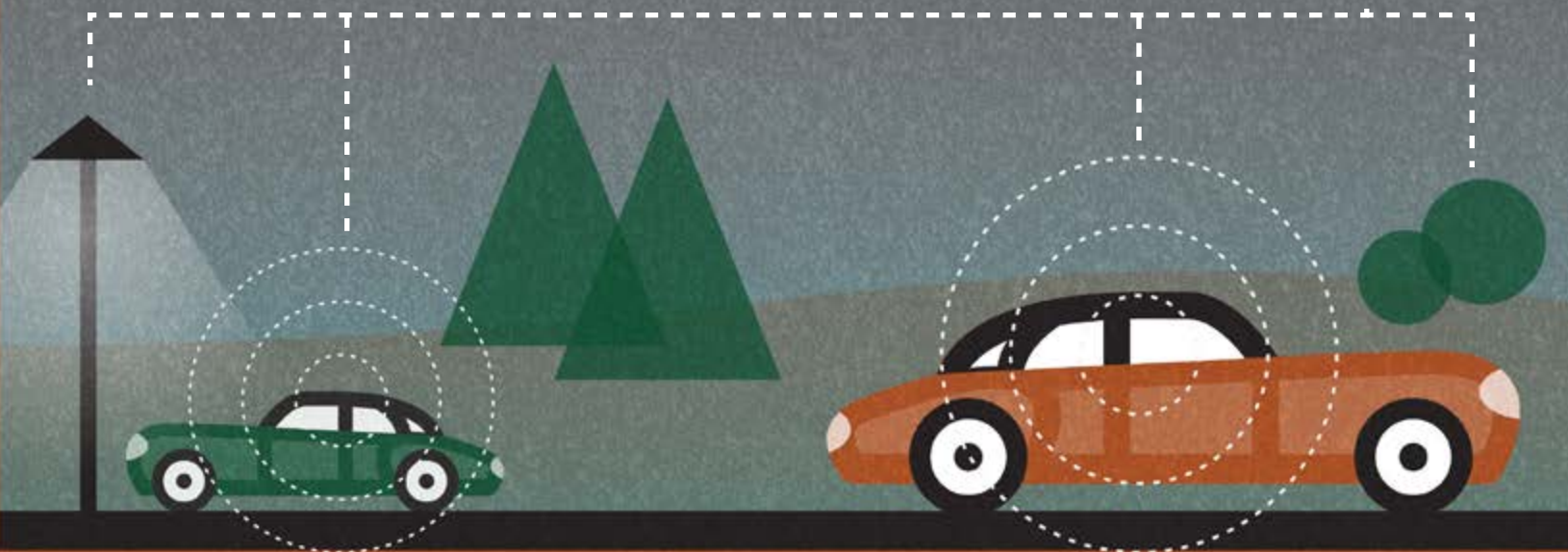


THE INTERNET OF THINGS:

Preparing Yourself for a Connected Government



INNOVATIONS THAT MATTER



COFFEE BREWED AT
140 DEGREES F



SENSOR ALERTED-
CALENDAR UPDATED

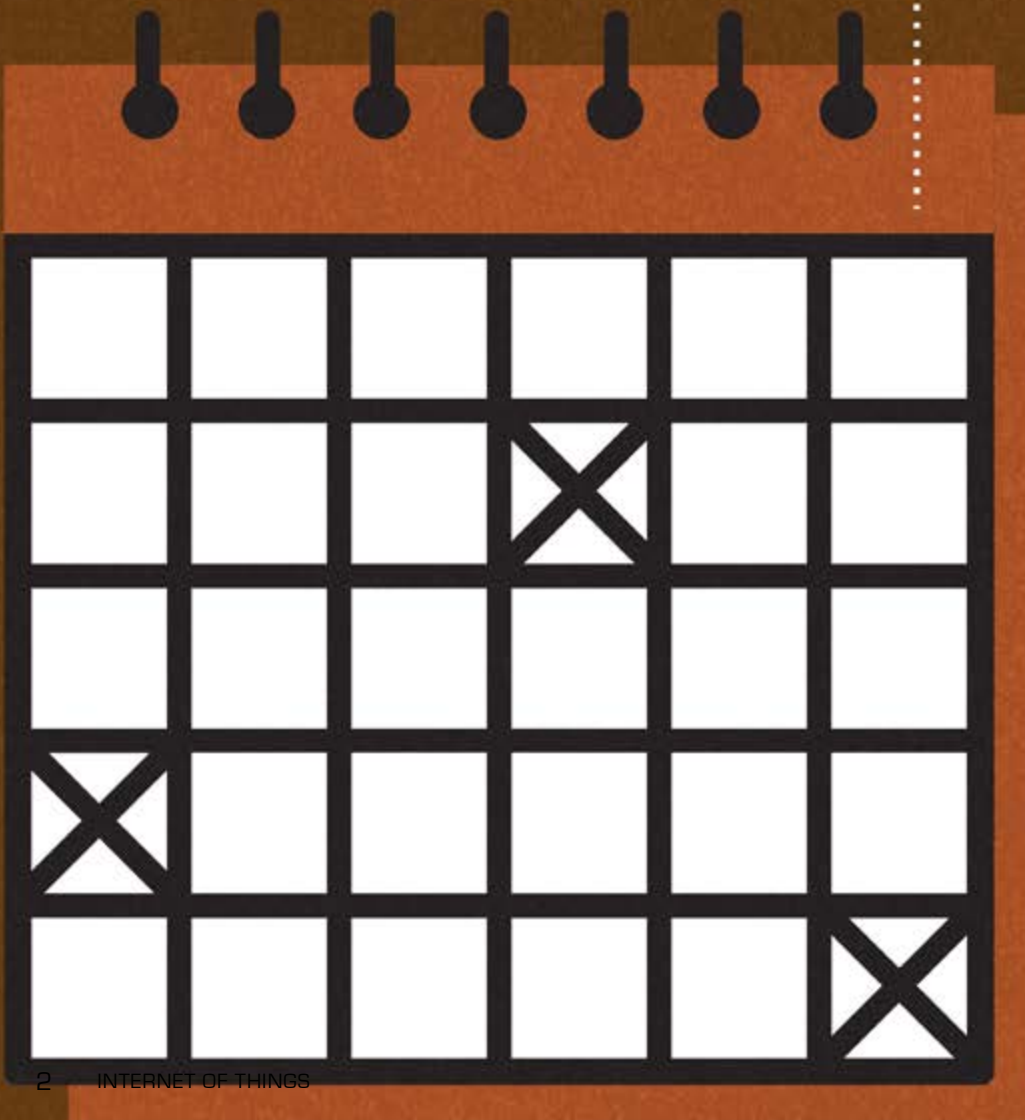


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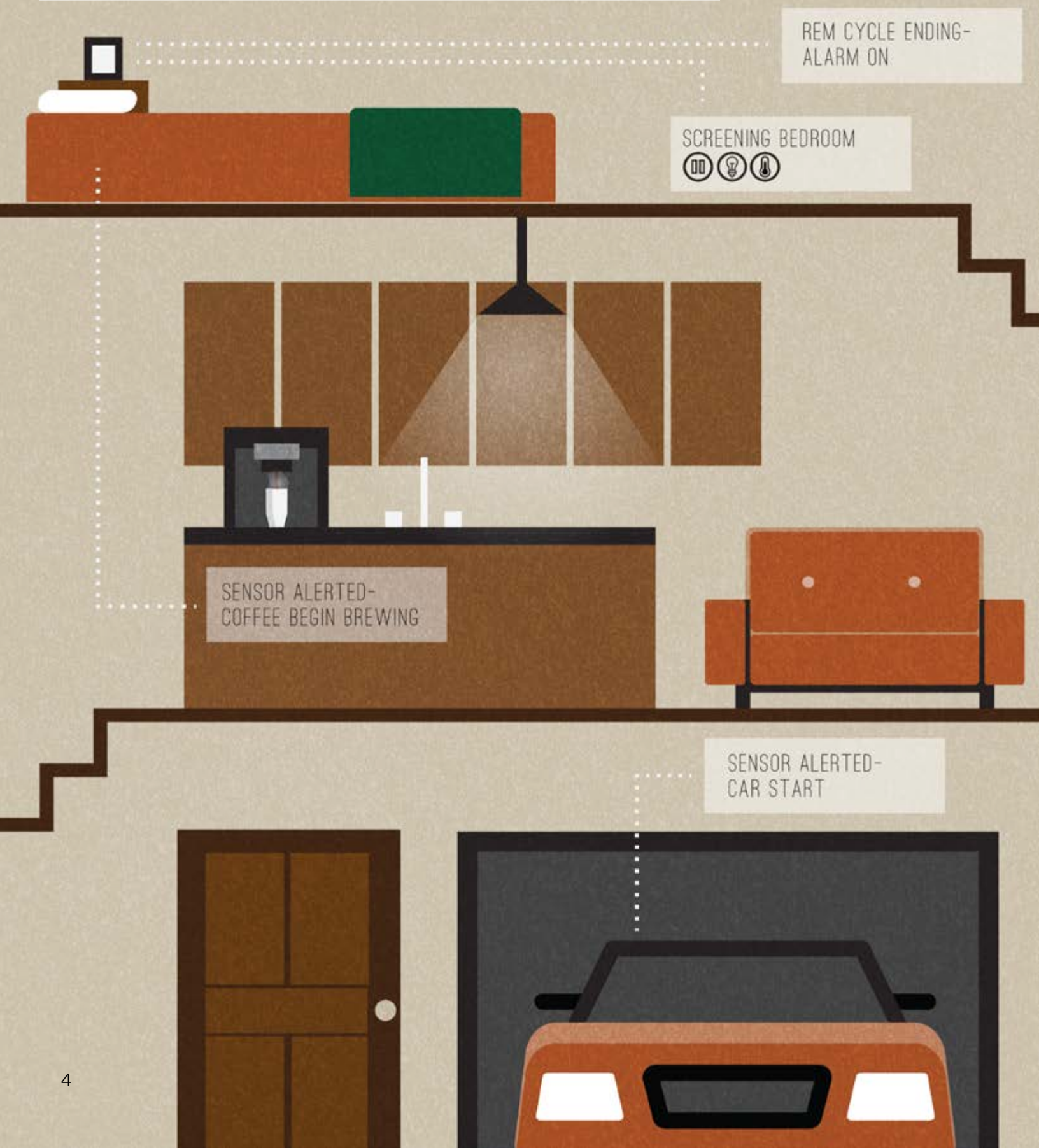
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ACKNOWLEDGMENTS



EXECUTIVE SUMMARY

We're Not in the 20th Century Anymore: The Internet of Things is Happening Right Now



Imagine the following scenario: At home, you're gently awakened by an alarm system that's tied to your internal sleep cycles. As you stretch, well-rested from just exiting a REM cycle, a sensor in your mattress registers that you're about to get up, and sends a signal to your coffeemaker to start brewing that required cup of joe. As you shower, the connected system in your house alerts your car that you will be starting it in about 20 minutes, giving it ample time to warm up and find your preferred radio station settings. And when you reach for milk to pour in your coffee, you have plenty — because yesterday, your wired fridge sensed you were running low and sent you a message to tell you to pick up a new carton.

