders.

WHO SAYS?

"The dream here is to treat the library as a different *kind of community infrastructure. You can conceivably be feeding live data about a city into an open data portal, and at the same time, turning the library into a real live information source — rather than something just static."*

www.govtech.com/quote-july15

MOST SHARED STORIES

5 Startups Helping to Bring Government into the 21st Century	**522** SHARES
Smart Cities Resources: Who, What, When, Where and How?	**467** SHARES
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Verified Facebook Status for States, Localities 2,462 VIEWS

Google Innovation Lab Participants Hope to Reinvent Government Services 2,183 VIEWS

5 Startups Helping to Bring Government into the 21st Century 1,918 VIEWS

" Designers need to be added to that list of essential skilled public servants. UX [user experience] and visual design are vital to the thoughtful analysis of data, as well as the translation of that analysis into effective and beneficial products and services. UX is especially important and conspicuously absent from state and local government job opportunities. You wouldn't build a new house without an architect to ensure that the design meets all the functional requirements for humans to live in it. Yet that is what is currently happening.

Nicole Maron in response to *Why Skills Matter More than Ever in Our Data-Driven Economy*

" The 'Amazon' effect is also conditioning citizens to use online chats and social communication with their government. It would be interesting to see how 311 departments are handling inquiries coming through their social media channels in addition to calls.

PeterMikhailov in response to *Scaling Down 311: Customer Service Is a 'Core Mission'*

" Shadow IT is a good thing. This is especially true in the states that have subjected users to IT consolidations, where the huge centralized model gets bogged down in the bureaucratic red tape of senseless policies, paperwork, poor service and incompetent management.

AndySmith5 in response to *Why Public CIOs Are Attempting to Move 'Shadow IT' to 'Shallow IT'*

" Who really cares about getting into a big fight to preserve cheap basic-cable plans? There is a lot of competition. ... What we should be worried about is ensuring affordable, quality broadband access to all. That's something that truly matters to the ability of people to participate in their communities, society, access government and educational services, etc.

Mike in response to *FCC Undermines Local Authority Over Basic Cable*

THE DEFINITIVE GUIDE TO DATA CENTERS

PLATFORMS AND SOLUTIONS THAT OPTIMIZE GOVERNMENT'S MOST CRITICAL ASSET

State and local governments are striving for greater efficiencies, reliability and cost savings when it comes to data center operations. To meet these goals, some governments are taking advantage of new technologies and business models. While the conventional dedicated data center is still the dominate platform of choice in the public sector, it is no longer the only option. The most recent Center for Digital Government and *Public CIO* Special Report acts as the definitive guide to data centers, providing state and local governments a roadmap to four well-tested approaches: the dedicated data center, shared data center or community cloud, public cloud, and outsourced data center. Download the Special Report for an overview of the benefits, challenges and best practices for building and maintaining a new generation of government data centers.

The Special Report can be downloaded at govtech.com/2015Q2report

An Oasis of Power

Located on the outskirts of the Mojave Desert near the California/Nevada border, the Desert Sunlight Solar Farm consists of more than 8 million photovoltaic panels, which absorb sunlight about 300 days per year. The facility's total capacity is 550 megawatts, 300 of which will be sold to Pacific Gas and Electric Co. (serving Northern and Central California), with the remainder earmarked for Southern California Edison.

Time.com cites the facility as evidence that "solar power in America has officially grown up," explained by a sharp global increase in solar panel production over

the past 10 years, making the technology much cheaper and making large-scale solar facilities viable. The Desert Sunlight Solar Farm's capacity is equal to that of the Topaz Solar Farm, which opened earlier this year, 400 miles west in Central California. The largest solar power plants in the world, the impact of their combined 1,100 megawatts on carbon emissions is akin to removing 130,000 cars from the road and powering 340,000 homes using clean energy. **GT**
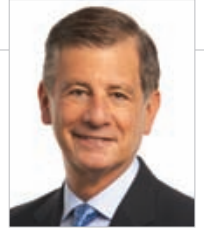
Analytics with a Side of Discretion

To fully realize the benefits of advanced analytics, government needs to build "documented exceptions" into health inspections.

In recent months we've seen many new technologies and partnerships aimed at helping local government workers conduct restaurant health inspections more effectively and efficiently. In Boston, participants in a civic innovation competition are using Yelp and city data to develop an algorithm to predict potential violations that will help better target health inspections. In Chicago, a recently completed pilot harnessed advanced analytics to reduce the time it takes inspectors to identify critical violations in city food establishments by seven days. And in cities across the country, health inspectors are trading in clipboards for tablets and other mobile tools, making it easier and faster to access and report information out in the field.

These laudable initiatives are transforming the way local governments inspect and regulate food establishments, providing a valuable and much-needed boost to public health while better deploying limited government resources to focus on bad actors instead of rule-abiding restaurant owners.

Yet there is still more work to be done. As innovators in government and civic tech continue to develop initiatives to improve health inspections, they would be wise to empower the inspectors in the field to exercise greater discretion in decision-making.

It's high time for a broad re-evaluation of employee discretion in local government health

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.*

inspections to accompany the rethinking of the technologies that support these workers. Indeed, amid the recent flurry of innovations in predictive analytics and mobile tools in restaurant health inspections, there has been less progress in overturning the bureaucratic conventions that govern how much leeway government health inspectors

FLICKR/SETH ANDERSON

are given as they do their work. Too often, these inspectors are constricted by a rigid checklist of confusing rules and codes developed long before social media and open data transformed the relationship between restaurants, government and citizens. As a result, for many health inspectors, following a checklist is given priority over the higher virtue of advancing public health.

We need government managers to empower their employees to think differently: to be more creative, innovative and thoughtful in confronting a situation in which the written rule may not align

with what's best for public health. We need greater adoption of what Columbia Law Professor William Simon and other leading thinkers on this issue refer to as "documented exceptions," instances in which bureaucratic workers deviate from a rule that does not fit the given situation and then carefully and transparently record their decision and alternative course of action.

I've been advocating for greater employee discretion in government health inspections for years. But now, with the rise of predictive analytics and mobile tools to advance this work, there's more incentive than ever for bureaucratic conventions to get up to speed. These new technologies should ease fears about greater employee discretion by providing powerful accountability tools to ensure that empowered health inspectors do not abuse or otherwise misuse their enhanced discretionary powers. And best of all, greater employee discretion can ensure that these new technologies are not underutilized.

After all, even health inspectors empowered with state-of-the-art predictive analytics and the latest mobile tools can do little if they are obstructed by outdated rules that prevent them from exercising thoughtful discretion in the field. GT

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EMERGENCY MANAGEMENT
STRATEGY AND LEADERSHIP IN CRITICAL TIMES

1 **What are your overall IT priorities?** There are three main objectives: First is to boost the reliability and security of the city's core infrastructure that's been aging for a while. It's our backup, and any cool civic tech I throw on top of it is at risk unless I invest in improving that network — the servers, the structure, the data centers, etc. The second piece is around improving customer service quality by adopting a service management model for our department and best practices for how we run IT. The third is improving the internal operational efficiency of IT, implementing project and governance standards for all the technology access, and then enforcing those standards.

2 **How do you plan to modernize your infrastructure?** We're going to follow the state of Georgia and move our [Microsoft] Exchange environment to Microsoft Office 365 in the cloud. That seems to be the direction that a lot of municipalities are going and so we're moving that forward. We're also going through a huge data center consolidation and modernization effort.

3 **What are your goals for civic tech?** We have a key objective to drive civic enablement, which we've broken down into three areas. There's strategy and projects around leveraging tech to deliver operating efficiency across the various departments. The second is delivering tech that's citizen-facing and improving tech that enables transparency of city services and delivery. And then the third part is around smart city enablement.

4 **What kinds of projects are under way?** Coming soon we will have e-citations so police officers won't have to write tickets anymore. It'll be electronically done through a tablet and automatically fed into the court system for easy payments. Body cams are a hot topic across the country, and we're a few weeks away from doing our official rollout to our police departments. ... We see the body cam as an opportunity to do more than just capture video. It can capture other [searchable] data that the police can use to improve situational awareness and communication between officers.

We also have a demo program that's run through Invest Atlanta, our economic development arm. They're hosting a program to invite entrepreneurs and tech startups with great ideas to demo a pilot product within the city.

Additionally we have rec centers all over the city, and 10 in particular that the mayor has coined "centers of hope." The strategy is to evolve these rec centers into tech centers and to start leveraging the computer labs to do things like teach code to low-income kids. **GT**

— Jason Shueh, Staff Writer

Samir Saini
IT Commissioner and CIO

Samir Saini, the former Atlanta Housing Authority CIO, also spent more than nine years as an executive at General Electric. With roughly a year under his belt as Atlanta's CIO, he's looking to secure the city's core IT infrastructure while making headway in civic tech. Free Wi-Fi has been launched in various areas, a new 311 system aims to consolidate service payments, a partnership with Google and Waze alerts citizens to traffic delays, and tech startups can now pitch ideas to officials through Invest Atlanta, the city's economic development agency. Here are a few of his thoughts on the road ahead.

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By Adam Stone / Contributing Writer

The technology that's the backbone of bitcoin may have far-reaching impacts in government.

Unchaining
Innovation

Money becomes more abstract over time. Instead of trading apples for chickens, we start trading apples for beads. Beads (pretty and useful) eventually are replaced by gold (still pretty, less useful), which is supplanted in turn by paper money. Paper money is a vast abstraction over chickens, but in time people come to accept it. It isn't "real" in any meaningful sense, but it gets the job done, and it can be handed back and forth with little fanfare.

Now we have reached the next level of abstraction, in the form of digital money. We don't mean gold-backed paper money merely funneled along through PayPal or Amazon, just another credit card transaction. We mean electronic currency: "Money" that exists purely in the digital space and can be traded directly between individuals. Let's start racking up the worries. Data can be copied, right? So couldn't somebody just "mint" more money? And who will keep track of all those financial comings and goings? Every layer of abstraction is met with similar concerns.

