

Internet of Everything: A \$4.6 Trillion Public-Sector Opportunity

More Relevant, Valuable Connections Will Boost Productivity, Revenue, and Citizen Experience, While Cutting Costs

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Executive Summary

- 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).
- The \$4.6 trillion in public sector Value at Stake will result from IoE's ability to help public-sector organizations manage assets, optimize performance, and create new business models.
- 70 percent of the public sector's IoE Value at Stake will come from agency-specific implementations, while 30 percent will derive from cross-agency adoption of IoE.
- The five primary drivers of IoE Value at Stake for the public sector are:
 - 1) employee productivity, 2) connected militarized defense, 3) cost reduction, 4) citizen experience, and 5) increased revenue.
- More than two-thirds of IoE's Value at Stake for the public sector (69 percent) will be powered by citizen-centric connections (person-to-person, machine-to-person/person-to-machine).
- \$4.6 trillion in public sector Value at Stake is equivalent to about one-third of the expected civilian labor productivity growth over the next 10 years.
- 95 percent of IoE's total Value at Stake for the public sector will come from just over half (23) of the 40 use cases analyzed by Cisco.
- Cities will generate almost two-thirds (63 percent) of IoE's overall civilian benefits. To maximize value, cities should combine uses cases rather than approaching them individually.

More than perhaps any technological advance since the dawn of the Internet, the Internet of Everything (IoE) – the networked connection of people, process, data, and things – holds tremendous potential for helping public-sector leaders address their many challenges, including the gap separating citizen expectations and what governments are currently delivering.

Introduction

Just as broadband has been a critical enabler of economic growth, social inclusion, and improved government service delivery over the past few decades, the Internet of Everything (IoE) – the networked connection of people, process, data, and things – is creating many new opportunities (and risks) that public-sector leaders need to consider. In addition to connecting people, IoE's ability to connect ever-growing numbers of sensors and actuators to objects or things on the Internet, to extract and analyze growing amounts of useful data, and then to use that analysis in automated and people-based processes has enormous potential across all sectors.

IoE is capable of helping organizations achieve many public-policy goals, including increased economic growth and improvements in environmental sustainability, public safety and security, delivery of government services, and productivity. These benefits, of course, don't come without costs and public-policy concerns.

Now is the time for governments at all levels to assess where and how they might use IoE in their own operations, as well as the role it could play in achieving broader economic and social goals.

To help public-sector organizations better understand the IoE opportunity, Cisco recently concluded a comprehensive economic analysis based on 40 agency-specific and cross-industry use cases. This "bottom-up" analysis spanned the public-sector spectrum, encompassing education, culture & entertainment, transportation, safety and justice, energy & environment, healthcare, defense, and next-generation work and operations.

Why IoE for the Public Sector?

Governments at the city, state/province, and federal levels confront a similar dilemma worldwide: how to meet increased citizen expectations in the face of reduced or flat budgets. This challenge has contributed to an increasing gap between citizen expectations and what governments actually deliver. In addition, a large set of other issues needs to be addressed across federal, city/state/local, healthcare, defense, and education (see Figure 1).

More than perhaps any technological advance since the dawn of the Internet, the Internet of Everything – the networked connection of people, process, data, and things – holds tremendous potential for helping public-sector leaders address their many challenges, including the gap currently separating citizen expectations and what governments are actually delivering.

IoE offers governments the opportunity to make significant advances in citizen services. For example, IoE will enable governments to create services that leverage Big Data and crowdsourcing to expand the power of machine-to-machine communications for citizen delivery. As large organizations, government departments and cities can benefit directly from the same new technologies that are transforming supply-chain management and logistics in the private sector. Similarly, they can build on the potential of mobile technology to develop "smart working" for

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their employees, resulting in significant cost savings. “Smart building” strategies can also reduce costs, while generating a positive environmental impact.

Figure 1. The Public Sector Faces a Multitude of Issues: Productivity, Revenue, Costs, and Citizen Experience.



Source: Cisco Consulting Services, 2013

The transformational impact of IoE in the public sector will be realized through wholesale transformation of the way services are designed and how they utilize information to meet the needs of citizens more effectively.