As you drive to work, constant signals from your car interact with the street signs, street lights and even other vehicles on the road. Ack! The driver in front of you brakes suddenly. Luckily, your vehicle received an alert to slow down, allowing enough time to avoid a rear-end collision and keeping everybody safe.

As you walk into work, your computer turns itself on because your car has alerted it that you've entered your office parking lot. The thermostat in your office begins to adjust to your desired setting — a little cooler than most of your officemates prefer. This morning, you're running a little late, so your calendar pushes back your 9 a.m. meeting because it can tell by the route your car took that you're not going to make it to the office in time.

At the end of the day, you have a late start to leaving the office, too, so as you start your car, your phone automatically sends your spouse a text message saying you'll be 10 minutes late for your dinner reservation. After a delicious meal at your favorite Italian café, you groan as your phone tells you the amount of calories you've ingested — and suggests a healthier meal plan for tomorrow, based on what ingredients you have in your fridge.

Finally, you drift off to sleep on your sensor-connected mattress, as a device next to your bed tracks your body movements, breathing cycles and heart rate, simultaneously screening your bedroom for noise pollution, room temperature and light levels. It's been a productive day — and you barely had to do anything.

The reason? It's called the Internet of Things (IoT). And this scenario may sound far-fetched, but in some cases it's already happening — or will be, and sooner than you expect. As the famous movie line goes, "Toto, we're not in Kansas anymore."

But while it's easy to find ways in which IoT has affected private and consumer-facing enterprises, its effect on the public sector and government is less concrete. What's clear, though, is that although government may not yet be taking advantage of the technology and applications that IoT can offer, it's coming hard and fast toward the public sector — and it's time for government workers to get ready.

That's why GovLoop has put together our guide, *The Internet of Things: Preparing Yourself for a Connected Government*. More even than the consumer-facing sector, government is set to be completely transformed by this new, futuristic technology. But most government workers don't know yet what IoT means.

In a GovLoop survey of 800 public-sector and industry employees, 49 percent said they had never heard of IoT, while 15 percent said that they "had heard of it and were not sure what it means, but want to learn more." About a third — 35 percent — said they were aware of the phrase and knew its meaning, but only 9 percent of survey respondents said that their agency or organization was currently exploring or using IoT.

"If the Internet of Things has to do with home automation or automation of the car, controlling devices like security systems through the Internet and wireless networks — things affecting things, what does this even have to do with any of the service-provided departments of government?" asked one survey respondent.

Quite a lot, actually. So let's get started.

This guide will give you:

- A solid understanding of what IoT is.
- Case studies of current IoT usage in the public sector.
- Ways in which all of government is poised to be affected by this technology.
- Best ways you can prepare for its adoption.
- And much more.

IoT is going to change life, and government, as we know it. You'll want to be ready.



Cisco, Enabling a World of Many Clouds

Government IT organizations are facing a new set of challenges, as the consumption of IT is shifting from the traditional model of acquiring hardware and software and deploying it onsite, to a managed or cloud services model.

Cisco is helping public sector organizations use technology to access applications, content and services through the cloud.

To learn more about how Cisco can help manage these changes in IT consumption, visit Cisco.com/go/ITconsumptiongov.



“It’s People, Processes and Data That Create the Real Value”

An interview with Dan Kent, Chief Technology Officer & Sr. Director of Systems Engineering for Cisco US Public Sector

What’s at stake for the public sector when it comes to the Internet of Things?

Kent: As the IoT (composed of connections between data and things) continues to transform into the Internet of Everything (IoE), which fully integrates process and people into that mix, a great deal is at stake in terms of both opportunity and confronting new challenges. Cisco recently produced research on the IoE value at stake for the public sector, which estimates the value of new revenue, increased productivity and cost savings, to be roughly \$5.4 trillion worldwide in the next 10 years. Now again, this isn’t just about dollar and cents – this is about innovation, customer service and asset utilization. How can we utilize or repurpose assets differently to lower overall cost of operation? How do you enable employees to be more productive? And of course, enhancing customer experience – how can you give your constituents a better experience with how they work with you as a government entity and how you provide services to them? It’s about people, processes, data and things working together and reacting in real time, and that’s where you really start to see the value.

How is Cisco helping the public sector get ready for the Internet of Things?

Kent: Well, if you look at what’s needed for the Internet of Things and what lies ahead for Internet of Everything, there are several critical elements that Cisco can help with to shape IT for the future. First, you have to have ubiquitous connectivity delivered by a ubiquitous network, which is where Cisco plays and has been playing a significant role for a long time. You also need to have, and I’ll use the term loosely, a “cloud.” From a cloud perspective, the value is about delivering centralized storage and compute capabilities to the Internet of Things. All of the “things” or sensors out there are creating or collecting data. For the data to be useful it must be delivered to a central and accessible space, and the users need to be able to do something with that data: consolidate it, analyze it, establish processes to take action on that data. And of course, Cisco is a big deliverer of the cloud.

As the role of IT leaders changes, navigating this increasingly complex landscape requires more than delivering isolated systems. It’s more than business as usual. Today, it’s critical to assess how platforms and trends integrate and converge. The need for IT is to become increasingly simple, smart, mobile and secure. The result: rapid new service deployment, compen-

ling customer/citizen experiences and organizational agility for public sector organizations. We call this concept “Fast IT” and it is a key mantra on how we are developing our products.

Where do you expect the Internet of Things to make a big impact?

Kent: I think public safety is an area that we’re really seeing the transformation empowered by the Internet of Things come to life. It includes things like surveillance systems being deployed to augment the police forces, providing safe learning environments in schools and delivering economic development in some previously difficult municipal areas. We’re also seeing connected lighting being used to help with public safety, lighting systems that turn on only at certain times, or only when there are people around, ensuring that citizens are not left in the dark and at risk, and would-be criminals are in the spot light and less inclined to commit a crime. So you’re seeing public safety as a whole being impacted in positive ways.

We are seeing IoT impact transportation already. Processes ranging from enhanced fleet maintenance (leveraging predictive analytics and connected sensors in vehicles), to real time bus and train schedule visibility – these are becoming common.

The Internet of Things will have an impact on every vertical within public sector; education, defense, government and healthcare to name a few. I see the reach of IoT pervasive as these unconnected systems start to get online.

What are some ways agencies can prepare themselves for this new technology?

Kent: To get your agency prepared for the Internet of Things, you must first ensure your infrastructure can support it and second, understanding that the non-IT lines of businesses will be critical in these developments, you must educate the LOBs on IT enablement. The former is critical to ensure that you have the ubiquitous secure infrastructure (wired/wireless) that can allow communication between those sensors and the systems which they will be accessing. Delivering an IOT framework will stretch the perimeter of most agencies networks as IOT typically expands beyond the walls of an agency. This also means that you need to have an infrastructure that can support mobility. Asset visibility and data security will be scaled like never before, so good policy and processes are paramount.

INTERNET OF THINGS 101: UNDERSTANDING THE BASICS

First things first: What the heck does the phrase “Internet of Things” mean?

Turns out that the definition can vary, but [a recent Pew Research Center report](#) defined the Internet of Things as a catchall phrase for the array of devices, appliances, vehicles, wearable material and sensor-laden parts of the environment that connect to the Internet and to one another and feed data back and forth automatically.

San Francisco provides an example. The city has connected several thousand of its parking meters via sensors so that drivers using an app can find open spaces faster. To help get to a reasonable level of parking availability, the program and its parking sensors periodically adjust meter and garage pricing up and down to match demand.

In summary, IoT is a series of devices connected to one another via the Internet — and these devices can talk to you, too, via the information you enter or sensors that you

wear and operate. And most of it is automated, meaning these interactions can happen without you even having to do anything.

It might sound simple when you put it that way, but it's a big deal: Internet-connected machines are expected to number 200 billion by 2020, according to research firm IDC Corp. At that rate, these automated machine-to-machine transactions will outnumber human-to-computer transactions.

In terms of public-sector impact, Cisco Systems [estimated in a recent white paper](#) that IoT will offer “a \$4.6 trillion opportunity for global public-sector organizations over the next decade, as a result of cost savings, increased productivity, new revenues and enhanced citizen experiences.”

But how exactly will IoT affect the public sector?



DEVICES
INTERCONNECTED

GOVLOOP SURVEY FIGURES

HAVE YOU HEARD OF THE INTERNET OF THINGS?

YES

35%

NO

50%

I'VE HEARD OF IT AND AM NOT SURE WHAT IT MEANS
BUT I WANT TO LEARN MORE

15%

IS YOUR AGENCY OR ORGANIZATION CURRENTLY ACTIVELY EXPLORING OR USING THE INTERNET OF THINGS?

YES

9%

NO

40%

UNSURE

51%

WILL YOUR ORGANIZATION BE USING THE INTERNET OF THINGS IN SOME WAY WITHIN THE NEXT THREE YEARS?