Enter bitcoin, a digital currency scheme that seems to satisfy most of the worries, with encryption that prevents it from simply being copied ad infinitum. Even more interesting to some, bitcoin's underlying technology takes care of the who's-in-charge dilemma. Known as the blockchain, bitcoin's driving force is a sort of infinite running ledger, keeping exact track of every bitcoin transaction.

And it could be a powerful new tool for government.

Keeping a ledger is easy. Early man cut notches in bone to count the moons. Sumerians struck cuneiform writing into clay tablets to record grain and livestock inventories 5,000 years ago. The ancient Egyptians scribbled virtually everything on papyrus. Modern banks track billions of transactions among tens of millions of users daily. So what's the problem?

Typically a ledger rests with a single bean counter, and while PayPal and a few others have nominated themselves as the Internet's financial hub, there's really no central online bank yet. Still, digital currency requires accountability, some means of ensuring accuracy in the absence of that trusted third party. Electronic records also must be tamper-proof.

The blockchain presents the latest iteration in record-keeping, one custom-tailored for the needs of a digital transaction. It's decentralized: Everyone who participates in the system is plugged in, so there's no vulnerable hub, no single keeper of the keys. It's transparent for all to see. And it is said to be inviolable, a chronological record that cannot be altered. If anyone did try to tweak it, well, everyone else would know.

And now we come to the really fun part. Here's this decentralized, transparent, tamper-resistant means of keeping records.

In the realm of pure speculation, let us ask: What can government do with this?

Starting Point

Experts in the bitcoin (and therefore blockchain) universe say the low-hanging fruit for government ought to be obvious. First up is electronic voting. Government needs an accurate record of how many people voted and when. Why not hand out digital tokens, each worth one vote and each tied to the blockchain for accuracy? If it is transparent, anyone can see how many people actually pulled the lever in Ward 6.

"We are talking about radical transparency," said Perianne Boring, president and founder of the Chamber of Digital Commerce, a trade association focused on promoting digital assets to policymakers. "Anyone can look into the blockchain and look into every transaction that ever happened on the blockchain. And you can use it for any type of provable fact."

Another provable fact would fall under the heading of land records, a flavor of government ledger-keeping that would benefit from a digital upgrade. Land records are kept over very long periods of time, exponentially expanding the possibility of error. They must be sufficiently visible so that anyone with an interest in a parcel can track ownership easily and accurately.

The blockchain satisfies all this, while potentially lowering operating costs for the municipality. "Keeping these records involves hiring people, training these people, auditing these people, paying for the building, paying for pensions. So blockchain simply removes a lot of that inefficiency, along with a lot of the busy-work," said Aaron Lasher, a board member of the iPhone bitcoin wallet, breadwallet.

If paring down on traditional record-keeping really can trim costs, there's a temptation to look even further afield. Voting and land records are the blockchain uses that come most readily to mind, but proponents say the technology's potential could go much further than that.

Tracking Services

Take, for instance, the human services aspect of government. An analyst at Blue Hill Research, James Haight foresees blockchain as a means to ensure validity in social service programs like food stamps and welfare checks. A blockchain record would guarantee that recipients received their allotment, while potentially helping government to track when and even where those funds were used. Such transparency could help ensure the system's integrity.

One could follow the possibility a step further. Rather than dole out cash, cities and states could distribute benefits in the form of "civic tokens," online cryptocurrencies similar to bitcoin. This could make it possible to insist on verification of identity prior to use, with blockchain keeping track of the transaction, said Melanie Swan, an affiliate scholar at the Institute for Ethics and Emerging Technologies and principal of the MS Futures Group.

While the management of human services benefits might be a boon to civic leaders, it's also a bit abstract. Perhaps something more concrete is in order?

Patent ... Verified

Now consider patents and intellectual property. It's a natural fit, "if a court can be convinced that information in the

"We are talking about radical transparency. Anyone can look into ... every transaction that ever happened on the blockchain. And you can use it for any type of provable fact."

Perianne Boring, president and founder, Chamber of Digital Commerce

blockchain is permanent and unforgeable," said Shaun Appelbaum, special projects director at law firm Mearkle Trueblood Adam, which specializes in cryptocurrency and bitcoin. The blockchain would also show who got there first, resolving any question about patent precedence.

Doesn't government already record (and thereby protect) intellectual property filings? Absolutely. But as with all these hypotheticals, the question is not whether the Egyptians are still writing on papyrus but whether we can use blockchain technology to do it better.

One thing we could do better is file taxes. The blockchain is decentralized — it exists among all users. In principle this means that the same record could be shared between employer and employee. This means the W-2 as recorded by the employer and the income as described by the taxpayer could co-exist in a shared space and be reconcilable by a means more efficient than ever tried before.

Nifty.

This notion of interoperability across the blockchain could have ramifications throughout government. "So many different government systems could interact so much more cohesively," Swan said.

Take an example from the often frustratingly complex and fragmented world of health care. Suppose the patient, insurance company, doctor and a government payer all had their financial records come together on a single ledger, visible to all, for any given transaction. The potential for transparency would be matched only by the opportunities for new levels of efficiency.

Swan offers another vision: Suppose motor vehicle departments could share a blockchain from state to state. There'd be a single record to verify and transfer vehicle ownership or to confirm a driver's identity or status.

Who Are You?

This notion of identity verification is among the more intriguing visions of a governmental blockchain. Within the nature of the blockchain it is possible for a user to create a digital signature,

Doing Government Better

Experts predict blockchain could be a game-changer for:

- ✔ Contracts
- ✔ Electronic voting
- ✔ Health care
- ✔ Land use
- ✔ Motor vehicles
- ✔ Patents
- ✔ Purchasing
- ✔ Social services
- ✔ Taxes

one that cannot be spoofed or utilized by another user. Such a signature could be used to authenticate or witness documents, sign transactions and verify identity — all of which would leave a verifiable, demonstrable mark in the chain.

This has interesting implications for the public sector. Take for example the emergency management function. Blockchain "would give mobile phones and digital wallets the ability to store private keys, which can be used to prove the identities and attributes of first responders anywhere in the world with an Internet connection," said Steven Sprague, blockchain expert and CEO of cybersecurity firm Rivetz.

When it comes to identity verification and skills assertion among rescuers, "the blockchain is an ideal solution, because it is very scalable and extremely hard to destroy," Sprague said. "In the case of an attack, a government contractor with a list could easily be taken down, creating confusion. However, it is extremely hard to eliminate access to the blockchain as it is an Internet-scale resource. As long as one copy exists, the integrity of the network remains safe."

Among the broad array of possibilities, it would be remiss to overlook a major

function of government that could be helped by the blockchain: buying stuff.

Suppose a government wanted to acquire American-made police cars. "Right now, I don't know where the rubber or the metal came from. It just looks like a car to me," said Stephan Tual, chief communications officer at Ethereum, a Web publishing platform helping to drive bitcoin development. Imagine instead a future world in which, in order to sell to government, manufacturers would be required to keep blockchain logs of all their processes. "This would be a way to track each component at each stage through the production process," Tual said.

In much the same way, blockchain could be used as a means to ensure that contracts were executed, as those doing business with the city could be required to mark milestones with their digital signatures. It would cut down on record-keeping expenses and help ensure accuracy.

What's Next?

All of this is purely theoretical, but such is the nature of these things. In times of upheaval, speculation precedes actualization. Bitcoin advocates are eager to point out the parallels to past experience: This is like the early days of email or the Internet. We can't even begin to guess where it might take us.

Naturally, skeptics take this to mean we should all be looking over our shoulders. While some view voting as a great test case for the blockchain, for example, others have just the opposite reaction.

"This is a bad idea," Appelbaum said. "Anyone with sufficient funds could purchase participants' voting tokens. Additionally, linking a participant's digital wallet to their real-life identity would result in votes being made public."

The only certainty in all this, so far as the public-sector technology community is concerned, is that whatever is going to happen will likely happen sooner than expected. Just as bitcoin blasted past the theoretical stage on its way to becoming a reality, the blockchain is too powerful a tool to be ignored for very long. **GT**

