



# CONVERGENCE

THE FIRST STEP TO THE INTERNET OF EVERYTHING

INDUSTRY PERSPECTIVE





# UNDERSTANDING THE INTERNET OF EVERYTHING

*The whole is greater than the sum of its parts, Aristotle said, long before the Digital Age was a possibility. And yet his observation applies today perhaps more than ever. The proliferation not only of technological devices, but also their capabilities and interconnection holds new levels of promise for improving the lives of people all over the world and government workers in particular.*

Looking back at technology's evolution, it's as though each individual development was intended all along to ultimately create the Internet of Everything (IoE), a term coined by research firm Gartner that means the networked connection of people, process, data and things.

"The benefit of IoE is derived from the compound impact of connecting people, process, data, and things, and the value this increased connectedness creates as 'everything comes online,'" states a 2013 Cisco Systems report titled "The Internet of Everything: Global Public Sector Analysis." Our report examines how IoE is changing government from the very first step of the process: convergence. For expertise, we turned to Cisco, where IoE has become a focus of executives in the past few years as they've watched IoE converge elements to make network connections more relevant and valuable than ever before.

IoE must not be confused with the Internet of Things (IoT), a term that first appeared in 1999 and focuses on machine-to-machine communication, excluding the people and process elements of IoE.

"We believe the term Internet of Things (IoT) does not describe the complete picture and thus that's why we use the term Internet of Everything," said Dan Kent, Senior Director of Systems, Cisco's U.S. Public Sector business. "IoE is about the interaction between machines, machines and people, and modifying processes to leverage what the systems can now do. This is because they have more intelligence at the device itself and these machines are communicating and interacting with the entire system."

The heart of IoE is also the first step to being part of it: convergence.

"While there is no doubt that mobility, cloud and big data are each enabling business transformation, imagine what they could do collectively," Carlos Dominguez, a senior vice president at Cisco, wrote in [a blog post](#) in July 2014. "That's the power of convergence, and it's revolutionizing the IT and business landscape. This convergence brings together applications, systems and processes to help meet current needs while preparing for future innovation. It's at the heart of the Internet of Everything (IoE) in connecting people, process, data and things in new and innovative ways. And mobility is a driving force fuelling this evolving landscape, breaking down barriers and enabling the birth of entirely new kinds of business and economic models."

What does that all mean for the government? A few things, Kent said:

▲ **Cost savings** – "If you look at the simplest use of IoE, it's about automating systems or automating the things that have not been automated before," he said. For instance, automating street lights to turn on when a sensor detects motion, saving energy costs and keeping people safe.

▲ **Productivity** – "Whether it's individual productivity or productivity over the organization or a function, I think that's another benefit for the government," he said. For example, physicians and other health care professionals can use technology to monitor, communicate and assist patients remotely, extending reach, reducing travel time and the need for on-site visits.

▲ **New capabilities** – "The IoE is very clearly providing an enhanced citizen experience at the state and local government level," Kent said. IoE extends the reach of experts beyond the office. It provides field workers like inspectors and case workers more visibility in the field and access to information while on site, allowing for better service and timelier citizen response. In some cities, they are providing real-time bus locations so that riders know exactly when their bus will arrive.

▲ **Innovation** – "I think this is really where it gets exciting," he said. "What we see with IoE is melding of the technologist with the lines of business, and that's where innovation happens. It's not about the IT department saying, 'Hey, I can use this technology to bring efficiency to you.' It's about the business side saying, 'Can we use this technology to redefine my processes?'"

IoE is ripe with potential. In its report, Cisco estimated that 99.4 percent of physical objects that may one day be part of IoE are still unconnected and that \$4.6 trillion of value is at stake in the public sector. At some government agencies, the concept is already having an impact.



# IOE IN ACTION TODAY

*The benefits of IoE may sound futuristic, but they're happening today. Here's how several government entities have converged resources to take advantage of IoE.*

## *The Defense Department:*

DOD has a huge but stove-piped sensor network. For example, sensors that are monitoring the environment around a missile system or hospital can't communicate with one another to provide full visibility. IoE is changing that. "The secure convergence of mobility, security, cloud, and big data enables an integrated mission fabric and provides the power to connect the battlefield in ways that fundamentally change military operations," states a 2014 Cisco report titled "Internet of Everything for Defense." "Today's missions require real-time and untethered interactions between soldiers, decision makers, subject matter experts, and machines."