Immediate IoE benefits will occur in the domain of statistical services and the availability of near-real-time data pertaining to various citizen behaviors – their location, the way goods are moved across borders, citizens’ consumption habits, and their future intentions. When applied to large populations, Big Data and the associated analytics will increasingly enable predictive modeling and, as a result, improvements to public infrastructure. These capabilities will also allow better anticipation of emerging trends, short-term fluctuations in demand driven by external factors (such as weather conditions or public events), and better management of emergency responses. In safety and security, predictive modeling is already being used to help deploy policing resources for greater effectiveness in fighting crime.¹

These developments are already driving sector-specific IoE infrastructure programs – such as smart grid, smart metering, early-warning systems, and critical-infrastructure protection – that support governments’ strategic policy objectives.

IoE-driven benefits from programs such as connected transportation, smart roads, social care, and education accrue as reductions in overall costs, especially through better targeting and control of resource usage. Other programs have indirect benefits for government – economic, social, or environmental – but *direct* benefits for citizens and businesses in terms of reduced transactional costs and time saved, or in external benefits such as better quality of life. For example, improved traffic

Researchers at Harvard University have identified whole system impacts of smart road systems that go beyond shorter journey times and reduced traffic congestion to also promote better land use as car parking space is used more efficiently – eventually resulting in reduced pressure on urban land use and, hence, lower housing costs.

flow saves time, money, and energy for individuals and businesses. Researchers at Harvard University² have identified whole system impacts of smart road systems that go beyond shorter journey times and reduced traffic congestion to also promote better land use as car parking space is used more efficiently – eventually resulting in reduced pressure on urban land use and, hence, lower housing costs.

IoE also offers public-sector bodies the ability to manage regulatory and transfer-payment functions better. Many agricultural systems around the world rely directly on subsidies and payments to farmers based on returns about such things as land use and livestock numbers. In Australia, measures that will allow farmers to monitor their cattle herds offer the possibility of more accurate and timely returns to government for subsidy regimes, and for managing animal health on a national and potentially international scale.³ Similar principles apply to the management of food chains in the interest of public health. Management of land use with Big Data is being trial-tested on a global scale by projects developed by the Planetary Skin Institute, a collaboration supported by Cisco, NASA, and a number of governments.

IoE Is Happening Now in the Public Sector

The current state of IoE-based public-sector programs is characterized by a high degree of sponsorship and encouragement by national governments. IDC estimates that 70 percent of spending on Smart City projects in 2013 will be focused on energy, transportation, and public safety, and 90 percent of it will be at least partially funded by national or international governments.⁴ IoE development strategies for the public sector typically fall into one or more of the following categories:

National Strategies

In South Korea, for example, two ministries have been involved in the promotion and deployment of Internet of Things (IoT)⁵ visions, R&D activities, and use cases in terms of radio frequency identification (RFID), USN (ubiquitous sensor network), and M2M (machine-to-machine) as the enabling technologies for IoT. The intention has been to coordinate development under these technology-defined categories, but with a view to articulating the broader vision of “IoT for the future direction.” With this in view, the department with responsibility for the manufacturing industry has a goal to make RFID and sensor networks penetrate the everyday life of people to deliver a better quality of living.

Economic Development/Industry Strategies

The United Kingdom has recently included the Internet of Things and Smart Cities as two of five strands, alongside cloud computing, e-commerce, and Big Data, in its Digital Economy Strategy.⁶ The approach is based on a wish to coordinate existing public-sector efforts, including work in the research community, and to create an environment conducive to private-sector innovation and investment.

Visible impact of IoE technologies in the delivery of public services is most advanced in single applications that support specific policy goals.

Single-Sector Transformation Programs

Visible impact of IoE technologies in the delivery of public services is most advanced in single applications that support specific policy goals. This most often involves a high degree of public-private partnership, with governments (including city and regional governments) taking initiatives to bring about or accelerate solutions that the market might not otherwise deliver on its own. The United Kingdom's Smart Metering program, for example, aims to deliver a visual display of energy consumption in every household by 2020.⁷ The national policy goal is to reduce energy consumption through better awareness of usage, thereby also decreasing household expenditure. The program was designed by the regulator (Ofgem) in consultation with industry, consumer, and academic interests, and delivery will be handled by the utility companies.