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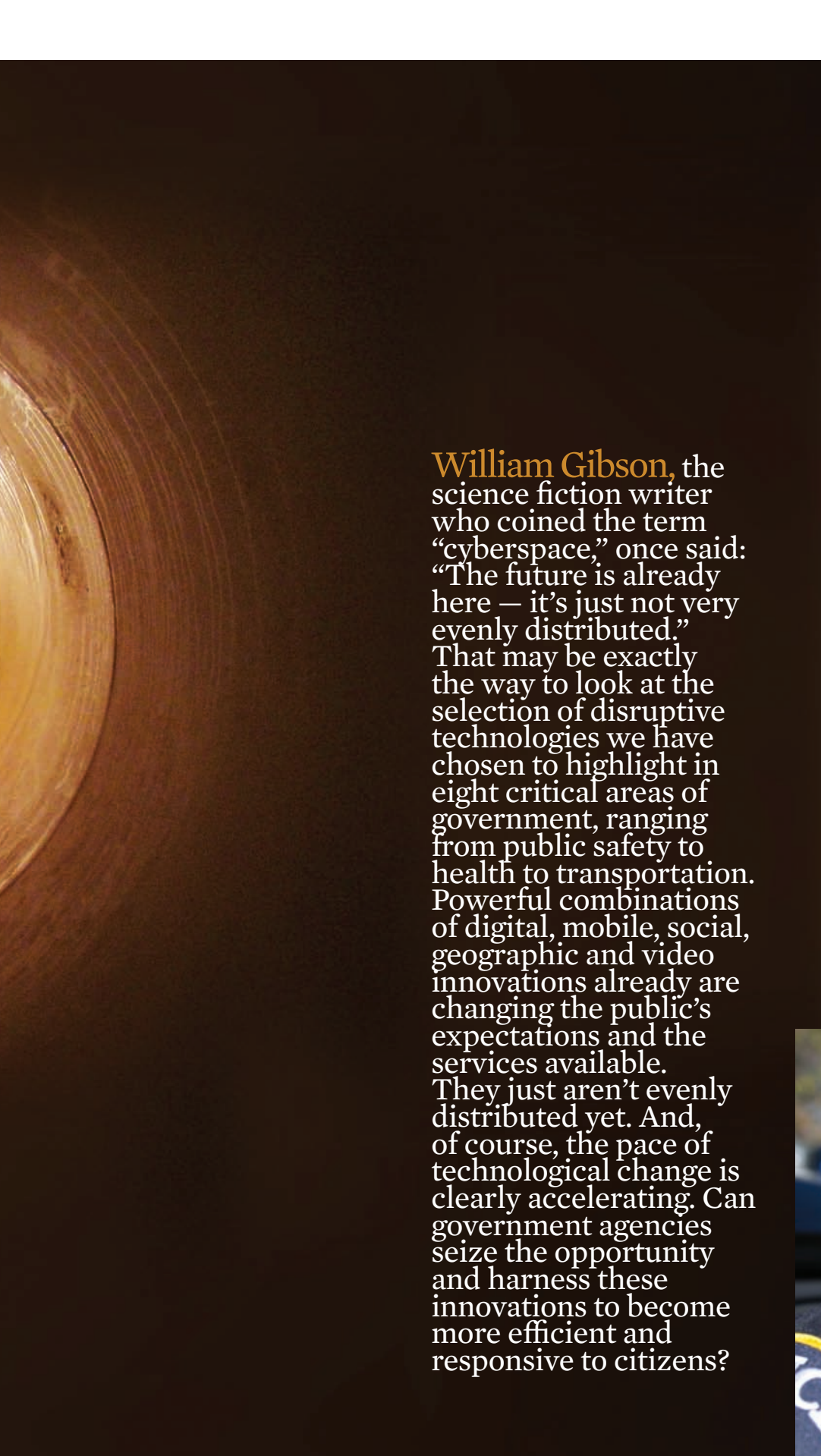
Power on Tap: Hydroelectric generators are transforming Portland's water pipes into sources of renewable energy.

Examples across the spectrum prove that leading-edge technology is spilling into the public sector today.

The Disruption Pipeline

BY DAVID RATHS

William Gibson, the science fiction writer who coined the term "cyberspace," once said: "The future is already here — it's just not very evenly distributed." That may be exactly the way to look at the selection of disruptive technologies we have chosen to highlight in eight critical areas of government, ranging from public safety to health to transportation. Powerful combinations of digital, mobile, social, geographic and video innovations already are changing the public's expectations and the services available. They just aren't evenly distributed yet. And, of course, the pace of technological change is clearly accelerating. Can government agencies seize the opportunity and harness these innovations to become more efficient and responsive to citizens?

Public Safety

Wearable Tech Is Transforming Emergency Response

The wearable technology market is expected to grow from $20 billion in 2015 to almost $70 billion in 2025, according to research firm IDTechEx. As commercial applications bloom, more will find their way into the public sector and emergency response.

This year has seen an increase in the number of police departments using body cameras. And already under development are wireless devices that monitor a responder's breathing, heart rate and blood pressure, as well as potentially harmful environmental conditions, and relay concerns back to incident command.

But rather than sitting back and waiting for the market to develop, the U.S. Department of Homeland Security is determined to spur innovation in the field. DHS' research and development arm is funding a startup accelerator program called Emerge managed by the Center for Innovative Technology (CIT), a Virginia-based nonprofit. Two accelerators, in Texas and Illinois, will work with 10 to 15 startups this year to develop wearable products and adopt them for first responder use.

DHS is using a broad definition of wearable technology, including physiological sensors, high-performance materials, health support such as hydration, communications capabilities and situational awareness.

David Ihrie, CIT's chief technology officer, said that although it probably won't

DAVID KIDD

be part of this cohort, an example of the type of startup the accelerators would be working with is a company founded by a tennis pro that focuses on eye-tracking. "They work with sports teams to enhance performance to see where the players' focus is," he said. They also have cameras that point outward to overlay in real time where you are looking in a scene versus what is going on. "So from a situational awareness and training point of view for first responders, that was interesting," Ihrie said, adding that eye-tracking also enables some physiological monitoring. "If a responder gets a concussion, their eye motions change. That kind of dual use also is interesting."

Emerge startups will demonstrate their products in September.

Health & Human Services

'Hot-Spotting' for Population Health Management

A hot health-care trend is population health management: using data to improve health at a community level as well as an individual level. The growth in sophistication of GIS tools has allowed public health researchers to more clearly identify and start addressing health resource disparities.

Dr. Jeffrey Brenner, a Camden, N.J.-based physician, uses data gathered in a health information exchange (HIE) to target high-cost individuals. The Camden Coalition of Healthcare Providers uses the HIE data to identify high-cost "hot spots" — high-rise buildings where a large number of hospital emergency room "super users" live. By identifying and working with these individuals on patient-centered care coordination issues, the coalition has been able to reduce emergency room use and in-patient stays.

Speaking at the recent Healthcare Information and Management Systems Society annual conference in Chicago, Dr. Brian Jacobs, chief medical information officer for the Children's National Health System in Washington, D.C., said that care model redesign needs to encompass other factors beyond patient encounters with

clinicians. Geospatial analytics can bring qualitative and quantitative information forward in augmenting traditional approaches to health care, he said. Many factors around the patient don't make it into the electronic health record, Jacobs said, including diet, exercise, medication compliance, pollution and climate. "There are all these things in the environment that providers have no visibility into," he said. Understanding geographic distribution can impact targeting of epidemiology, prevention, treatment and research efforts. An example he gave was burns affecting infants in Washington, D.C. By geocoding data on 344 children who had scalds or contact burns, researchers were able to create hot-spot representations of where these burns were occurring and develop a targeted public awareness campaign around lowering water temperatures, and the rates of burns dramatically decreased.

Parks & Recreation

Tracking Trees for a Better Future

A combination of advances in mobile data collection systems and geocoding lets natural resources and parks agencies be more proactive about collecting tree data, managing urban forests and quantifying their value, as forests become increasingly important resources in an era of climate change.

DAVID KIDD

Philadelphia Parks and Recreation has added approximately 2 million trees to its database in the past few years. It plans to create a digital management system for all of them. Los Angeles City Parks uses the Davey Tree Expert Co.'s Web-based Tree-Keeper management software to manage existing tree inventories and administer work orders. The department can also more easily look at species balance to manage against pests, disease and drought.

The Wisconsin Department of Natural Resources has completed an analysis of street trees and canopy cover for 19 communities in the northeastern part of the state. It used a software suite from the USDA Forest Service, called i-Tree, that provides urban and community forestry analysis and benefits assessment tools. The i-Tree tools help communities of all sizes strengthen their urban forest management and advocacy efforts by quantifying the environmental services that trees provide and the structure of the urban forest.

"Our goal was to use i-Tree to create fact sheets so that decision-makers — mayors and city councilors — can see the value of their trees," said Tracy Salisbury, northeast region urban forestry coordinator for the Natural Resources Department. Municipal budgets are tight and it's difficult to fund forestry programs, she added. "We want to show them the value in a new light. Some municipalities have created these fact sheets and been able to get elected officials to rethink budget cuts."

Public Works

New Benefits Emerge from Traditional Infrastructure

As regions of the country seek renewable sources to replace energy from coal-fired power plants, city public works agencies are turning to new approaches for conservation and energy production.

In January the Portland Water Bureau (PWB) in Oregon flipped the on switch for the first project in the U.S. to produce energy from in-pipe hydropower in a municipal water pipeline.

PWB partnered with a Portland-based startup called Lucid Energy Inc., a provider

of renewable energy systems for in-pipe hydropower. The company's system, which it says was installed at no cost to PWB or the city of Portland, uses the gravity-fed flow of water inside a PWB pipeline to spin four 42-inch turbines that are now producing electricity for Portland General Electric customers under a 20-year power purchase agreement with the utility.

"Water agencies are looking for ways to be more energy efficient, energy utilities are seeking more renewable sources of energy and investors are seeking opportunities in smart water and energy infrastructure," said Gregg Semler, president and CEO of Lucid Energy, in a statement. "The industry is looking to Portland as an example of how all of these entities can partner to take advantage of in-pipe hydropower to generate investment returns and reduce the cost of delivering clean, safe drinking water."

A *PBS NewsHour* report on the project noted that Lucid is negotiating agreements with San Antonio and New York City, and hopes to have more pipes and turbines in place in Portland over the next few years.

Corrections

Video-Based Tools Transform Prisons and Jails

Videoconferencing is disrupting business as usual in U.S. jails and prisons in two ways: One is the rising use of telemedicine to reduce inmate health-care costs and to increase access to certain types of care for prisoners. The other is video

visitation between inmates and families.

A March 2015 report by Southern California Public Radio noted that the federal court-appointed receiver overseeing inmate health care in California is reviewing telemedicine capabilities to reduce costly overtime billing by physicians and nurses at prisons. In one year, overtime has more than doubled for this branch of corrections, from more than $12 million to nearly $30 million.

The Maryland Department of Public Safety and Correctional Services, which cares for 22,000 inmates in 27 facilities, including the Baltimore city jail, was spending $5 million to $6 million annually in transport and overtime pay to take prisoners to off-site clinics. It recently made a significant investment in telehealth equipment in partnership with its private-sector partner, Pittsburgh-based Wexford Health Sources Inc. Dr. Thomas Lehman, Wexford's corporate medical director, said Maryland is not alone in expressing interest in expanding the equipment's use. "When we look at the new bids and proposals, all corrections departments across the country are now interested, not only from the aspect of public safety and decreasing overtime costs, but also of delivering good care and access to specialists for inmate patients."