YES

14%

NO

10%

UNSURE

76%

A FEW WAYS SOME SURVEY RESPONDENTS' AGENCIES ARE CURRENTLY USING THE INTERNET OF THINGS:

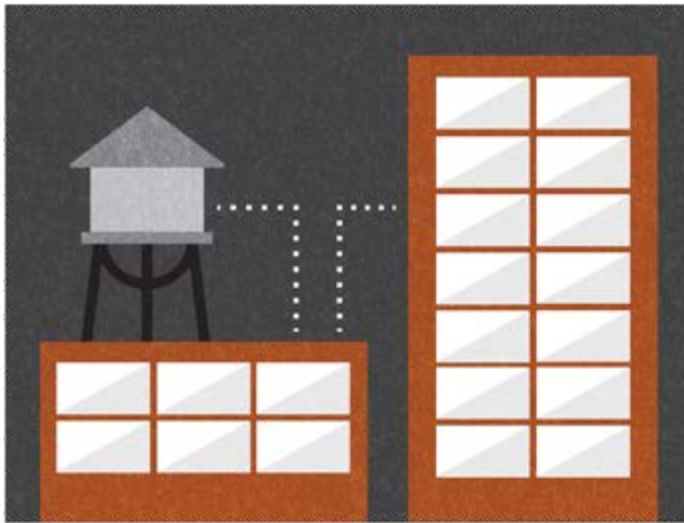
- Smart buildings — automated information from our building systems to help better drive efficiency.
- We're looking at how vehicles will talk with each other and the environment.
- Traffic management, pollution sensors, smart parking systems, wayfinding and pedestrian traffic monitoring.
- Printers, copiers, lights, computers, phones, etc. are all on intelligent systems. We have "smart" surveillance systems. We are increasingly using AI and autonomous systems, connecting multiple devices on multiple networks. especially interesting for energy efficiency.

SOME CONCERNS THAT GOVLOOP SURVEY RESPONDENTS CITED ABOUT THE INTERNET OF THINGS:

- Passive info gathering/being unaware that we are sharing/receiving data
- Information overload. And what happens when the information is wrong?
- Loss of autonomy and having a machine or software program make decisions for me.
- How would you maximize usefulness while maintaining privacy?
- Economic inequity as it applies to access.
- Privacy of information — and security.

4 WAYS THE INTERNET OF THINGS WILL CHANGE GOVERNMENT

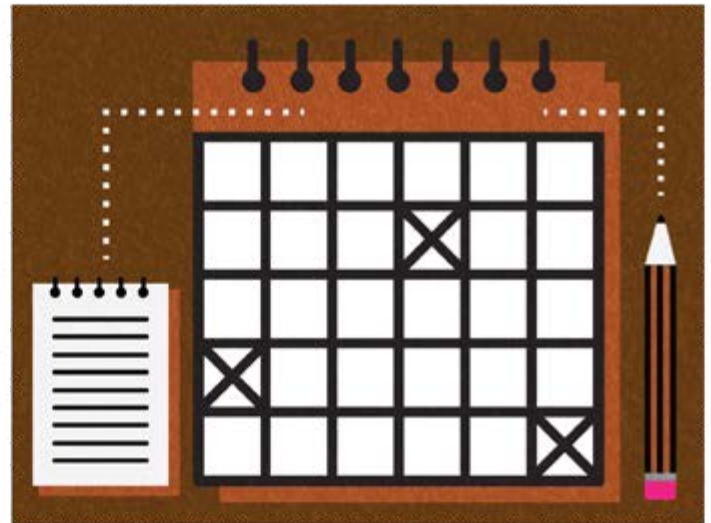
Perhaps by now you've gotten the sense that IoT will affect government. Here are four of the ways we see the technology transforming public-sector operations.



1. COST SAVINGS/REVENUE

The massive cost savings potentially available via use of IoT are reason enough for government and public-sector workers to get excited about the technology. These cost savings can be achieved in many ways, such as building maintenance. “Smart” buildings — those with connected, automated, continuously self-monitoring energy systems — could generate \$100 billion by lowering operating costs by reducing energy consumption through IoT integration of HVAC and other systems, according to Cisco.

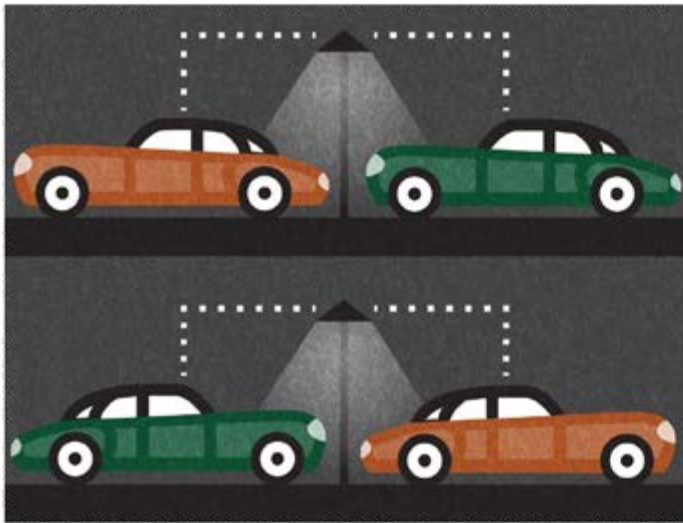
The General Services Administration is already taking advantage of these savings in its building maintenance. Through the GSALink initiative, thousands of sensors are monitoring energy use in federal buildings. “In every building in [our] test, there’s an average of 2,000 sensors on various points in the building,” said GSA Administrator Dan Tangherlini at a recent IoT event. “We then measure the performance data against the manufacturer’s expectations for usage to determine if the buildings are consuming the right amount of energy, and to determine whether there’s an opportunity for cost savings.”



2. EMPLOYEE PRODUCTIVITY

The effect on employees’ personal productivity is obvious. If a worker can get to the office faster and safer via connected sensors, that’s a plus for everybody involved. And if calendar updates or meetings can be automatically moved depending on people’s locations and availability, that’s another productivity bonus.

But the increases in employee productivity due to IoT adoption will make themselves clear in many other ways as well. The increasing availability of data on citizens and their behaviors will create opportunities to fine-tune current government practices and innovate novel services and public-sector models.

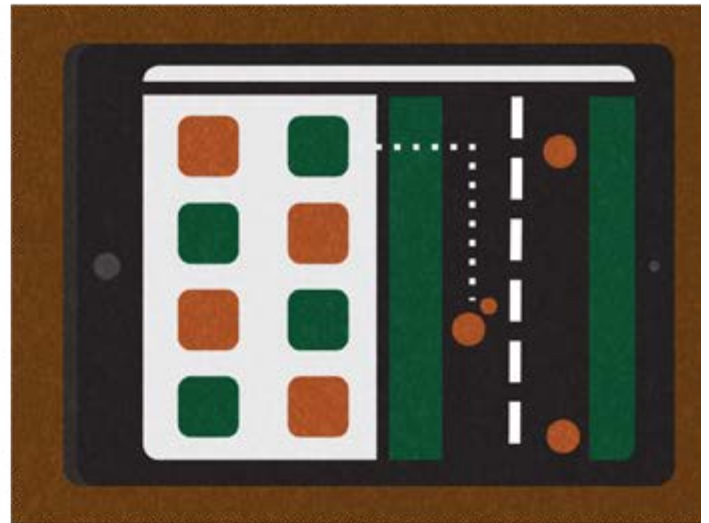


3. IMPROVED CITIZEN REQUESTS AND SERVICE DELIVERY

Governments at all levels worldwide have long been dealing with an important dilemma: how to meet increased citizen expectations in the face of slashed budgets. IoT may be one answer.

IoT promises us advances such as improved traffic flow and better, more intuitive building maintenance and water management. Another option: Imagine a system of sensor-connected streetlights that could be used to monitor pedestrian traffic. If someone is walking down a dark street, the sensors could tell the lights to turn on.

IoT is already affecting citizen service in a slightly less glamorous way: via trash cans. In a variety of international cities, some garbage cans are tagged with connected sensors that measure weight. The idea is simple: Officials know when bins are full or empty and are able to plan more efficient routes for trash collectors — and ideally, never let the bins overflow.



4. IMPROVED INNOVATION

It goes without saying that as IoT applications rise, so does the amount of data they generate — and along with this data comes an amazing opportunity for innovation.

“If some of IoT data is made available as open data, you could enable civic hackers, data scientists, anyone to do amazing things,” said Abhi Nemani, GovDelivery’s Civic Innovator-in-Residence. “There are already some examples of apps built on real-world infrastructure data (like Street-Bump, a pothole-measuring app in Boston), but those are really just the start. Once civic hackers can dive into the Internet of civic things, the results should be exciting.”

NetApp storage powers FlexPod™, the world's #1 integrated infrastructure?



Yep, NetApp.
yepnetapp.com

Get the *IDC Worldwide Quarterly Integrated Infrastructure and Platforms Tracker 2014Q1 Report*

[Learn more ↗](#)

Get the *Cloud Computing—the Path to Increased Efficiencies and Cost Savings for Government Agencies* Whitepaper

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NetApp®

“It’s Turning a Torrent of Data into Useable Knowledge”

An interview with Steve Fritzinger, NetApp’s public sector alliance manager

How is NetApp helping public sector adapt to using the Internet of Things, and how your technology will come into play?

Fritzinger: The biggest thing about the Internet of Things is it is an order of magnitude greater number of devices connected to the Internet than we have today. Gartner estimates that there will be something like 26 billion devices connected to the Internet of Things by 2020. It’s a factor of ten larger than what we have now. That means there’s going to be a torrent of data coming in that is going to have to be stored, managed, analyzed and basically turned into usable knowledge. NetApp’s play in this is in the storage of the data, trying to keep up with the flow, as it all comes in. In some applications there will be such a torrential amount of data you will need to be able to record all of it, store it as cheaply as possible – and then figure out new ways of turning it into useable knowledge. It’s very unlikely that you’re just going to be dumping all of this into a file system and then trying to read it.

Our role is to show people how to build an infrastructure that can capture all the data as it comes in and then get it into these databases, deploy it to multiple analysts and help them accomplish their mission with it.

That’s where FlexPod comes in. Our FlexPod Select architecture is built for Big Data workloads. Whether you’re using a NoSQL database, Hadoop or other analysis tools, FlexPod Select gives you a solid base on which to build those solutions.

“figure out how to use that data appropriately – not just deploy the technology because it’s there.”

What areas of the public sector that will be most impacted by the Internet of Things technology?

Fritzinger: I don’t think the Internet of Things is going to be as revolutionary as the Internet itself was. At least not at first. It’s going to take us time to figure out what the real uses of it are. The applications I think it’s going to make the biggest impact on first are anything where you need to gather a lot of data cheaply across a large geographic area. That could be something like water management, traffic monitoring, pollution control, or forestry research where you want to be monitoring large swaths of a territory and you can’t afford to put Wi-Fi across all of it because it’s just so large. That’s where the Internet of Things will have its first and probably most important impact. After that, I think people will get very clever figuring out new applications that can be built on top of the ubiquitous connectivity that you get when you deploy the Internet of Things.