## *U.S. Patent and Trademark Office:*

In 1998, the trademarks arm of USPTO made a push for telework, equipping workers with Cisco Jabber for voice, video, presence and instant messaging. As of 2013, 65 percent of the agency's workforce was teleworking at least once a week. This initiative has brought many benefits, including at least \$24 million in real estate cost avoidance, greater productivity, higher employee satisfaction, and cost savings from lower transportation subsidies and recruiting costs due to less attrition. Additionally, the program has meant 46 million fewer miles driven annually, \$5 million in gas savings and 27,000 fewer tons of greenhouse gas emissions, [Danette Campbell, senior telework adviser, told Cisco](#). One more benefit is continuity of operations. When snow led to a federal shutdown in Washington, D.C., USPTO still completed 83 percent of the patent examinations and 93 percent of the trademark examinations it would have done at the office, Campbell said.

## *General Services Administration Smart Buildings:*

An initiative spurred by President Barack Obama's 2009 [executive order](#) calling for a 30 percent reduction in energy use in federal buildings by 2015, GSA's Smart Buildings incorporate multiple technologies. One benefit is simplified property management, [according to GSA](#). Instead of taking pressure readings in person and adjusting valves by hand, those can be done in the network operations center with a few keystrokes. There's an environmental advantage, too. "For example a daylight-harvesting system could work in concert through the GSA Smart Building [IP] backbone with interior lights and occupancy sensors to provide optimum light levels and save energy use," GSA's website states.

## *Smart cities*

Popping up nationwide and globally, smart cities probably resonate the most with residents because they have more direct involvement with local governments than with the state and federal governments and more involvement with the state government than the federal government, said Alan Balutis, Director of the Global Public Sector Practice's Internet Business Solutions Group at Cisco. Smart parking is one smart city service. Solutions such as Cisco Smart+Connected City Parking give residents real-time information about free and full parking using IP cameras, sensors and smart phone apps. They can also alert parking enforcement officers when meters run out.



# HOW TO GET IOE-READY

*Becoming IoE-enabled doesn't happen with the flip of a switch. It's an iterative process that involves government workers at many levels both in and outside the IT department. For organizations to better take advantage of the IoE, Kent recommends the following:*



## *Education*

Teach the IT and non-IT teams about the transformation, he said. “IoE will have an impact on both IT departments and the business functions. As IoE is about connecting the unconnected, creating a scaling and compliance issue for the IT department. Also, since those new devices will not be IT devices like printers and computers, rather devices like an HVAC system at GSA or a medical instrument in a VA hospital, this will create new demands on the organization. LOB will need to work with IT to better understand the implications of newly connected devices and their implications on the



organization’s information processes.”

With IoE, the IT department no longer controls the perimeter because the perimeter is gone, Kent said. It has to re-evaluate the governance process and security strategies. (See more about security on [Page 9.](#))



## *Third-party help*

Bring in a data analyst or scientist after IoE is mapped out. “When you start deploying all these sensors or devices, the output is a plethora of data which needs to be analyzed and possibly acted upon,” Kent said. “The logical next question is what do you do with the data and valuable information. Who owns it? Where does that information go? How long should it exist? Is that information in an open environment? All these are some very complex governance-type questions, some complex technical questions and some fairly simple technical conversations as well.”



# ENABLING IOE FINANCIALLY, TECHNOLOGICALLY & SECURELY

*“In addition to shifting what’s possible with data and technology, IoE is changing how the government does business,” Balutis said.*

"We've seen a fundamental shift in how organizations buy hardware and IT services, and see a convergence of technology and IT services in terms of what government agencies are wanting from their contracting private-sector partners," he said. "I think government is going through a change process in terms of moving from wanting to own their own infrastructure to buying things."

And it's worth the government's while to make these adaptations. IoE is a \$4.6 trillion opportunity for the public sector, but a \$19 trillion one globally between 2013 and 2022, [Cisco's public-sector economic report](#) states, and those numbers can't be ignored, Balutis said.

To facilitate the changes needed to adopt IoE, Cisco released the [IoT Reference Model](#) at its IoT World Forum in October 2014. Based on information flow, it provides a common, replicable framework for IoT deployments, which are part of IoE. The seven levels of the model are, from the bottom up:

1. Physical devices and controllers.
2. Connectivity – communication and processing units.
3. Edge computing – data element analysis and transformation.
4. Data accumulation – storage.
5. Data abstraction – aggregation and access.
6. Application – reporting, analytics and control.
7. Collaboration and processes – people and business processes.

"Data alone is not very interesting or very useful," Balutis said. "It's really where the data can be used and become actionable that they can truly change process and can have a direct impact on people's lives."

To that end, the government needs to equip IP networks to deliver big data insights.