A January 2015 report by the Prison Policy Initiative estimated that more than 500 facilities in 43 states and the District of Columbia are experimenting with video visitation, and prison and jail telephone companies have started to bundle this feature into phone contracts. Research has found that increasing the number

of visits with family members reduces both recidivism and prison violations, and visitation via video may be more convenient for some family members.

But the Prison Policy Initiative report was critical of how video visitation has been deployed so far, saying it is "ironically the least prevalent in state prisons, where it would be the most useful given the remote locations of such facilities, and the most common in county jails where the potential benefits are fewer."

Finance & Budgeting

Data Portals Offer Transparency at Unprecedented Levels

The transparency and open data movements have hit the government finance sector in a big way and promise to be an area of innovation in the years ahead.

A partnership between Ohio Treasurer Josh Mandel and the finance visualization startup OpenGov will result in one of the most sweeping statewide transparency efforts to date.

The initiative offers 3,900-plus local governments — from townships, cities and counties to school districts and more — a chance to place revenues and expenditures online free of charge through the state's budget transparency site OhioCheckbook.com. Citizens will be able to track local government revenues and expenditures via interactive graphs that illustrate not only a bird's-eye view of a budget, but also the granular details of check-by-check spending.

Across the country, other cities and counties are moving toward financial transparency as well. In Oakland, Calif., OpenOakland, a civic-tech innovation brigade from Code for America, has developed a visualization tool called Open Budget to allow the public to explore the city budget. A conversation feature lets users ask questions and discuss every line item of the city budget.

Residents in Houston can take part in a Budget Bootcamp, a Code for Houston project that was conceptualized at a city-sponsored hackathon to help citizens

better visualize and understand the city's annual operating costs. When it was introduced in 2013, City Finance Director Kelly Dowe said, "Budget Bootcamp has something for every budget/policy wonk. Whether you want to break down our revenues for FY14, see the trends over time or see how the city's taxpayer-supported general fund transforms from revenues into department expenditures, this application is a terrific step in terms of financial education and transparency."

No doubt, other cities, counties and states will feel pressure to follow suit if they haven't already.

DMV

Drivers' Licenses: There Will Soon Be an App for That

The laminated driver's license you keep in your wallet may eventually give way to an app on your smartphone, and that change may have wider significance for how citizens interact digitally with their government. Legislatures in at least three states have seen bills introduced authorizing their transportation departments to begin piloting digital drivers' licenses.

The Iowa Department of Transportation announced in December 2014 that it has a driver's license app under development. Officials say it could transform the citizen/government relationship. Mark Lowe, director of the Motor Vehicle Division at the Iowa DOT, said the idea isn't yet to replace the traditional driver's license, but to first offer the app as an alternative to the temporary paper licenses issued before permanent licenses are mailed out, then as a supplement to permanent licenses, and maybe someday as an optional full replacement.

The Delaware Legislature passed a bill in January 2015 to study and consider using a digital driver's license, noting that its residents routinely use smartphones in their daily lives and that there are financial and environmental costs of producing plastic drivers' licenses. In California, Assemblymember Matt Dababneh, D-Encino, introduced legislation that would allow the DMV to develop a digital driver's license mobile app.

"I think the longer-term prospect is if you can really be successful in establishing a driver's license as an app, it really transforms the way we can interact with the customer," Iowa's Lowe said. "Instead of a thing in your pocket, it becomes a customer relationship."

Transportation & Mass Transit

Big Breakthroughs Are Just Around the Corner

Nothing is likely to be more disruptive to transportation, mass transit and urban planning than the double whammy of connected vehicle technology and autonomous vehicles.

The U.S. Department of Transportation expects great things from the connected vehicles of the future — and that future may be just around the corner. Vehicle-to-infrastructure communication capabilities and anonymous information from passengers' wireless devices relayed through dedicated short-range connections could provide transportation agencies with improved traffic, transit and parking data, making it easier to manage transportation systems and improve traffic safety.

Now regions around the country are positioning themselves as connected vehicle (CV) research hubs. In September, the U.S. DOT will name the first wave of CV pilot deployment project sites. One region vying to take part is Chattanooga, Tenn., where a team, including experts from Oak

Ridge National Laboratory and the University of Tennessee, is joining stakeholders from the state government, private companies, commercial vehicle operators and freight shippers. CV applications being considered for the proposed deployment include dynamic speed harmonization, an application that aims to recommend target speeds in response to congestion, incidents and road conditions to maximize throughput and reduce crashes, and eco-traffic signal timing, an application that uses data collected wirelessly from vehicles (and other sources) to optimize the performance of traffic signals, thus reducing fuel consumption and emissions.

On the autonomous vehicle front, the Contra Costa County Transportation Authority in Northern California has opened the GoMentum Station research center to test connected and autonomous vehicle technology. The county and authority want to position the GoMentum Station, located in Concord, Calif., as a cutting-edge research and development site that will create new jobs and businesses as the technology involved in building autonomous cars continues to advance.

"Our roads cannot continue to grow larger, they must grow smarter," said Concord Mayor Timothy Grayson. "Concord is poised to become the largest site in the world for autonomous and connected vehicle testing."

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Cities throughout the country are vying to become connected vehicle research hubs.

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IT was sometime in 1998 that most people suddenly became familiar with the Internet. In 1997, people called it "that Web thing," and they would confuse email addresses and URLs — generally no one paid the whole affair too much mind. The transition that people talk about today — between spending hours trying to remember some fact to just looking it up online — happened in less than a year.

Society is rapidly approaching an era in which technology is no longer outmatched by even the most fantastic trappings of human imagination. It's miracle enough that instantaneous remote communication via the telephone is commonplace, but each day researchers are pushing the boundaries of what people think is possible. And when a good idea is found, it can enter society and begin making subtle and widespread changes in behavior, landscape and culture in a matter of months.

The Internet is the foundation of 21st-century technology, but the Catch-22 of developing new Internet technologies is that scientists are often constrained by the very environment they are attempting to innovate. A test bed for researching new networking ideas was needed, and that's why the Global Environment for Network Innovations (GENI) was created by the National Science Foundation in 2007 and has since received $80 million in federal investment.

GENI is a network of more than 50 sites in more than 30 countries that allows its 3,700 member researchers to test their ideas in a low-latency, high-bandwidth digital environment unconstrained by the foibles of the regular Internet. Before cutting-edge networking technology can enter the real world, it needs to be tested on a broad scale, and GENI is where that testing happens.

The Internet as we know it is imperfect — that's why the GENI ultra-high-speed test bed is helping researchers develop the next generation of connectivity.

By Colin Wood

Web2.0

(and Beyond)

PROJECT DIRECTOR
MARK BERMAN SAYS
GENI BREAKTHROUGHS
WILL ENABLE PRECISION
MEDICINE AND OTHER
ADVANCED TECHNIQUES.

In March, GENI partnered with US Ignite, a nonprofit dedicated to developing next-generation Internet apps, to lead a three-day event that showed off what they could do. Event coordinators demonstrated to an audience in real time how a low-latency fiber network could enable functionality that public safety officials can only dream about using in the field today.

In one demonstration, a connected vehicle simulated a crash, which triggered an automatic notification to a police station. Instantly police knew where the crash was and which vehicle was involved. A video-equipped drone was immediately deployed to the site to collect information, like whether there was fire, hazardous chemicals or other threats that might warrant the use of special equipment. The crash was fake, but everything else was real. The audience watched everything happen via a video feed delivered at the speed of light, and though today's infrastructure and policy can't support such an implementation in the real world, the technology for this type of application is ready when the people are.

Today's Internet is constrained mainly by three things. The first is bandwidth. There's not enough uniform connectivity across the Internet to ensure that content can be delivered at the quality and speed necessary for sophisticated new applications to perform effectively. The second is latency. Even relatively low latencies like 100 milliseconds are far too slow for real-time applications that require high precision. The third is security. Security issues will never be thwarted completely, but today's Internet can't be used for certain applications in good conscience — remote surgery, for instance. But GENI technologies, said Glenn Ricart, CTO of US Ignite, allow people to do things that are usually impossible on today's Internet.

Software-defined networks (SDN) and other software-defined technologies are a big part of what makes GENI so innovative. SDN is changing how private companies ply their networks thanks in part to GENI's demonstration

Glenn Ricart

A Tennessee student remotely manipulates a research-grade microscope at a March 2015 GENI Engineering conference in Washington, D.C.

of how powerful these technologies are. Companies like AT&T, Cisco, Comcast, Juniper Networks, Amazon and Hewlett-Packard support US Ignite and stand to gain big from the advances demonstrated by GENI's network. One unique component of SDN is that it allows Internet architecture to be divided into slices or channels.

"The basic idea of today's Internet is that both the control signal and the data signal are being run over the same Internet," Ricart said. "SDN is the notion that you separate the data and the control into separate channels, so that way when you want to have a connection to a health-care provider, the SDN checks [that the user has adequate clearance to do this] and then it creates what's called a flow, keeping it separate from other traffic."

These software-defined slices of Internet provide several benefits, security among them. If the Internet is to be used regularly for things like dissemination of electronic medical records or the aforementioned public safety application, segregating functionality into different slices provides an additional layer of security beyond what's possible today. It would also let Internet service providers sell users varying levels of service, like access to a health-care channel or a financial services channel, Ricart suggested. While such commercial arrangements raise net neutrality issues, the concept could add functionality to the Internet that simply isn't available today.

"For example, if someone had a home dialysis unit and wanted a secure medical channel, they could have that," Ricart said. "That might be paid for by health-care insurance, and that gives a low-latency, high-quality channel with highly reliable monitoring of a home dialysis machine or home infusion pump for cancer drugs. We hope to have more health care delivered at home, so if a doctor needs to go and see if a diabetic is healing properly, being able to get 4 Kbps video upstream from the person's home to the hospital

means that we can save an ambulance run to take that person to the hospital."