Look at how people have used previous generations of new technology. I don’t think anyone guessed beforehand that mobile Internet would allow African fisherman to find out which ports offered the highest prices for their catch or that small, HD cameras would allow amateur drone pilots to market condos before they have even been built. We have to get the technology into people’s hands and see what they develop. That’s how the Internet of Things is really going to improve the quality of people’s lives.

How can people start thinking about the Internet of Things and preparing for more widespread adoption of it in the public sector?

Fritzinger: My biggest piece of advice would be to think very, very carefully about what data you want to collect and what you’re going to do with it. Once the sensors and networks are cheap, the temptation is going to be to put them everywhere, and then assume that just because you have this massive amount of data coming in you’re going to understand what is actually happening inside your system. That kind of a thing very rarely works. It’s going to be much more important to think about the problem domain that you’re responsible for and to figure out how to use that data appropriately – not just deploy the technology because it’s there.

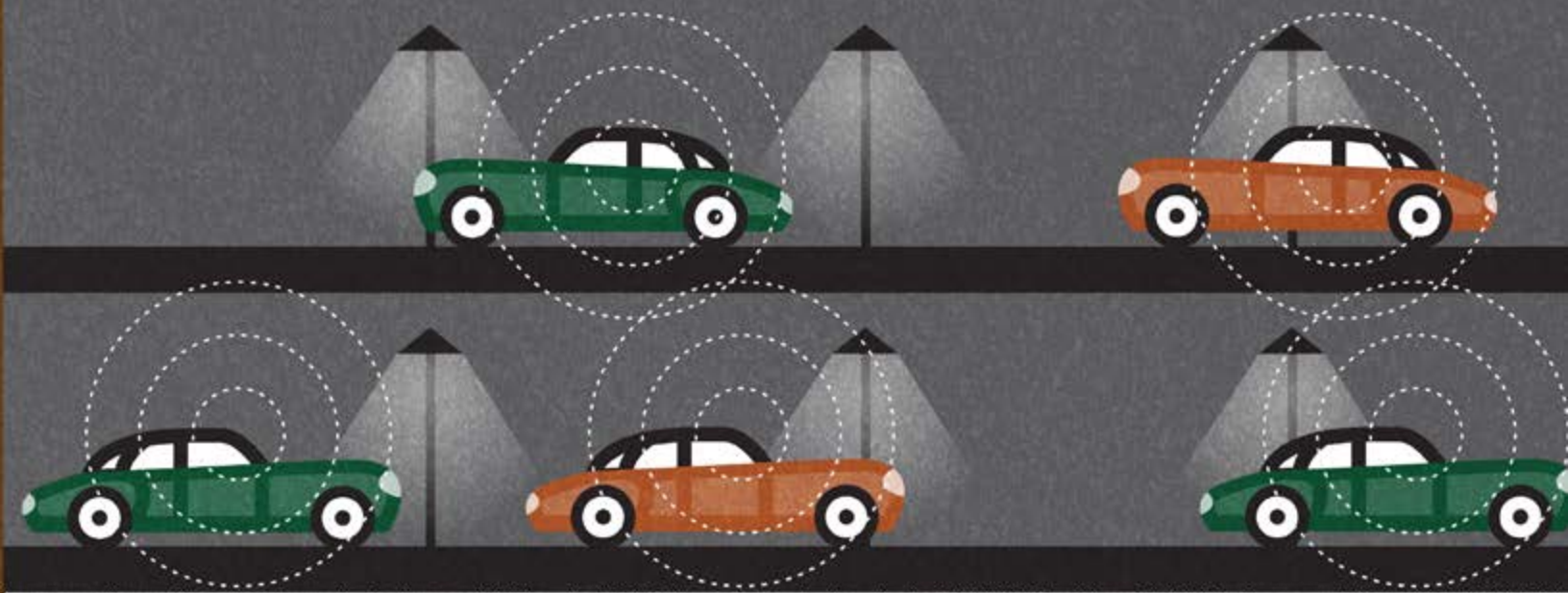
THE INTERNET OF THINGS IN THE PUBLIC SECTOR: GOVERNMENT CASE STUDIES

Overall, IoT has thus far been more of a consumer-driven field, where massive brands such as Starbucks, Nike and Disney are the ones moving the technology forward and using it in day-to-day applications. Adoption of IoT in government has been relatively limited so far, due in part to issues such as how difficult it is to build the infrastructure for the technology in this fiscal climate and a general limited understanding of the potential applications and technology.

But though IoT has not yet overtaken the public sector, if there's one thing we're sure of, it's that it will. And there are already plenty of departments and agencies nationwide that are innovating and establishing IoT test programs.

On the following pages are four case studies about real government programs that are using IoT technology to improve efficiencies, save money and better serve citizens.





Case Study 1: Connected Vehicles on the Road in Michigan

Motor vehicle crashes are the largest single public health crisis facing the United States, according to NHTSA. Crashes are the leading cause of death of people under 35. Road accidents cause more than 32,000 fatalities a year, 2.3 million patients visit emergency rooms annually, and there's a \$70 billion economic cost of congestion-related delay, including accidents.

From seat belts to airbags, the auto industry and the government have long been implementing ways to keep automobiles safer. And today, their latest innovative safety efforts involve IoT.

The **Safety Pilot Model Deployment** is a joint research project between the University of Michigan Transportation Research Institute and the Transportation Department (DOT). This \$30 million project is the largest deployment of connected vehicle technology in the world — and its goal is to make drivers safer via connected and automated technology deployed in vehicles.

"Research indicates that connected vehicle technology has the ability to address as much as 80 percent of crashes of unimpaired drivers," said Francine Romine, the institute's director of communications and marketing.

The vision for the program is to provide a test deployment that showcases the benefits of connected vehicles for safety. In the past, DOT and organizations like the National Highway Transportation and Safety Administration have focused on helping people survive automobile crashes. Connected vehicle safety would focus on helping people avoid crashes altogether.

The 12-month pilot program launched last year in Ann Arbor and involved 3,000 vehicles. The vehicles were deployed with dedicated short-range communications and video recording facilities. This means they could communicate with one another and traffic signals, and share data to a central platform, which then issued warnings during risky situations or when accidents were about to occur.

"The vehicles are communicating with each other and the infrastructure," Romine said. "They send what we call a basic safety message 10 times a second. That BSM communicates speed, location and direction to other cars that are connected. A warning signal is sent when a connected vehicle brakes suddenly, or crosses into a lane, or a vehicle is going around a curve too quickly."

The pilot program ended recently, achieving its objective of testing whether the data collection and vehicles' use of the technology were successful. The data now goes to the National Transportation Systems Center for analysis, and DOT will be taking the next steps soon in the process of rule-making.

Romine hopes that the pilot program will soon lead to a much wider deployment of connected vehicles on the road — and one day, maybe even connected pedestrians.

"We need to expand beyond the basic vehicle-to-vehicle and vehicle-to-infrastructure and protect all road users," Romine said. "Motorcycles and pedestrians are important road users and we need to ensure their safety as well. Traffic management and emergency management are also critical applications we are working on."

Case Study 2: Sensors for Safety

How can IoT improve day-to-day quality of life for citizens — even those who are not connected to the Internet, who don't know what IoT is or who may not be able to afford IoT-enabled technology?

It's a difficult question, but officials in Montgomery County, Md., have been tackling it through a recent pilot program that helps address health and housing issues for vulnerable populations in that county.

The project is called "SCALE: Safe Community Alert Network," and it's a collaborative partnership between the county and researchers from the University of California at Irvine and the Massachusetts Institute of Technology in addition to private vendors including IBM, the France-based low-bandwidth provider Sigfox, and Twilio, a cloud communication firm.

The pilot has put 14 sensors into units in a Rockville apartment building. These sensors work to detect environmental distress factors such as smoke, heat, carbon monoxide and hazardous gas; transmit the data to a cloud service; and if a problem is detected, dispatch emergency response services — all without any of the residents picking up a phone.

The idea started, said Montgomery County Chief Innovation Officer Dan Hoffman, with an existing county smoke detector distribution program.

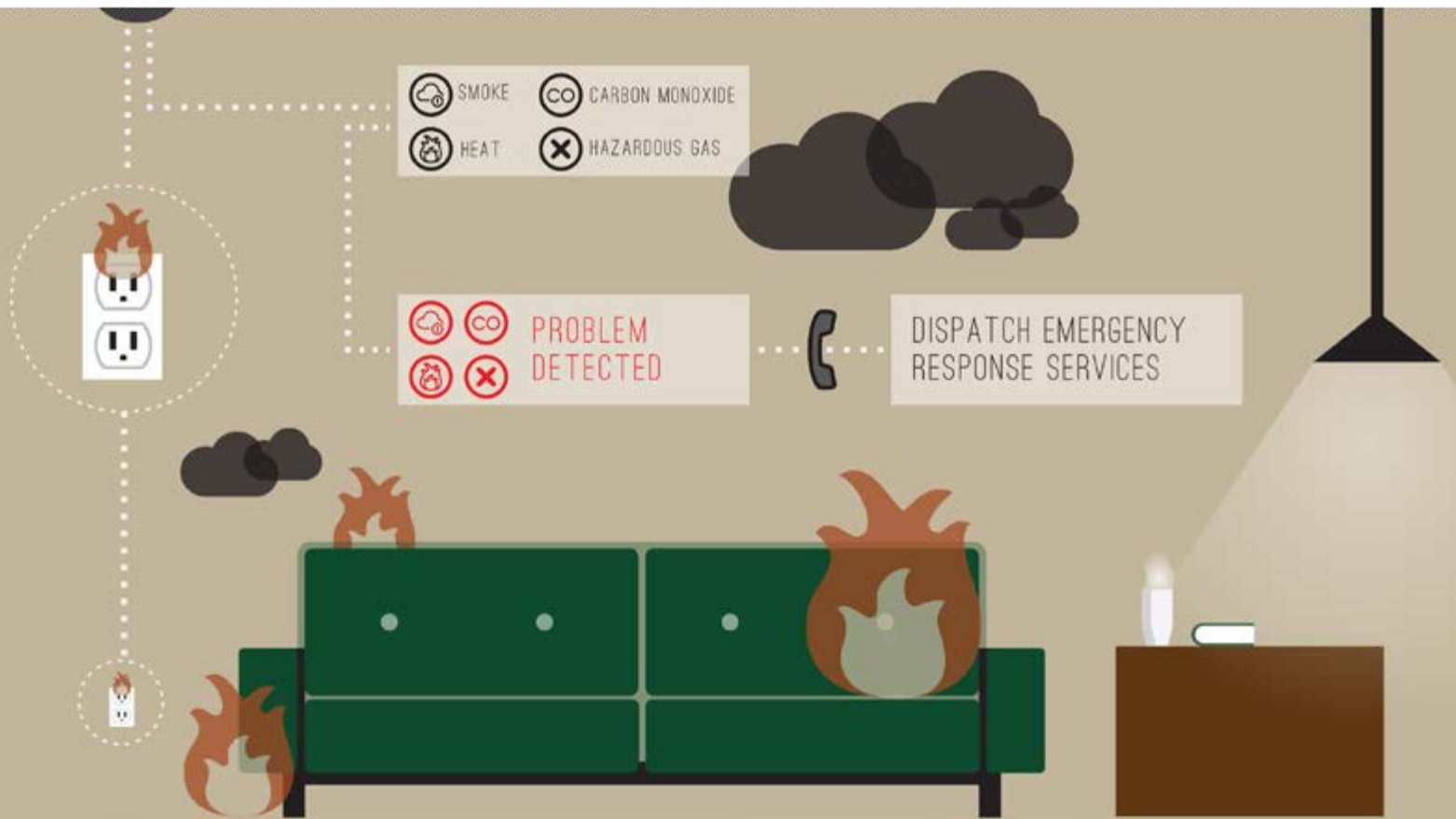
"We started thinking about the fact that Montgomery County already distributes smoke detectors to anyone who wants them, free of charge," Hoffman said. "We'll come out, we'll install it for you, we'll even come back out and change the battery if you ask for that."