"I think the kinds of things that need to be done are infrastructure improvements, connecting all things, including unintelligent ones; securing the infrastructure; improving data center traffic flows; and increasing the ability to manage the networks – building intelligence into the network," Balutis said.

A natural follow-on to the technological requirements is security. Breaches in 2014 highlight how hackers aren't accessing information only via back-office break-ins anymore.

"With IoE and with more devices online, they provide an exponential growth in new attack vectors, new vulnerabilities as more devices access the network and the ability to remotely cause destruction or death," Balutis said. "I think we're really at a very critical stage in this arena."

He cited [a report on a 2014 study](#) by the President's National Security Telecommunications Advisory Committee that gave the government three to five years to adopt IoE "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."

One way to bolster security is to lobby support for IoE from the people involved in it.

There's a sense of losing control as machines take over work. "When you have convergence – and it can be any level of convergence – you're taking roles and functions and merging them with other roles and functions," Kent said.

In general, public trust in most – and especially emerging – IT hasn't been earned, Balutis added.

But "I think the technology is going to be there, whether we want it there or not," he said. "I think it's incumbent on the private sector and the public sector to partner to be sure that the public and the American citizens have faith in the privacy and the security of the data they're generating and the transactions that they engage in."



# IOE ON PACE TO BE MORE THAN A TREND

*Before agency officials invest time and money in convergence for IoE, they need to know whether this next phase of technology is a fad or more enduring. So before we look further ahead, let's look back at what history has shown us about IT revolutions.*

The spread of technology tends to happen according to three laws, which all have a role in IoE:

- ▲ Moore's Law, which states that a microchip's processing power doubles every 18 months. That means computers become faster and the price of a given level of computing power halves every 18 months. In IoE, data becomes more valuable because you have more power to analyze it and that power comes at a lower cost.
- ▲ Gilder's Law, which states that the total bandwidth of communication systems triples every 12 months. For IoE, that means sensors and networks can transmit more data in real time.
- ▲ Metcalfe's Law, which states that the value of a network is proportional to the square of the number of nodes. As a network grows, the value of being connected to it grows exponentially, while the cost per user remains the same or decreases. Because of the first two laws, you will put more sensors and devices on the network, therefore increasing the value of the network without affecting cost.

Compare IoE with the state of mobile computing a few years ago. Few would consider mobility a trend today, however, in 2012, the field made Gartner's "[Top 10 Tech Trends through 2015](#)" list. In January 2014, more Americans used smart phone and tablet apps than PCs to access the Internet. Last year's Pew Research Center's "Mobile Technology Face Sheet" states that 58 percent of American adults have smart phones, while 42 percent have tablets. The most telling statistic, however, comes from GSMA Intelligence, a mobile analysis firm, which says the number of mobile connections worldwide is 7.4 billion, while Earth's population is about 7.2 billion.

IoE is on a similar fast track to widespread adoption. It even made Gartner's [annual list of top strategic technology trends](#) in 2014. Consider these numbers from "[Pay Attention IT: A New Convergence is Afoot.](#)" an April 2014 report from Moor Insights & Strategy:

- ▲ Between 2011 and 2016, Cisco estimates that global IP traffic will quadruple, reaching 110 exabytes per month.
- ▲ Less than 1 percent of all of the potential connected devices are actually connected currently.
- ▲ By 2020 the number of connected devices is expected to reach 50 billion.

David Bray, Chief Information Officer at the Federal Communications Commission, predicts that the 7 billion networked devices today will grow to 50 billion by 2010, while Deloitte has estimated that by that time IoT is powered by 1 trillion sensors, Balutis said.



## CONCLUSION

*Technological convergence has happened in three phases, Kent said. The first started with communication, such as voice over IP to human data. Next came convergence around compute, storage and network infrastructure. IoE is the third phase, joining non-technical and technical and bringing the value of the connected environment to traditionally unconnected systems.*

*It just so happens this phase is happening pretty quickly – despite the iterative process IoE requires.*

*“It’s going to be a lot of innovations happening pretty much across all of government and therefore I think it’s all from a citizen perspective going to be a much better experience than today,” he said.*

## ABOUT CISCO:

We create solutions built on intelligent networks that solve our customers' challenges. The convergence of mobility, big data analytics and cloud is transforming IT and the business of government landscape. This convergence brings together applications, systems and processes to help meet current needs while preparing for future innovation. It's at the heart of the Internet of Everything (IoE) in connecting people, process, data and things in new and innovative ways.

Learn more at: [www.cisco.com/go/convergencegov](http://www.cisco.com/go/convergencegov)



## 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 150,000 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.

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