SDN also mitigates bandwidth limitations and reduces latency by distributing data across a network. In another demonstration by US Ignite, researchers in five cities — Potsdam, Germany; Brussels, Belgium; Victoria, British Columbia; Washington, D.C.; and Tokyo — collaborated on a huge database project in real time thanks to minimized latency and distributed data. Rather than transferring and updating the project's huge data sets with each edit, small signals were instead sent between the collaborators, and their local applications reflected the changes being made across seas. To accomplish this low level of latency, copies of the data were distributed physically close to the user in each country, rather than each user drawing from a central database.

On today's Internet, conversely, thousands of users across the nation might access the same video streaming service at the same time and draw the same information from the same far-flung data center, pulling gigabits of redundant data across thousands of miles — an arrangement less efficient than if the data were distributed nationwide and accessed from across shorter distances.

GENI's products, particularly an SDN open standard called OpenFlow, are making their way onto the regular Internet. GENI's first project director, Chip Elliott, said it's just a matter of time before the software behind the apps people see on their screens begins using networks in smarter, more innovative ways.

"I think this is really going to change the way the whole Internet is built and operates pretty soon," Elliott said. "I'm not saying GENI will change it, because GENI is a research project, but a lot of the technology we pioneered is moving into the commercial space very quickly. OpenFlow has completely taken the data center world over. People are enthusiastic about it, and it's being applied in long distance as well. You're starting to see the Department of Energy, the Department of Defense and various other groups who are beginning to think this could be handy for the way they do business."

Elliott recognized the potential conflict between a preservation of net neutrality and the concept of Internet channels. Millions signed a petition last year asking the FCC to preserve net neutrality, and though it's expected that the reclassification of Internet service as a Title II utility under the Communications Act of 1934 will preserve net neutrality in the short term, a new technology like SDN, no matter how useful, would inevitably raise the public's ire if it upended that hard-fought victory.

"The word 'channel' itself is a red flag, but this type of technology really does give ways to either do net neutrality or not do net neutrality. It's a powerful tool," said Elliott. "My own view is net neutrality is basically a policy decision. People already have enough knobs to control whether they favor something over something else, and so ultimately it has to be resolved at a policy level. And the tech is growing fast now. There are versions of the equipment from Cisco, IBM, HP, Dell, Sienna. People are starting to buy it and just plug it in. It really is snowballing quickly at this moment."

One of the most exciting applications of GENI technology is the potential to speed the transformation of industries like medicine. GENI Project Director Mark Berman noted that researchers at the University of Chicago and elsewhere are using GENI to create a bioinformatics exchange to share huge repositories of genomic data for cancer research and to advance personalized medicine that lets clinicians tailor care to individuals'

Chip Elliott

genes and cellular biologies. President Obama allocated $215 million in his 2016 federal budget toward building a personalized medicine infrastructure, mainly through projects at the National Institutes of Health and National Cancer Institute.

"We're getting to the point where the data that my doctor might need to customize my personal treatments based on my genomic data could be available at a price that makes sense," Berman said. "However, that doesn't solve the problem because the problem remains that even if my doctor has that data, it's not clear she can do anything with it.

Doctors are going to want to compare my genome against databases of many thousands or tens of thousands of other patients. So we need to couple some very powerful analytics with some powerful networks."

In the coming decades, discoveries in the human genome and their applications in personalized medicine will make today's medicine look primitive. The cancer drug Avastin, for instance, is often used in treating non-squamous cell carcinoma, but differentiating between squamous cell and non-squamous cell can be difficult even for experienced pathologists.

"You want to get this diagnosis right, and you can do it quite accurately if you compare the genomes," Berman explained. "This is a good example of personalized medicine, but you can't compare the genomes until you can move the data around and get the analytics in place. And that's the kind of thing you can do with GENI."

When people think of improving the Internet, they think it's all about increasing bandwidth, but there's much more than that, said Berman. It's also about detailed data flow control, minimizing latency and intelligent software that can handle fast-moving mobile devices. "In the case of a moving ambulance, you're moving in and out of coverage, you may want to change the resolution of your video or prioritize patients' vital signs data over a video stream or something like that, and these are things that are not quite impossible but really hard to do with existing wireless networks," Berman said.

One research project led by Rutgers University, called MobilityFirst, integrates with GENI to issue notifications without relying on a traditional centralized host server. Projects like this show that developing the technology to support innovative ideas is no longer the highest hurdle, because the technology itself is basically ready. The barrier is that cities are missing the roadway network infrastructure as well as the strong governance and policy to support those technologies.
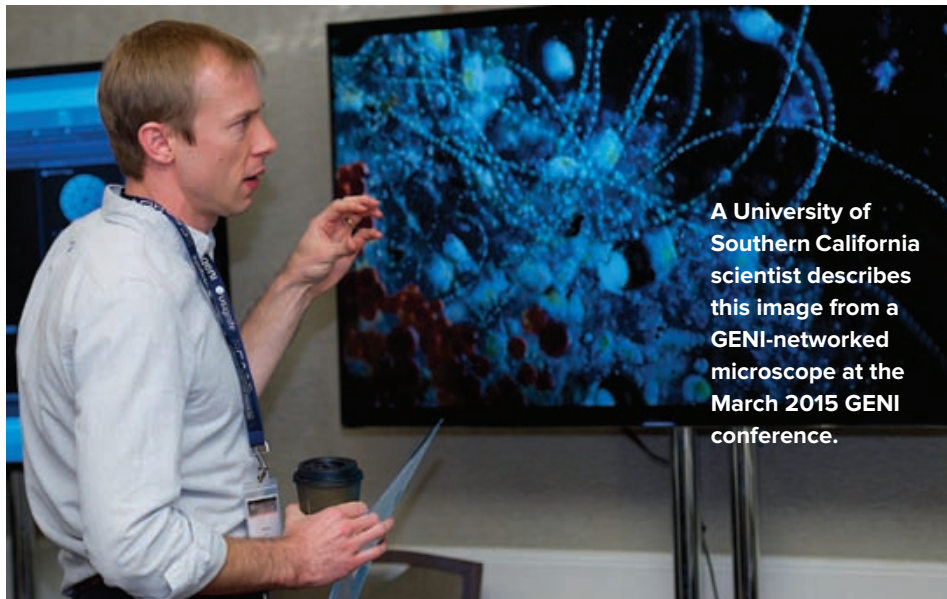
A University of Southern California scientist describes this image from a GENI-networked microscope at the March 2015 GENI conference.

"I think we're going to change how people think about the Internet," Berman said. "What GENI and some of our projects are going to do is make that control aspect accessible to people who are building important applications, and that will allow them to do a lot of things they can't do today."

Students from George Washington University pushed the bounds of today's software in a $10,000 GENI software contest sponsored by Cisco and launched in conjunction with the school's 22nd GENI Engineering Conference. Winners developed tools for real-time SDN monitoring, load balancing and dynamic topology modification, and packet mapping. GENI technology is exciting because it opens new areas of research and gives developers greater control over what their apps do, said Donald DuRousseau, the university's director of Research Technology Services.

"It really gives us the ability to operate networks at scale because that's what GENI is about," he said. "It gives us a chance to run things across the country, not just a simulation in a lab."

One barrier between the realm of research and the mainstream is the capability for automatic configuration. Complex technologies can be sold to the public today thanks to software conventions and standardized protocols that don't require the user to have any knowledge of the product's mechanics. That's why almost anyone can plug in a wireless router and get a home network running without needing to configure ports and set IP addresses. GENI is approaching the point where its underlying technologies will be ready for public consumption, so the market potential is enormous, DuRousseau said.

"It's a multibillion-dollar potential market space, just in the GENI domain itself," he said. "At our conferences, we've gone from letting everyone know that this technology exists and getting people interested in it, to getting it into more people's hands to actually use it and develop. I think it's reached a pinnacle."

In one US Ignite conference demonstration, a 5 Kbps camera mounted on a microscope at the University of Southern California relayed video to students in Chattanooga, Tenn., who could view and control the microscope's stage in real time. The demonstration showed how a reduction from a typical latency of about 100 milliseconds to an SDN latency of about 35 milliseconds made the stage's movement appear to be instantaneous and made the application much easier for users. But setting up the demonstration wasn't easy. Organizers reported spending an hour on a conference call with five network managers who each needed to manually adjust their SDN settings so everything would work properly. Automating the process of establishing such a low-latency flow is work that researchers will focus on in the next three to four years and could bridge the gap to the mainstream.

GENI technology like OpenFlow was even adopted by the very network that hosts GENI, an innovation test bed called Internet2. "It's a virtuous circle," said Rob Vietzke, vice president of network services for Internet2. "In some regard, we were created to support things like GENI, and they are created to incubate technologies that we would adopt and bring to deployment."

Internet2 moves more than 60 petabytes of data across its network each month, with parallel purposes to GENI, as the network supports things like genomic research, astrophysics and remote learning. How long until the premarket technologies researched under Internet2 and GENI enter the mainstream depends on the technology, Vietzke said, but it can happen very quickly.

"What we want to do is let people with fairly low resistance try new ideas and adopt them, and fail as well as succeed," he said. "For some things, like what happens with OpenFlow and SDN, you saw this massive change in the way industry was thinking about developing networks over a very short period of time. You can't imagine that every rural health clinic is going to adopt ultra-high-definition microscopes in the short term, but you can imagine that major research hospitals in each part of the country will start to do that within 18 months or so."

Vietzke observed overlap between the work he does in cutting-edge networking technology and his experience working for state government.

"A lot of [IT managers] deal in constrained environments where they are constantly fighting with just getting a little more capacity, capability to solve urgent problems," Vietzke said. "What's happening in US Ignite, GENI and Internet2 is they are helping to create a platform where local innovators find ways to do innovation without having to make a major investment." 🟠GT

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SCIENTISTS SAY MOVING PROCESSING POWER TO THE EDGE OF NET

Mesa, Ariz., is enlisting the Internet of
Things to get a detailed view of traffic
in the city, said Manager of Technology
and Innovation **Alex Deshuk.**

COLIN WOOD/STAFF WRITER

IS EDGE COMPUTING

WORKS SOLVES TOUGH PROBLEMS. PRACTITIONERS SAY IT'S TOO EARLY TO TELL.