Hoffman said he realized that if the county was already investing this much time and effort into making sure residents had functioning smoke detectors, why not take things a step further?

"Why couldn't we also increase the capability to sense more things?" he asked. "Why can't we connect them so that folks can get immediate assistance?"

And so the SCALE pilot idea was born.

Here's how it works: Say a low-income resident in an apartment building has never bought a carbon monoxide detector and one night, while the resident was asleep, the gas levels rose, putting the person in danger. A county-provided SCALE sensor would detect the presence of the gas and automatically transmit a distress signal to emergency responders. To verify the emergency, the dispatch center would then call the resident to confirm there is an emergency taking place, and then a first response unit would be sent to the scene. Within minutes, responders would arrive to evacuate the apartment — all without any need for manual action by the person in distress.



One of the best parts of this, said Hoffman, is that the program is affordable, so it can help everyone, especially vulnerable populations such as the elderly and low-income residents. Hoffman stressed that he believes IoT technology shouldn't help only people who can afford Wi-Fi or new gadgets.

"These shouldn't be big expensive government programs," he said. "They should be relatively small iterative entrepreneurial bootstrap projects that we try out quickly."

"This one we built in four months," he added, "and I think that's pretty good for a government project."

Next up, Hoffman and his team hope to take the proof-of-concept findings from the SCALE pilot program and work

with vendors and the private sector to put the sensors into commercial production and use them on a broader scale throughout Montgomery County.

And Hoffman doesn't plan to stop there — he sees dozens of possible uses for IoT technology in his county.

"I'm open to anything from bridges to kids," he said. "I've thought about putting these full transmitters in key fobs and giving them out to parents who want make sure their kid got on the bus, or got on the right bus. Or putting them in all sorts of different scenarios where people want affordable awareness of something they care about, whether it's a person, or a car or a thing."

Case Study 3: Tackling Data with Light

Big data is big news, and cities have spent a lot of time, money and effort trying to figure out the best way to collect and harness it. And with good reason: Data about the way people interact with cities and their functions can help everybody from engineers to mayors better design places and policy. For example, an analysis of a city's historical fire data could be used to build a risk model for potential future fires in particular places, enabling officials to address those sorts of emergencies before anything happens.

Chicago officials know the value of data better than almost anyone. The city appointed a director of data analytics in 2012 and in the past few years, data coordinators have been placed in city agencies, part of an open data executive order from Mayor Rahm Emanuel.

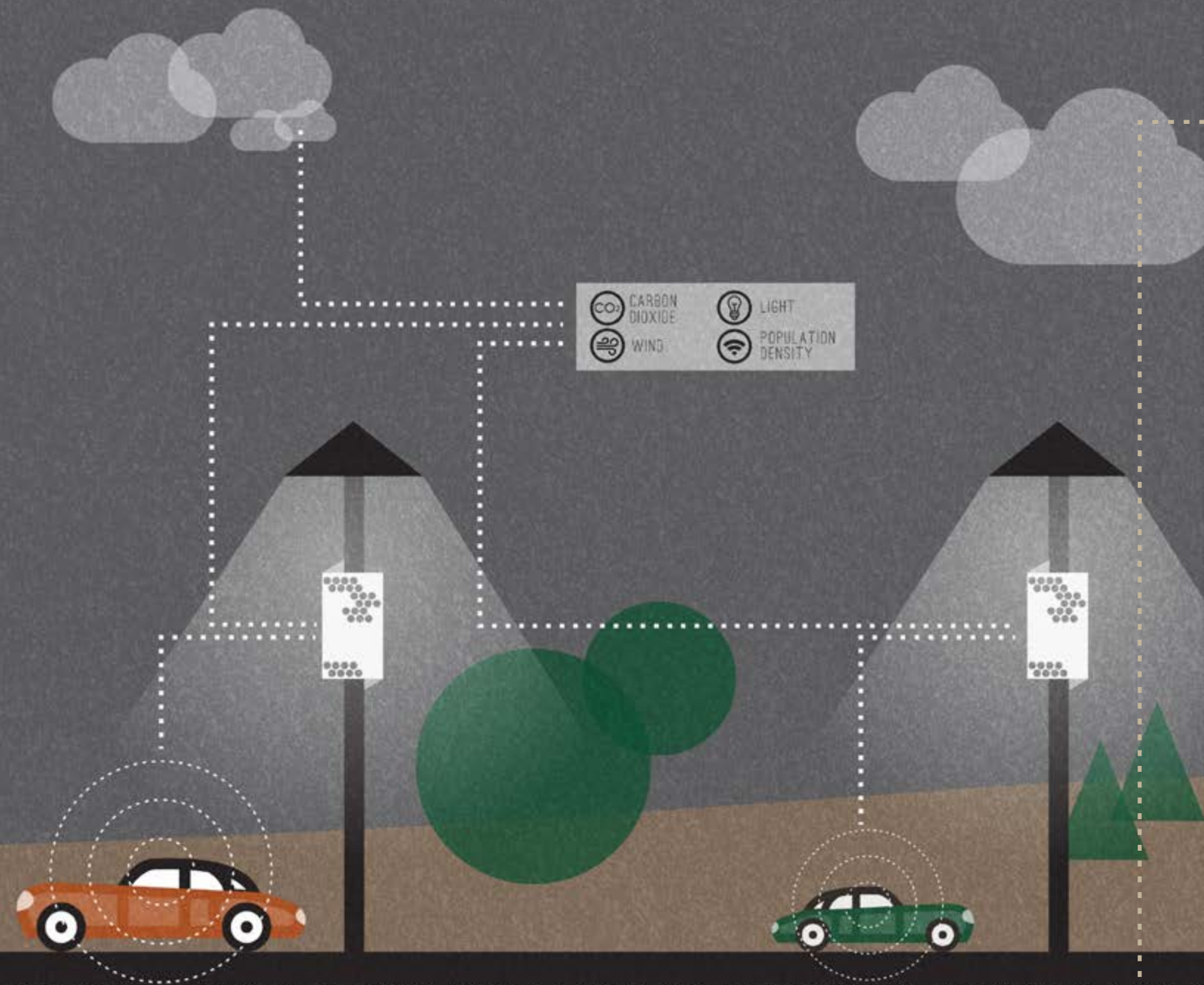
Chicago's next step in collecting data melds brand-new IoT technology with a 19th-century invention: the street light. In July, Chicago began placing sensors on light poles — a network officials have dubbed "The Array of Things" — throughout the downtown Loop neighborhood in an effort to gain more insights about everything from air quality to light to carbon monoxide levels. The sensors will also detect mobile devices, so smart phones can serve as a gauge of pedestrian density.

"We are prototyping a platform that will be mounted on signal light poles at intersections, collecting a dozen differ-

ent types of data, and publishing these data streams (which are time stamped and geolocated) in near-real time," said Charlie Catlett, senior computer scientist at the Argonne National Laboratory and a senior fellow at the Computation Institute at the University of Chicago, who is working with the city on the project. "The intent is to create a public sensor platform."

Catlett says he expects four major outcomes to the Array of Things project:

- "First, we have scientists from over a dozen universities and from Argonne National Laboratory who have proposed specific experiments ranging from understanding the city's impact on regional climate (thus providing insight into what city designers and planners and architects might do to mitigate any negative impact) to exploring optimized traffic flow, to providing real-time data on pedestrian flows through the city."
- "Second, we have education and social/behavioral science partners who are interested in exploring new ways by which people might interact with the built environment, or through which the built environment might make the city safer, more friendly or easier to navigate for visitors or people with sensory challenges."



- “Third, we are working with companies who are interested in research, development and prototyping of new services and technologies for cities, but who have no urban-scale test bed on which to do such work.”
- “Fourth, we will be developing [science, technology, engineering and math] education and training, geared primarily toward middle school and high school, in areas ranging from sensors and computer science to environmental sciences, using the Array of Things as their laboratory.”

Catlett said that the data gathered from the light pole sensors will be open and available immediately, and developers

can subscribe to the data stream of the instruments — and perhaps build their own apps or projects using the data.

He imagines that the Array of Things project will help cities change the way people interact with the built environment to make everything safer and more efficient for all residents — ultimately creating a “smart” build environment.

“How can cities work more efficiently to save people time? More safely?” Catlett asked. “How can cities use less energy or more renewables? How can they adapt to long-term trends or short-term events?”

With the Chicago light pole sensor data collection project, hopefully we’ll soon have those answers.

Case Study 4: Leading the IoT Charge at NIST

A fully functioning IoT won't be of much use if standardization and a common framework for the billions of devices aren't put in place. The National Institute of Standards and Technology is working on such benchmarks with the help of two Presidential Innovation Fellows, Geoff Mulligan and Sokwoo Rhee.

Mulligan and Rhee are leading a team of experts from the private and public sectors to create a framework consisting of standards and protocols for IoT, or cyber-physical systems (CPS), as they refer to it.

"We believe it is the government's role to facilitate and coordinate these efforts, as well as accelerate the adoption of progress of the Internet of Things," Rhee said.

To that end, as part of their work as Presidential Innovation Fellows, Mulligan and Rhee co-led the SmartAmerica Challenge. The challenge, which culminated in a live expo earlier this year, brought together IoT programs and pilot tests to demonstrate how IoT can save lives, improve the economy and create new business opportunities.

"The SmartAmerica Challenge was conceived by Geoff and me when we first came into the Presidential Innovation role last June," Rhee said. "What we realized is that there has been a lot of investment that has gone into developing new technologies and making specific applications more ben-

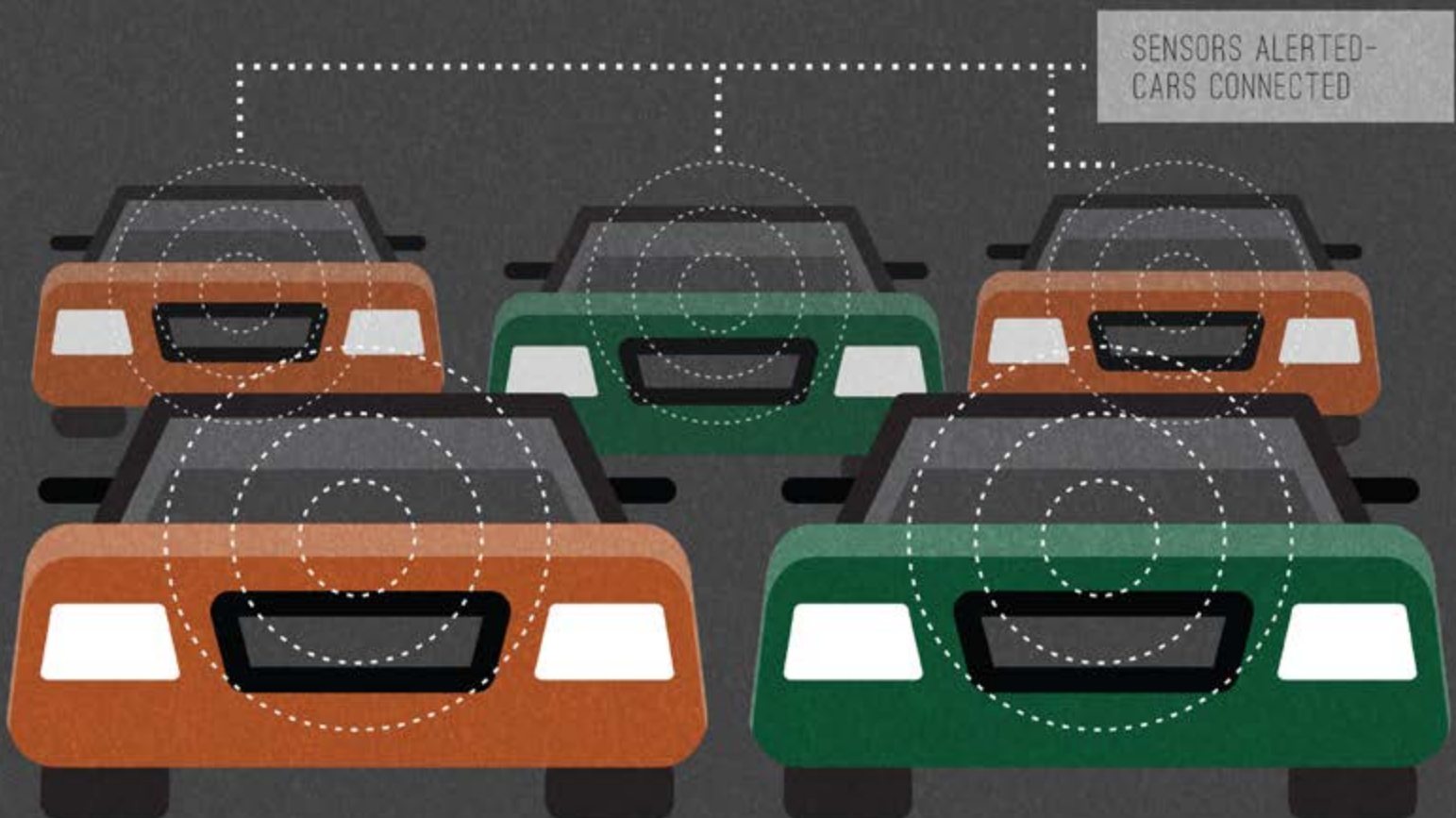
eficial. The government has invested hundreds of millions of dollars on basic research for cyber-physical systems, but what we realized is that they are very sector-specific."

For example, Rhee added, there is a medical CPS that is making tremendous progress, but it is all medically focused. Additionally, many investments are being made to make transportation systems applicable to CPS.

"There are 2,800 cars running right now in south Michigan, it is a test bed of the future of cyber-physical systems-based cars," Rhee said. "But what we realized is all of these projects are not talking to each other. A lot of these sector-specific systems can be interconnected or federated. We believe that one plus one can be more than two."

"We're hoping that this excited community, who wants to make a difference in this space and wants to see where the Internet of Things is going to create jobs, lights the American economy on fire," Mulligan said. "Now, we need to work to make sure the community continues to thrive, that we continue to add some new projects to it and grow some new things."

Mulligan added that NIST is also focusing on expanding IoT technology and standards worldwide. "NIST is going to try to find ways to take some of this technology and deploy in cities across the U.S. and the world," Mulligan said.



BIG DATA

MORE THAN A MOUNTAIN OF INFORMATION.

Need help navigating the “big data” landscape? ViON’s platform-based solutions are designed for maximum performance and ease of use at a massive scale. Whether you’re seeking a customized packaged or one that’s ready-to-deploy, our team leverages the scalability, power and open architecture of Hadoop to reduce time to value. The result is a “big data” solution with big impact.

“Government is Leading the IoT Revolution”

An interview with Rodney Hite, ViON's Big Data Product Manager

How do you see the public sector adapting to the Internet of Things?

Hite: At ViON, we see tremendous benefits for government, healthcare and education when it comes to the Internet of Things. Traditionally, government has not been an early adopter of new technology; however, this is not the case with IoT. In many instances, government is leading the IoT revolution. Government and education are leading the charge because of the inherent benefits.

In particular, we see Department of Defense exploring the advantages of IoT – this is due in part to the Cloud First Mandate of looking to Internet technologies as a primary resource.

What's at stake for the public sector when it comes to the Internet of Things?

Hite: When you consider what is at stake for public sector and IoT, consider the advantages of having near real-time data in the hands of today's warfighter. Having the right intelligence at the right time can literally save lives. As data is collected from the battlefield from hundreds or thousands of different sources, the ability to aggregate that data, analyze it and distribute it within seconds goes beyond mission critical.

Some other benefits across public sector that we see are reduced costs (driving efficiency through reduced manpower, automating processes that were previously labor intensive); improved citizen experience (enabling the collection of information and analyzing it, and putting knowledge at the fingertips of the right people at the right time); and employee productivity (enabling mobility and collaboration and sharing of information and breaking down information barriers).

How is ViON's Big Data Solution helping governments adapt to the Internet of Things?

Hite: ViON's Big Data Solution is a fully integrated system Hadoop-based analytics platforms that focuses on volume, variety and velocity of data on a time-to-value approach to a Big Data solution. We provide petabyte-scale storage and processing capabilities, high-speed data access, leading to immediate insight the customer needs. Our platform provides Elastic Ingest, Search, System Monitoring, Data Management, Geospatial Integration, and more.

When you consider how this relates to IoT, think of it this way: you have a huge volume of data coming in, and that data is only useful if you can process it, analyze it and get information in the right hands of the right people. And this is where ViON has a unique capability. Our fully integrated solutions provide the platform for data collection, analytics and distribution capabilities, depending on the end-users specific requirements. Because most big data solutions require customization, our Professional Services team helps builds solutions based upon the customer requirements and unique data. Because we have pre-integrated and configured over 200 products in our platform, we can deploy this in a matter of weeks as opposed to months or even years.

What areas of the public sector will be most impacted by these new technologies, and how?

Hite: With the increase in technology and the data being produced, the ability to derive value from that data will impact everyone. So we see every area of public sector being impacted by IoT. For government, it's providing a enhanced citizen experience while reducing costs and driving efficiency. For education, it's connecting students, teachers and administrators with resources and information. And for everyone, it's the ability to do it in new and exciting ways.

How does ViON think the Internet of Things improve our world?

Hite: The opportunities for the benefits of IoT are boundless. When you consider the volume, variety and velocity of data that can be collected, analyzed and processed and what that means to government, education and healthcare, the potential benefits are astounding.

From the warfighter having the right intelligence in their hands are the right time, to tracking changes in weather patterns, monitoring soil conservation, to protecting citizens, the technology is truly transformative. And then there are the business benefits – automating processes, driving greater efficiency, reducing and redirecting manpower, reduced power consumption – the opportunities are endless.

The critical element to maximize this technology is not just the collection of data, but what you do with it. The ability to process it, analyze it and get information in the right hands of the right people is where the real power of this technology lies. Having the right solution for your organization is critical.

PRIVACY AND SECURITY: THE POTENTIAL DANGERS OF A CONNECTED WORLD

The connected world that IoT brings is bound to improve our lives and create services once believed to be science fiction. But as the scope continues to be realized, there's one question on many people's minds: Is government ready? And more importantly, is government's security ready?

"We are seeing an intersection of different industries with the Internet of Things," said Daniel Castro, senior analyst at the Information Technology and Innovation Foundation, a nonpartisan think tank that promotes public policies to advance technological innovation.

Many of the industries that are converging have typically not worked together in the regulatory process, Castro said, which makes security alignment even more difficult. Ultimately, though, agencies will be forced to collaborate, which could lead to numerous challenges in creating the necessary regulations, defining the necessary data standards and protecting customer privacy, all of which are imperative to drive innovation with IoT.

Think about the potential scenario of driving a connected car. As you're whizzing down the road, your car is collecting data about your surroundings, your energy use, inside and outside temperatures, music preferences and the closest restaurant. It's also pulling data from your cell phone to give you a customized driving experience.