KEY TO THE IoT?

Some say edge computing will be the brains behind the Internet of Things. Others aren't so sure.

Like its name implies, edge computing pushes computing power to the edges of a network, so instead of devices like drones or smart traffic lights needing to call home for instructions or data analysis, they can perform analytics themselves on streaming data and communicate with other devices to accomplish tasks. Researchers contend edge computing will allow systems to degrade gracefully, work autonomously and deliver information to decision-makers faster and more efficiently. Practitioners say they'll wait and see.

Ryan LaMothe

Ryan LaMothe, research scientist at the Pacific Northwest National Laboratory, has worked on edge computing for the past four years. No one talks much about it, but it's coming, LaMothe said. The transition to edge computing is subtle. But slow shifts in technology are frequently the most pervasive and have the greatest impact on society.

Edge computing would solve many of the most difficult problems facing robotics and computing infrastructure. A swarm of air- and land-based drones examining a remote forest fire, a collapsed building or a vast tract of farmland is today challenged by an inability to connect and transmit large quantities of data over wireless networks or to receive instructions from a central controller in a timely fashion. These problems are exacerbated by the confusing terrain of disaster environments, but edge computing circumvents these obstacles.

"You don't necessarily have the bandwidth to send the compute or the data back to a cloud system, so the compute needs to happen on the devices," LaMothe said. "They need to be able to figure out who is in their area and they need to understand the context of their mission, and then take that data and send it to the human in the field who needs that data right at that time. It's ultimately to make the human emergency response significantly more efficient."

HIDING IN PLAIN SIGHT?

As a trend, edge computing tends to fly under the radar because it's not necessarily a discrete technology. Instead, mobile devices, the Internet, the Internet of Things (IoT), health care, public safety, personal vehicles and public infrastructure are coalescing into a dervish that merely brings incidents of edge computing along for the ride.

Cities like Mesa, Ariz., are experimenting with new sensors that more intimately connect city infrastructure and citizens' personal property. Alex Deshuk, Mesa's manager of technology and innovation, detailed a new traffic pilot program that doesn't just count cars, but also would show the city traffic patterns and where each car is going. By detecting the radio frequencies transmitted by a car's OnStar system or satellite radio device, along with any smartphones or tablets in the vehicle, the city hopes to take a more granular view of what its traffic looks like and where individual cars are going.

Mesa also uses RFID tags to track assets, like expensive public safety radios. "As those become cheaper, more connectable and more powerful in edge computing, they can do more than just count something," Deshuk said. "They become integral to the function of the devices."

Palo Alto, Calif., is another city with early IoT projects that may gradually push more computation to the edge of the network. A home energy smart meter program allows citizens to access their utility information online. A smart grid pilot in one neighborhood intends to identify usage patterns and improve energy use. A parking space sensor pilot could reduce time spent driving the car while looking for a space. Most recently, the city launched a $3 million smart traffic signal project that will enable traffic lights to integrate with connected vehicles, potentially enabling a future in which people don't need to sit waiting in their cars at a desolate intersection at 2 a.m. for no reason.

But while new IoT applications are sure to continue sprouting like weeds, the future of edge computing is less certain. "This is so early," said Jonathan Reichental, CIO of Palo Alto. "We don't even know where the value is going to be gleaned."

ABILITY TO INFER

Scientists at the Pacific Northwest National Laboratory are working on two main challenges surrounding edge computing, LaMothe said. The first is around a field of study called inferential controls, which is one of the core components needed for successful edge computing. As the name suggests, infer-
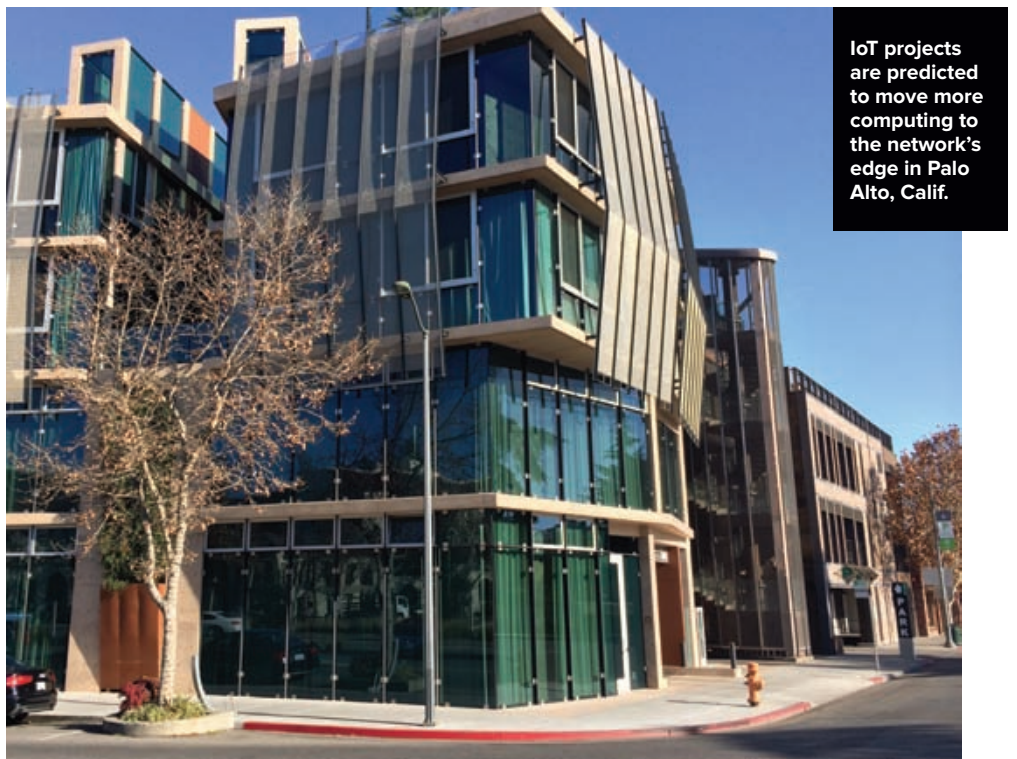
IoT projects are predicted to move more computing to the network's edge in Palo Alto, Calif.

ential controls are the capacity of a device to infer things about its environment and communicate with infrastructure controlled by other entities, a task that humans accomplish every day without much thought.

Anyone who sees a stampede of people running down the street, for instance, would immediately know that something unusual is happening. If the people were wearing paper numbers and running shorts, the observer would conclude a marathon was under way, whereas if people were screaming and there were helicopters overhead, the person might infer that there was a fire or a crazed shooter, depending on the presence or absence of other observable phenomena like smoke or gunfire.

The trouble today is that most devices are designed for one purpose only. "If you're asking a traffic system — because Fukushima happened — where the heck all the cars are going, that system's not worried about Fukushima," LaMothe explained. "It's worried about how traffic works."

Bringing inferential capability to traffic lights or other pieces of infrastructure is no small task. "We're talking about a highly chaotic system," he said. "We don't have all the answers to those problems."

Another big area of research is figuring out how to remove humans from the loop while ensuring that people can leverage the Internet of Things in a controlled and constructive fashion. Much like the Internet, the IoT is expected to take on a life of its own, controlled by no single entity, but because of its immense power will be in great need of oversight.

The National Security Telecommunications Advisory Committee recognized the security implications of rushed IoT implementations in a report to the president last year, which concluded that "there is a small and rapidly closing window to ensure that IoT is adopted in a way that maximizes security and minimizes risk. If the country fails to do so, it will be coping with the consequences for generations."

LaMothe predicts edge computing will take hold in the next five to 10 years and that its proliferation will be shaped by government policy. Just as doctors have had computers for the past two decades but only recently started adopting elec-

tronic medical records, edge computing may depend on the privacy and security framework formed around devices as they join today's next-generation networks and unleash powerful new functionality.

Pete Beckman of the Argonne National Library predicts that "dumb" sensors that only record stats will go the way of the abacus within 20 years.

MORE VALUE

For cities, edge computing could unlock the true value of instrumented infrastructure, said Pete Beckman, senior computer scientist at Argonne National Laboratory. The need for operational intelligence is driving city leaders to deploy sensors on roads, bridges and other physical assets. But in 20 years, today's "dumb loggers" — sensors that merely log metrics like temperature or weight — will seem as antiquated as an abacus, he said. Adding processing capability to those devices lets them act in real time based on the information they collect.

So instead of gathering data for analysis later on, traffic light cameras could analyze the data as they collect it and make immediate decisions to improve the flow of vehicles. Furthermore, traffic lights that can make their own decisions aren't hamstrung by network outages or limited connectivity.

"We're moving the algorithm to the data, not the data to the algorithm," Beckman said. "And that's because we now have really cheap, low-power

processing to make that possible."

There's also new software to support computing on the edge. Beckman and his team recognized a need for an edge computing platform and developed one — it's called Waggle and it's used by an IoT pilot project in Chicago called the Array of Things, a 500-node network to explore how such device networks can make cities smarter.

As infrastructure becomes more intelligent, cities will become better equipped to handle incoming generations of self-driving cars, which will employ edge computing by necessity, lest the streets be filled with the twisted metal of vehicles that momentarily lost their Internet connections and didn't know what to do.

Edge computing also might reduce challenges posed by the growing use of police dashboard and body cameras, which are poised to generate gigantic volumes of audio and video recordings that will tax storage infrastructure and bandwidth. Edge computing cameras could analyze video feeds on the fly and only send home relevant data when needed.

Pedestrian counters and bicycle-sharing sensors are another popular city application where edge computing can transform data held by city IT managers. Instead of a few figures that show how many times the service was used, these

Dynamic traffic management through the use of thousands of connected sensors is improving public transit in L.A., says CTO Peter Marx.

devices could create real-time maps that show how fast people are traveling, what routes they take and where they stop.

IOT TAKES SHAPE

Edge computing doesn't make sense for every use case, but sometimes it can bring an IoT implementation to life, said Miguel Gamiño, San Francisco's CIO.

Transportation will drive edge computing in cities, Gamiño predicted. Dynamic parking meter rating, traffic routing and public transit optimization, along with public safety, are obvious projects that cities will pursue first.

Los Angeles proved that dynamic traffic management works, improving traffic efficiency by 14 percent as it monitors its nodes in real time and communicates with municipal buses to ensure mass transit stays on schedule, said Peter Marx, chief technology officer for the city. "L.A. probably has the largest municipal management traffic system in the country," he said. "We have 4,500 different intersections with stoplights wired to a central computer, and in addition we have some 56,000-odd loop detectors

in the streets, which provide real-time traffic conditions across the entire city."

Boston is another city pursuing traffic and parking implementations in its IoT infrastructure. The city has pilots around smart parking space sensors, smart trash compactors and parking meters with connectivity to other sensing platforms. The city held a hackathon in April in which one team examined the relationship between the smart trash compactors and nearby restaurants.

"That's the kind of question that when you start to combine multiple data sources together you can not only react more efficiently, but you can plan," said Boston CIO Jascha Franklin-Hodge. "There's no point of having a smart trash can just to say the trash can's smart. Who cares? But if it can make the city work better, then that's a worthwhile investment."

Boston is expanding its sensor network in other ways too. Through data-sharing agreements with Uber and Waze, and a growing network of sensors on city vehicles, it's learning more about traffic patterns and other logistical data that can

enrich life for residents. Just as anyone can search Google for an address, other types of data, like where people can park easily or the location of litter problems, can be added to the tome of public knowledge.

But Franklin-Hodge doesn't see edge computing as an essential piece of the IoT. In fact, he said, as IoT applications explode in number, edge computing will be marginalized. "I think edge computing is highly overrated," Franklin-Hodge said. "There are some very specific use cases where edge computing is the antidote to not enough bandwidth and not enough connectivity. What cloud infrastructure has taught us over the last 10 years is that centralized, high-efficiency computing infrastructure in most use cases is going to outperform distributed, lower-efficiency systems in price, performance, scalability, resiliency and all the other things we value. I think a lot of the use cases of edge are going to fall off as we build more robust networks."

And regardless of how pervasive edge computing actually becomes, reliable networks remain a necessity as cities build out their infrastructure and develop the beginnings of an Internet of Things. An infrastructure to support all these devices and sensors is essential, said Reichental of Palo Alto, which currently is expanding its fiber network. Although edge computing may offload some tasks, there will still be a need for broader data aggregation and analysis that's beyond the scope of local computing.

Whatever combination of edge and cloud computing ends up enabling new generations of infrastructure, everyone seems to agree that new ideas and new ways of living enabled by technology will continue being revealed for decades and centuries to come.

"The Internet of Things is a new way of doing business more than it is a product or anything specific," Franklin-Hodge said. "It's a way of thinking that starts with this deep and rich set of data about the objects in our world and poses the question of: With all this knowledge, what do we do differently? How do we build our governments, how do we run our operations, how do we provide services in a way that takes advantage of this knowledge?" GT

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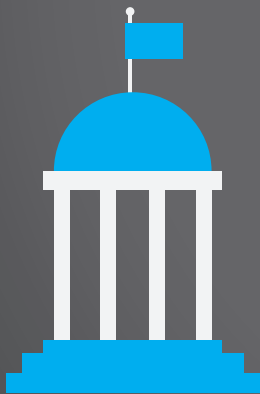
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Laying Groundwork for Open Gov

A new initiative looks to improve open data practices in 100 U.S. cities.

Editor's Note: Starting this month, Chris Gates will write a regular column on civic engagement, good government and the use of open data.

One of the most innovative solutions to help government work better is right under our noses. It exists everywhere, across services and sectors, inside agencies and departments. It's not magic — it's data.

There's a growing focus, both inside and outside of government, on putting data to work to improve services, create more transparency and increase public engagement. The Sunlight Foundation advocates for open data because we know that information is power. The public should have access to information about how government functions, and government should use the data it collects to improve how it works.

More often, data serves as a bridge between the public and government. Los Angeles recently made its water usage data publicly available, and technologists used it to create an app to help users conserve water. Residents can view water waste around them, get alerts about when it's crucial to conserve and engage with the community about water conservation via social media. In Philadelphia, civic hackers recently created a smartphone app to record bike trips in their city. With this data, the transportation department can identify area cyclists' needs and start improving the biking infrastructure.

A data-driven approach to decision-making increases accountability, particularly when the public can access the same information. In Chicago, technologists developed a Web app with crime data released by the police department that lets users explore crime trends citywide and create data visualizations. The app also gives users contact information for each ward alderman. Citizens can use such data to understand the true picture of crime in their community and hold city officials accountable for addressing the issues.

Initiatives like these foster a stronger working relationship between government and the public, and save cities the time and resources it would take to do these projects alone.

Sunlight recognizes that while governments, especially municipalities, are eager to find ways to improve their data use, they face challenges in adding the skills, policies and infrastructure to make it happen. Using data in ways that will benefit the public is something modern tech enables for even the smallest governments, but how can we help them make that transition?

Sunlight has begun work to do that as part of a new effort to support improved use of data in cities nationwide. The What Works Cities initiative, funded by Bloomberg Philanthropies, will work with 100 mid-sized U.S. cities over three years to create and implement better open data policies and practices. It's the most comprehensive initiative to focus on data use in city government. Participating cities will receive the skills, tools and knowledge to gather, interpret and use data to greatly improve decision-making and ultimately their residents' lives. We also hope to see sizable spillover, sparking conversations and leading to better data use in more U.S. municipalities.

While there's been a major shift toward engaging municipal governments to release data in the past several years, the movement still faces several challenges. Some governments argue a broad range of political, personal and practical reasons for not opening data. And some city administrations resist the changes in government culture that would result from data disclosure. There are also concerns over data release being resource intensive, and departments may fear losing funds if information reveals shortcomings in their operations.

But we're optimistic that much of the hesitation to adopt standards for data disclosure will be overcome with help from open data experts like Sunlight. Dozens of localities nationwide have already passed open data policies or developed open data portals to disseminate information, and these cities have made huge strides in adopting data-driven solutions to better their communities.

By putting data to work, we can improve the relationship between government and the public. We can solve real-world problems, which not only makes government work better, but also positively impacts people's lives. And perhaps most important, we can use data to empower citizens to become more active participants in their communities and democracy. **GT**

Chris Gates is the president of the Sunlight Foundation, a nonpartisan nonprofit that advocates for open government globally and uses technology to make the public sector more accountable. Gates is a thought leader in the fields of democratic theory and practice and political and civic engagement.

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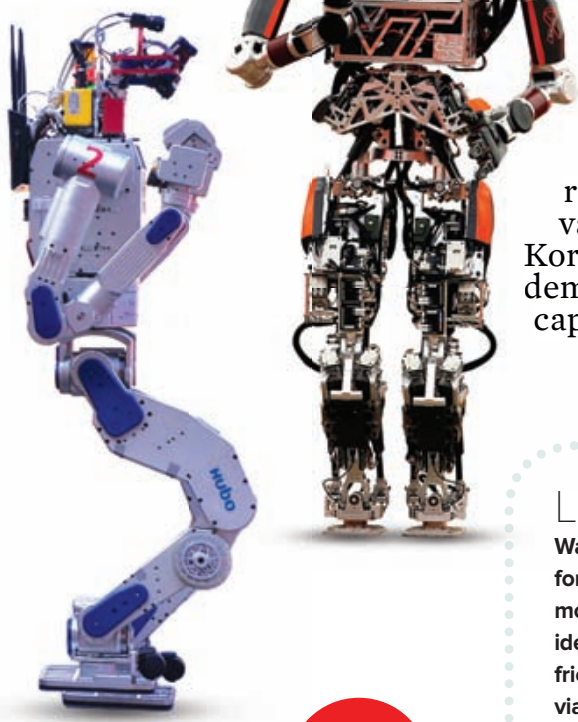
Robots to the Rescue

The 2011 nuclear disaster in Fukushima, Japan, helped accelerate the development of robots that could play a critical role in disaster recovery. The most recent DARPA Robotics Challenge in Pomona, Calif., brought together 23 international teams to compete in a disaster response obstacle course of sorts, challenging entrants' robots to walk through rubble, climb stairs, drive alone, trip circuit breakers and turn valves. Winners like first-place Team Kaist of Daejeon, South Korea, and second-place Team IHMC Robotics of Pensacola, Fla., demonstrate that we are fast approaching a time when robots can capably maneuver incident sites when the risk of sending in human responders is too great.

SOURCE: ENGADGET

DARPA ROBOTICS CHALLENGE

LEAN ON ME

Walking sticks that monitor temperature, blood pressure and pulse have been around for several years, but students at Birmingham City University in England are bringing more technology to the devices. XploR canes use cameras and facial recognition to identify people stored on the user's memory card, allowing him or her to pick out friends and family from 30 feet away. Embedded GPS capabilities that function via Bluetooth help guide users to their destination.

SOURCE: MEDGADGET
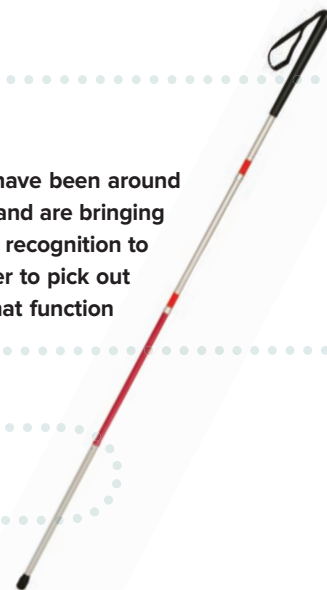
$68 billion

Predicted biometrics market revenue over the next decade, led by fingerprint, iris image and voice recognition technologies.