But IoT can go one step further. Let's say your car is also connected to devices in your home. Now, your car is communicating with your refrigerator to know what groceries you need to pick up. Your car has automatically turned on your alarm system, since it knows you're not home. Maybe

as you were driving, three light bulbs in your house went out, and your car just alerted you through a dashboard notification to stop at Target, which is only 3 miles and about 10 minutes away, assuming no traffic.

Now, think about this situation from a government perspective and through the lens of privacy and regulatory concerns. One hypothetical is from DOT. Tasked with the obligation of reducing accidents from distracted drivers, department officials might find that the apps you're using in your car lead to increased risk of accidents due to driving distractions. They might find that the dashboard notification in particular is a distraction and seek regulations to ban its use while the car is moving.

The Federal Trade Commission might also find that your data is being transferred illegally between services. The agency would issue restrictions on how your data and location can be transferred and require consumer consent and agreement on how data will be used.

And your local police department might not be thrilled that your home data is being shared through your car and across services, because it helps criminals know when you're not around.

By no means is this scenario farfetched, and it's the emerging new world our regulators are faced with. It's clear that more needs to be done with two important elements of IoT: the standardization of data and addressing privacy concerns. The wheels are already in motion to accomplish both tasks, which will help government achieve its primary goal of balancing innovation against risk.



THE NEED FOR STANDARDIZATION

With our car example, we showed how data could ultimately be used to create new services and applications. It's more evidence that when data is open and public, developers can create solutions that government does not have the time or resources to make. Still, there is a dire need for improved data sharing infrastructures and collaboration across agencies — something that has traditionally been very challenging for government.

"The Internet of Things scenario is about collaboration, building shared infrastructures and sharing data, and ultimately working together to create some kinds of standards," Castro said. "You don't want data generated for one purpose never to be allowed for another purpose. That's a very siloed approach that we know is not useful if you want to see innovation."

A group of tech giants have come together to try to create standards around IoT. Leading IT companies such as AT&T, GE, Cisco, IBM and Intel have recently partnered to form the Industrial Internet Consortium (IIC). Its mission is highlighted below:

The Industrial Internet Consortium was founded in 2014 to further development, adoption and wide-spread use of interconnected machines, intelligent analytics and people at work. Through an independently-run consortium of technology innovators, industrial companies, academia and government, the goal of the IIC is to accelerate the development and availability of intelligent industrial automation for the public good. This goal of the consortium is to:

- *Utilize existing and create new industry use cases and test beds for real-world applications;*
- *Deliver best practices, reference architectures, case studies, and standards requirements to ease deployment of connected technologies;*
- *Influence the global development standards process for internet and industrial systems;*
- *Facilitate open forums to share and exchange real-world ideas, practices, lessons, and insights;*
- *Build confidence around new and innovative approaches to security.*

But developing the proper standards is only half of the collaboration equation. The other side relies on a thorough analysis of privacy concerns.

PRIVACY CONCERNS

IoT presents many reasons for concern about security and privacy, including the potential for cyberattacks and misuse of personal data.

As we've seen with mobile, cloud and big data, security standards are being developed as quickly as possible — but standardization takes time. Take, for instance, the Federal Risk and Authorization Management Program, the federal government's attempt to standardize security qualifications for cloud adoption. This program took years of development and is still being modified to fit market need. But ultimately, it will spur increased cloud adoption governmentwide.

However, IoT is a new beast for government regulators. "As you have these different groups coming together to build these solutions, hopefully those different sides will be represented and those successful projects will be the ones with good collaboration," Castro said. "Then you have nothing being left off the table or considered in the development process."

To truly protect data, the following data principles should be explored:

- How can consumers gain access to their data?
- What kind of visibility will be provided to customers on what data is being collected?
- What data is sensitive in nature?
- Where is consumer data being stored?

These four questions set a foundation for data privacy and will bring transparency to consumers and help drive innovations with IoT.



ALERT FROM FRIDGE:
OUT OF MILK

REDIRECTING
ROUTE

DEVICES
INTERCONNECTED

INTERNET OF THINGS: EXAMPLES FROM THE PRIVATE SECTOR

Although the government is just starting to experiment with Internet of Things technology, the private sector has long been making use of connected devices to improve service for its customers and create efficiencies. Below, we detail several private-sector examples of IoT use to better illustrate the concept and to help you better understand the potential real-world effect this technology will have in the coming years on all sectors.

NEST LABS

By now, you've probably heard of Nest Labs, in no small part due to the fact that Google purchased the company this year for \$3.2 billion. Nest is best known for making a "smart," or connected, thermostat for homeowners. Most thermostats only let you set a desired temperature, monitor the current temperature and switch between heat and air conditioning.

Programming thermostats can be annoying. You might forget to turn it off or incorrectly program it, and an un-programmed thermostat can add 20 percent to your heating and cooling bill. Nest's Learning Thermostat aims to solve this problem. It has four types of sensors: activity sensors that detect when someone is home, humidity sensors, weather sensors and temperature sensors that detect how quickly the temperature is changing.

Nest's thermostat programs itself by learning your behavior patterns and desired temperatures for certain days and times during the week, and then building a schedule for your HVAC. Additionally, Nest has an app, so homeowners can check the thermostat's settings and adjust them from anywhere using a mobile device.

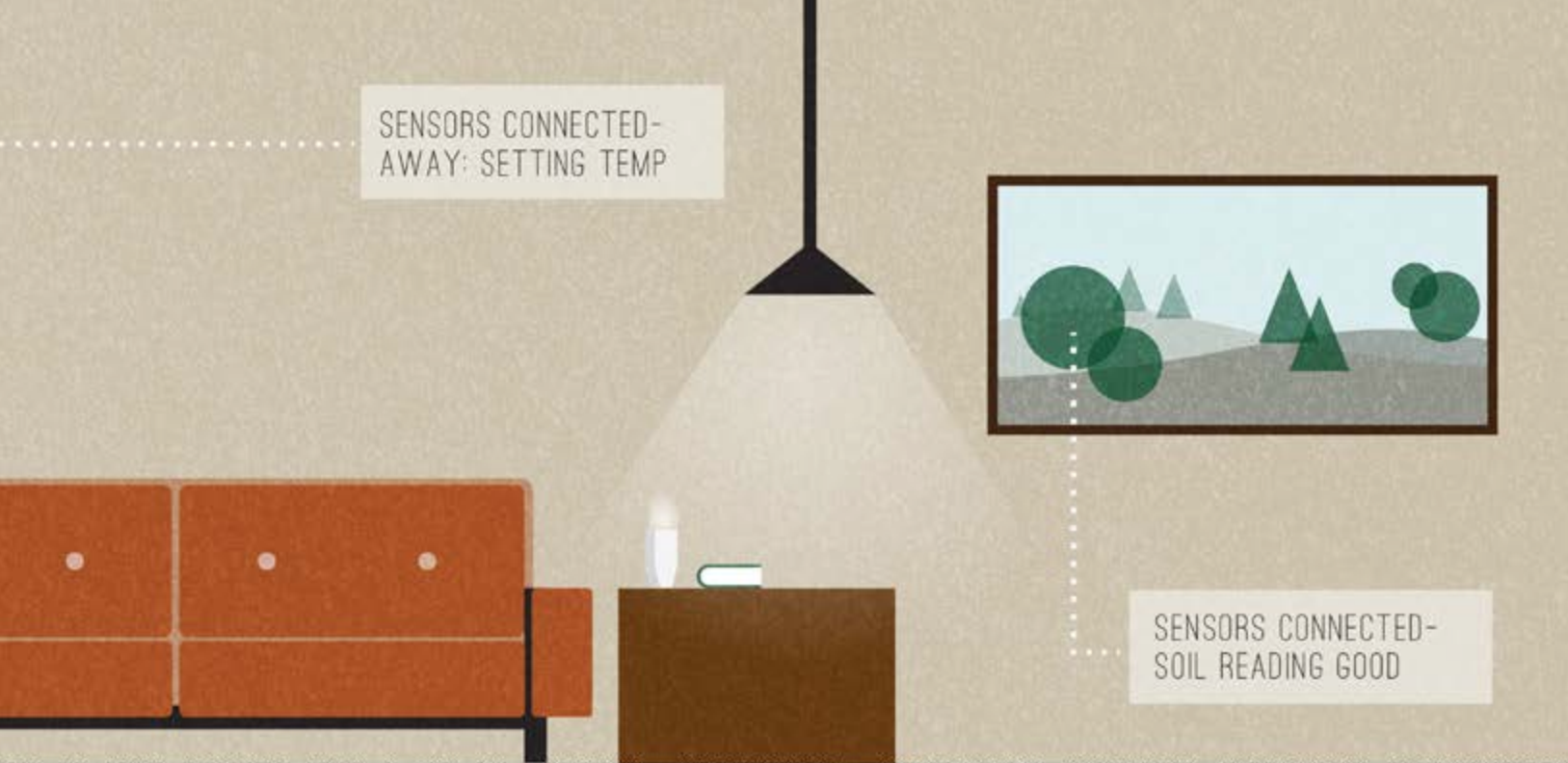
The company is now also working quickly to make sure its technology can link to other devices in your home. Recently it partnered with Whirlpool on an application that lets a Whirlpool clothes dryer and a Nest thermostat work together to save energy and money for a homeowner. The thermostat will detect a local utility's peak load times when electricity is most expensive, and send a signal to the dryer to run on a cooler, slower drying cycle at those times.

PROPELLER HEALTH

What if asthma sufferers could predict when, where and why they were having asthma attacks? A relatively new IoT-enabled inhaler is allowing them to do just that.

Propeller Health's sensor-connected inhaler tracks asthma sufferers' medication use by keeping a record of the time and place they have used their inhalers. Data collected by the inhaler sensors can help patients and government leaders (such as mayors of towns affected by pollution) better understand when and where people with asthma develop symptoms. Ideally, then, cities and regions can identify communitywide asthma triggers that can eventually be improved or eliminated.

The Propeller Health sensor wirelessly syncs with smart phones using the phone's built-in Bluetooth technology. Once the inhaler sensor is connected, the phone will automatically capture the data from the sensor whenever it is nearby. Then, the Propeller mobile app allows patients to view the data the sensor captures and gives personalized feedback and tips on ways to improve asthma control. It also automatically keeps a record of trends including time, date and location of when patients used inhaled medications.



AN INTERNET FOR TREES AND GARDENS

By now, you may be thinking of IoT technology as taking place mostly in mechanical devices such as home appliances or cars. But it has applications that are important for the environment, too — especially trees and soil.