SOURCE: TRACTICA

A Useful "Buddy" at Work

Who doesn't want to get more done with less stress? Workforce analytics company Sapience has released its Buddy PC app, which leverages more than 220 million hours of workplace data to help people gain control over distractions and ratchet up productivity. The confidential app analyzes individual work patterns, including time spent on different tasks, and recommends simple changes to boost wellness and work output. Buddy follows the company's Enterprise product, which now has 100,000 users around the world. Data from the individual version, though, is not uploaded to any server; it's intended only as a "virtual assistant, quietly holding up a mirror to your workday."

SOURCE: STREET INSIDER

Send Spectrum ideas to Managing Editor Noelle Knell, nknell@govtech.com, twitter@GovTechNoelle

Smart Disclosures

States should use open data to empower consumers.

Choice engines — interactive, online tools that use machine-readable data to help consumers make more informed decisions — are a private-sector staple. E-commerce sites, e.g., Amazon and Netflix, famously use recommendation algorithms that help consumers decide what product to buy or what movie to watch based on millions of consumer reviews. But state regulators have largely overlooked these tools, instead focusing their efforts on making specific information available to consumers, such as airline baggage fees or home mortgage terms. Such disclosures can also lead to improved business practices, such as when food manufacturers reduced the amount of trans fat in their products after the Food and Drug Administration began requiring them to include this information on nutrition labels. However, regulators should also consider how they can unlock additional data sets to enable the development of sophisticated choice engines that help consumers make wiser purchasing decisions in areas of the economy where the market lacks transparency.

Simple tools might bring together lots of useful data that consumers might otherwise not have at their fingertips when making a purchase. The National Highway Traffic Safety Administration runs safercar.gov, which helps drivers discover vehicle safety ratings, determine if a recalled used vehicle has been repaired and find the safest child car seat. More advanced tools help individuals understand complex data. For example, the company BrightScope harnesses a wealth of public data, like the 401(k) filings companies must submit to the U.S. Department of Labor, to produce independent ratings about the performance of retirement plans and financial advisers. These ratings help savers make better investment decisions, like learning how their employer's retirement plan compares to others.

While the federal government has led most smart disclosure efforts, including creating a presidential task force to explore this issue, states can do much more to promote market transparency by directly releasing the data they collect or facilitating the release of private-sector information about products and services. State insurance commissions, in particular, can adjust their practices to make detailed data about insurance products publicly available.

As a 2014 *UCLA Law Review* article found, states have failed to create policies that would uncover key data about property, casualty and life insurance. For example, in most states consumers can't compare the rate at which insurers deny claims or the kickbacks insurance agents receive for selling different products, even though state insurance commissions often collect this data. Nor can consumers easily compare competing insurance products because state insurance commissions don't require that policy terms and conditions be made publicly available, much less posted online in a machine-readable format. As a result, third parties haven't developed meaningful recommender systems to help consumers discover the best insurance products for their needs.

The lack of data in this market limits the incentives that insurers have to deliver better products since consumers cannot easily compare insurers or reward those that offer the best products. This contrasts with other sectors where policymakers have prioritized transparency. The Consumer Financial Protection Bureau, for example, altered the competitiveness of the credit card market, in part, by creating a public database of credit card agreements.

While states should take up the call for smart disclosures, they shouldn't do it alone. Smart disclosures work best when consumers can access well designed choice engines, but policymakers shouldn't reasonably expect third parties to develop separate choice engines for each state. Instead, states should work together, including through national forums like the National Association of Insurance Commissioners, to create common open data standards so a single choice engine can work for all governments. This way it's easier for third parties to develop choice engines.

San Francisco and New York City proved the value of such partnerships when they jointly developed a single standard to publish restaurant inspection information. Websites like Yelp quickly integrated the data so consumers can consider health scores when choosing where to eat. Smart disclosures are not a panacea and can't replace other consumer protection efforts, but they're an important tool that policymakers should use to empower consumers. ⑥

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.

Growing Local Security Talent

Can cybercompetitions help fill government security job vacancies?

Wherever I travel, the top concern on the minds of CIOs and chief information security officers is the same — everyone needs more cybersecurity talent. The problem has become especially acute in government, where it's compounded by an improving economy, growing enterprise cyberneeds and a retiring public workforce. The bottom line: Hiring cybersecurity staff is hard for state and local governments.

What can possibly be done? If the most experienced cyberexperts are becoming too expensive, how can the public sector attract the skilled security professionals it needs?

One answer growing in popularity is to "get in the game" — literally. Across the world, various forms of cybercompetitions are growing in participation. Federal, state and local governments are working with nonprofits to encourage the development of cybersecurity skills through individual and team competitions.

Or, to use a sports analogy, if you can't compete in the free agency market for top talent, refresh your "farm team" and grow your own talent starting at an early age.

All across the U.S., young people love to compete and not just in sports. There are many academic competitions, from university debate teams to the National Spelling Bee to high school quiz bowls.

But how do cybercompetitions fit in?

According to the U.S. Department of Homeland Security's website on cybercareers and studies: "DHS believes hands-on cybercompetitions are a valuable learning method for all students, regardless of level. Cybercompetitions are interactive, scenario-based events or exercises that help students develop and increase cybersecurity skills outside the traditional academic environment."

Typically teams of students work together to attack and defend against the opponent's networks and computer systems. For example, in a cyber "capture the flag" game, players race to answer security challenges by seeking digital "flags" hidden on servers, in encrypted text or in applications. When a player or team submits a flag, they receive points for solving the challenge. The team with the highest cumulative score wins.

There are plenty of cybercompetitions geared toward different skill and age levels. A few options:

1 / The Air Force Association CyberPatriot program has three main programs: the National Youth Cyber Defense Competition, AFA CyberCamps and the Elementary School Cyber Education Initiative.

2 / The annual National Collegiate Cyber Defense Competition, which began in 2004, is like the March Madness of cybercompetitions. Colleges compete in state events, leading to regional and national competitions.

3 / The U.S. Cyber Challenge consists of competitions, cybercamps and a virtual community to help the public and private sectors, as well as high schools and universities.

4 / SANS Cyber Aces offers state competitions as well as national opportunities for individuals to compete and learn. NetWars, also from the SANS Institute, is a cybergame based on the idea that the best way to learn is via hands-on experience with real-world scenarios.

5 / The National Cyber League provides ongoing virtual training for faculty and students to develop and validate cybersecurity skills using content aligned with individual and team games. This approach is used across diverse industry certifications, curricula, job roles and verticals.

6 / The Michigan Cyber Range offers many chances for public- and private-sector organizations to test team skills in Alphaville, a virtual small town. They can attack and defend the city hall, utilities, library and more in various scenarios.

Cybercompetitions have become the new normal for learning and improving ethical hacking techniques and cyberdefense in a safe, fun, challenging environment. Whether you're a middle school student just starting to learn cybersecurity concepts, an unemployed millennial who wants to switch careers, a midlevel security expert with a computer science degree or a government supervisor trying to attract the right employees, it may be time for you to join a cybercompetition.

My advice? Get in the game. ⒼⓉ

Daniel J. Lohrmann is the chief security officer and chief strategist at Security Mentor. He is an internationally recognized cybersecurity leader, technologist and author. From 2002 to 2014, Lohrmann led Michigan's award-winning technology and cybersecurity programs, serving as CSO, CTO and CISO.

Out of Ideas?

How to constantly come up with new social media content.

If your job involves posting on social networks on behalf of your government agency, odds are that you will, at some point, run out of ideas. One of the best tricks is to establish an ongoing system for constant idea generation. It's important that this is something you're always doing, so here are a few resources and techniques to have handy.

Establish Google Alerts

This type of email alert will be delivered to your inbox and allows you to monitor what is being posted online about your city, agency or event. It can also give you insight into what people want to know from or about your community. You can choose any keywords or phrases you would like to monitor. Make sure to put your keywords in quotations, such as "city of _____," to refine the alerts you receive. Combining this with another term like "ranked best for" or "was voted the best" is a good technique to receive an alert if your agency or city has been ranked by a publication. Use these announcements as the basis for social media posts.

Set Up a Facebook "Watch List"

This feature of the Facebook Insights panel allows you to see how other pages are performing. I encourage you to "watch" Facebook pages that your audience is following,

as well as similar jurisdictions that are doing exceptionally well on social media. Facebook will alert the managers of the other page that it was added to a watch list, but it will not identify your page specifically.

> **Generate more content by turning a stand-alone message into a longer campaign. Companies do this all the time, and it can be a great content technique for government agencies as well.**

Monitoring pages on your watch list will give you a bit of data on how well (or how poorly) their posts perform. This is a great way to see what types of content may work well for your page and to get several ideas for your own posts along the way.

Cover Events Live

Government agencies are no strangers to hosting events. Whether it's a council or committee meeting, seasonal event or community activity, public agencies host numerous events all year long. Many times, we stop promoting once we get bodies in the door. However, event coverage is one of the best ways to generate rich social media content. Live-tweet the activities as decisions are made, share photos in real time as citizens participate in activities, and even record a video and upload it directly to YouTube. Make sure to promote an event hashtag so your audience can follow along online.

Convert Single Messages into Campaigns

Generate more content by turning a stand-alone message into a longer campaign. Companies do this all the time, and it can be a great content technique for government agencies as well. For instance, say you want to promote Bike to Work Day. Typically this might involve posting an announcement on Facebook, as well as sharing one or two tweets. However, turning this single message into a campaign might involve separate posts showing photos from last year's event, reminders about bicycle safety, and perhaps photos of bicycles in front of city hall or the county building.

A little creativity can go a long way in creating a campaign experience that gives you a great deal of content to work with on social media. **GT**

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.

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