Cargo Tracck, a tech company in Brazil, has developed and deployed sensors that can be placed on trees in protected parts of the Amazon rainforest to help prevent illegal logging, which is a massive issue in that part of the world and presents countless environmental issues.

Here's how they work: The sensors are able to send alarm notifications and exact location information to officials as soon as trees pass within 20 miles of a cellular network. Then officials can trace these illegally forested logs to the sawmills where they end up and prevent the sale and harvest of this lumber.

On a smaller scale, a Kickstarter-backed project could soon be turning your black thumb into a green one. Edyn is a Wi-Fi-connected sensor and water valve that measures soil nutrition and waters your plants based on their data. Place the device in the ground, and it records lots of information — such as temperature, humidity, light and soil properties — that gets simplified, contextualized and passed along to you, the gardener. Eventually, the main goal, says the creator, is to create a massive Internet database of what plants grow best in which climates.

THE HOME HUB

Let's say your home eventually achieves the connected device nirvana we propose in our Executive Summary. It will be great when your house's air conditioning system turns on as your car leaves work on a sweltering day or when your shower automatically starts as your alarm clock goes off in the morning. But if you have dozens of connected devices in your home, how are you going to communicate with and manage them all?

The solution will likely be a connected home hub — sort of like a smart phone for all of your apps. Instead of managing all of these IoT home devices on separate platforms, home hubs promise to be centralized locations where you can get access to your home network and the potentially dozens of appliances you'll have connected.

Several companies are already offering these hubs. The latest is from Apple and is called HomeKit, but business such as Staples, Lowes and others are offering products, too.

YOUR INTERNET OF THINGS CHEAT SHEET

Looking to get smart on the latest buzzed-about technology? Look no further — our cheat sheet's got you covered.

IoT by Any Other Name...

One of the confusing things about IoT is the jargon surrounding it — and people's use of different terms for it. The following phrases have subtle differences but generally refer to the same sphere of technology.

CYBER-PHYSICAL THINGS

INTERNET OF EVERYTHING

INDUSTRIAL INTERNET

THE INTERNET OF NOUNS

M2M OR MACHINE TO MACHINE

CLOUD OF THINGS

IoT Homework: Assigned Reading

Want more information about IoT? These links and reports will round out your knowledge.

Pew Research Internet Project Report:
"The Internet of Things Will Thrive by 2025"

"This current report is an analysis of opinions about the likely expansion of the Internet of Things (sometimes called the Cloud of Things), a catchall phrase for the array of devices, appliances, vehicles, wearable material, and sensor-laden parts of the environment that connect to each other and feed data back and forth. It covers the over 1,600 responses that were offered specifically about our question about where the Internet of Things would stand by the year 2025."

Cisco White Paper: "Internet of Everything: A \$4.6 Trillion Public-Sector Opportunity"

"The Internet of Everything — the networked connection of people, process, data, and things — is opening up new opportunities (and risks) that public-sector leaders need to consider from multiple perspectives: policy leadership, services provision, and regulation. Cisco's analysis indicates that IoE is poised to generate \$4.6 trillion in Value at Stake for the public sector over the next decade (compared with \$14.4 trillion for the private sector over the same period)."

Infographic: "A Guide to the Internet of Things"

"How billions of online objects are making the web wiser."

"A Beginner's Guide to the Internet of Things"

"A handy guide that cuts through the geek-speak."



4 Steps You and Your Agency Can Take Right Now to Prepare

The public sector is right at the start of more widespread implementation of IoT technology, but that doesn't mean you should sit around waiting for it to be prevalent before taking action to get ready. We interviewed several IoT experts about the steps you can take right now, as a civil servant, to prepare yourself and your agency for this coming revolution.

#1: FIGURE OUT YOUR PROBLEM FIRST – THEN APPLY IOT.

Dr. Michael Chui, a partner at the McKinsey Global Institute: "First, go through your agency and think: If you could continuously measure something that was core to your agency's mission, what would that be? How would that allow you to provide your services? How would it solve problems for your citizens? Then, after you've figured that out, seek out IoT solutions — not the other way around."

#2: JUST DO IT: DON'T WAIT FOR A PERFECTLY EXECUTED IOT.

Geoff Mulligan, Presidential Innovation Fellow: "I personally have been working on the Internet of Things since 2001. And every year someone's like, 'Oh maybe next year is the year we'll use it.' I mean, the Internet of Things now, it's sort of been so overhyped and under-delivered. And it's because everyone keeps going, 'Oh, we need to solve this problem, we need to solve this problem, we need to wait till everything's done and then we'll start to do it.' And I liken that to this example: Henry Ford sits there and says, 'Oh, I'm going to build a car. But no, no, wait a second. I'm going to wait till we have a highway system. I'm going to wait till we have gas stations, I'm going to wait till.... Oh, we need an auto insurance industry, and then I'll start to build cars.'

"See, now it seems it's that way with the Internet of Things. 'Well, we'll wait until we solve all of the security issues. We're going to wait until we solve all of the privacy issues. We're going to wait until we solve all of the next protocol, and, everything else until we have a perfect solution.'

"No! In our view, the beauty of this technology is that is anything out there right now 100 percent perfect in IoT? Heck no. But is it good enough to start to get some experience with it to just put it out there? Yes. And we have to start doing that."

#3: BE AGILE — AND USE PROTOTYPES.

Dan Hoffman, Montgomery County chief innovation officer: "Don't get sold on a product. Don't just go buy a product because you got a good sales pitch off it. I would say, look to pilot, look to prototype something. Get some devices quickly, test them out, figure out how it would work, and then move forward in that iterative fashion. But, you know, sometimes these projects die because upfront we decide, 'Oh this is great, and I know that I want to budget money for this, and because procurement in government is often a time-consuming challenge, I'm just going to plunk down X number of dollars to build out my safe community network or whatever they want call it.' You know, it's those kinds of big, slow procurement actions that fail because by the time you get the technology, it's out of date. By the time you install it, you realize it's not quite right or that it's not quite what you need. By taking that agile, iterative approach, we can shift gears, we can learn what works without having invested millions of dollars into something. Sail fast and figure out what works."

#4: PICTURE REAL-WORLD APPLICATIONS.

Charlie Catlett, Argonne National Laboratory: "Start with a practical application or need, then figure out whether IoT technologies have a role to play."

THE FUNDAMENTAL ROLE OF PUBLIC INSTITUTIONS IN THE INTERNET OF THINGS



BY ABHI NEMANI,
GOVDELIVERY & GOVLOOP CIVIC INNOVATOR-IN-RESIDENCE

Whether we like it or not, the Internet of Things is becoming a reality. A McKinsey study estimates that the economic impact of IoT will be over \$6 trillion in 2025. From selling consumers devices to help them track their fitness to building in smart sensors in their retail stores, the private sector is already actively building the internet of things and leveraging it to optimize their businesses.

Our question:

What role do we see government playing in this new arena?

What's been made clear in this guide is that governments are starting to move from the sidelines into the Internet of Things arena. Current examples range from improving safety on the road to enhancing awareness in the home. Indeed, there is much more to explore. Take code enforcement as an example. On the service delivery side, could we change the way code enforcement is managed through sensors detecting problems early and often, making it easier for rehabilitation and care? Or on the efficiency side, could we help prioritize needs and responses using data that we never had before?

Beyond these optimizations, though, lies a deeper, more fundamental role that the Internet of Things could play in our public institutions. Could we make them, and the policies they enact, more data-driven? The Autobahn in Germany changes its speed limit based on the traffic patterns and volume. It is responsive to reality. As sensors begin to generate more data about the jurisdictions we govern, such opportunities will only grow. Imagine changing a law or policy from on-the-ground data on how it is working? Imagine changing the nature of a law as quickly as the Autobahn changes its limits.

Tim O'Reilly calls this notion "Algorithmic Regulation." I consider it data-driven policy, and no matter the term, it's not so far off. In Boston, for instance, they replaced their antiquated, paper-based school placement process with a

dynamic algorithm, better matching all the characteristics a parent may consider — walkability, safety, etc. — with available schools for their kids. Now consider building in real-time data from the Internet of Things into systems such as this. Properly managed, the Internet of Things could enable an era of data-driven policy.

"Properly managed," though, is an important caveat. The privacy and security considerations attached to the Internet of Things are real, difficult, and vitally important. Indeed, even without government's use of this new technology, our public institutions will be called into the debate. We must consider: what are the regulations of private sector companies using these sensors? Ideas have been proposed ranging from an IoT "Bill of Rights" to a full-out ban. And that's just for private actors. The debate becomes more complicated when we consider the public sector itself using these tools.

This too, though, strikes me as an opportunity for leadership. We can shape, inform, and push that debate, with a fervent commitment to the public good. Once we accept that the IoT is an inevitability — that consumer service providers will start to instrument the physical world with sensors — there is a compelling advantage to government charting this course along with them. Those institutions — private ones — don't have robust public feedback mechanisms, and are not beholden to the popular will.



Our governments are. When they push ahead into this new technological territory, it gives us all a chance to deliberate together around how are rights should be respected and regulated; a precedent hopefully for private sector actors.

We consider our governments, particularly those at the state and local level, to be our laboratories of democracy. The emergence of the Internet of Things, its opportunities and attendant challenges, may be an ideal moment for us all to run more tests — on how it could work, and how it should be regulated — to learn more together about how our democracy can and should work in the 21st century.

Abhi Nemani is a writer, speaker, organizer, and technologist. For the past four years, he helped build the national non-profit, Code for America, a technology organization dedicated to reinventing government for the 21st century. He currently resides as GovDelivery and GovLoop's first Civic Innovator-in-Residence, seeking innovative partnering opportunities to drive expansion of GovDelivery's ability to connect public sector organizations with more people.



ACKNOWLEDGMENTS

ABOUT GOVLOOP

GovLoop's mission is to "connect government to improve government." We aim to inspire public sector professionals by serving as the knowledge network for government. GovLoop connects more than 100,000 members, fostering cross-government collaboration, solving common problems and advancing government careers. GovLoop is headquartered in Washington D.C. with a team of dedicated professionals who share a commitment to connect and improve government.

For more information about this report, please reach out to Catherine Andrews, Director of Content, GovLoop, at catherine@govloop.com, or follow her on Twitter: [@candrews](https://twitter.com/candrews)

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Notes

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