Sponsorship of Demonstration Projects

The present wave of investment includes a large number of demonstration projects as public authorities and industry alike seek to learn more about sustainably implementing and managing IoE programs. This is particularly true in Smart City programs such as those in Nice, Barcelona, and Glasgow, where the U.K. government recently announced funding of £24 million by the Technology Strategy Board to showcase how cities can grow their local economy and improve the lives of their citizens by using new technologies to integrate and connect city systems.⁸ Japanese cities are similarly looking to develop programs that respond to concerns about public safety and energy security following the earthquake and tsunami of 2011, while also addressing other local issues, especially those of an aging population.⁹

Programs that Build the Knowledge Base Through R&D Funding

The public sector has played a crucial role in the development of the Internet of Things by actively promoting involvement of the academic sector. This has been achieved through existing research funding mechanisms and specific programs. The EU made the Internet of Things a major domain of the FP7 program, creating the Internet of Things Initiative (IOT-i)¹⁰ and an IoT European Research Cluster, which aimed to provide "a lightweight portfolio management for overcoming isolated, redundant research and knowledge barriers." The cluster created a systematic portfolio with 14 programs, including technical, social, and organizational themes.¹¹

Challenge Funding and Competitions Aimed at Stimulating Innovation

Governments are also eager to ensure that the Internet of Everything provides an opportunity to develop new, innovative businesses that grow and become significant employers as IoE's domain expands. One favored approach has been competitions that offer funding, mentoring, and other support to the best entries. Examples are the U.K. TSB's funding competitions, including several that are specific to the digital economy.¹²

For the public sector, Cisco defines IoE “Value at Stake” as “the potential value that can be created by public-sector organizations based on their ability to harness IoE over the next decade (2013–2022).”

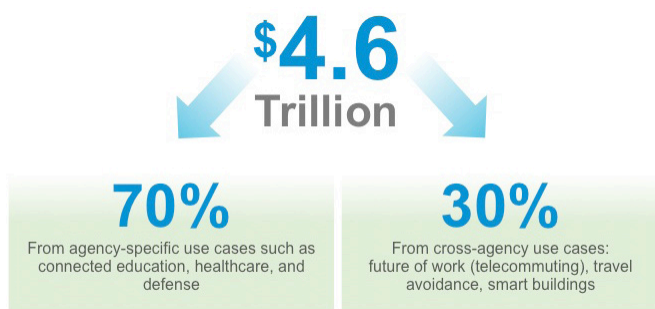
IoE is already delivering value for the public sector. Here are some examples:

- 7 percent crime reduction based on smart lighting (U.K.)¹³
- 15 percent travel savings due to immersive video (high-definition video collaboration, U.S.)¹⁴
- 30 percent reduction in waste-collection costs driven by usage of sensors (U.S.)¹⁵
- \$950 savings per court appearance through use of video technology (U.S.)¹⁶

IoE Will Create \$4.6 Trillion in ‘Value at Stake’ for the Public Sector Globally

For the public sector, Cisco defines IoE “Value at Stake” as “the potential value that can be created by public-sector organizations based on their ability to harness IoE over the next decade (2013–2022).” Cisco predicts that the IoE Value at Stake will be \$4.6 trillion for the public sector worldwide over the next decade (see Figure 2).

Figure 2. Agency-specific Use Cases Will Drive 70 Percent of IoE’s Value for Public Sector.



Source: Cisco Consulting Services, 2013

When combined with Cisco’s estimated IoE Value at Stake for the global private sector over the next decade (\$14.4 trillion), the overall Value at Stake reaches \$19 trillion.¹⁷

The \$4.6 trillion in IoE Value at Stake for the public sector is equivalent to about one-third of the expected civilian labor productivity growth over the next 10 years.

Cisco's public sector Value at Stake estimate includes:

- Benefits for agencies, employees, and citizens
- Quantified citizen outcomes (such as reduced traffic congestion, crime, etc.)
- Hard cost savings, increased revenues, and productivity gains
- Allowances for implementation and operational costs

The public sector Value at Stake estimate *does not include*:

- Privately owned citizen services
- Private-sector impact from public expenditure

Cisco's analysis shows that most of the potential Value at Stake (70 percent, or \$3.2 trillion) will be agency-specific, while 30 percent (\$1.4 trillion) will be driven by cross-agency adoption of IoE.

Cisco calculated the IoE Value at Stake for the public sector by taking a bottom-up approach considering the value created by 40 use cases – both agency-specific and cross-agency. Top-down analysis was also performed as a cross-check to validate the completeness and order of magnitude of the more thorough bottom-up approach. Finally, care was taken not to double-count value across use cases.

The \$4.6 trillion in IoE Value at Stake for the public sector is equivalent to about one-third of the expected civilian labor productivity growth over the next 10 years (see Figure 3). Worldwide public sector labor productivity increases by around 3 percent each year.¹⁸ Dividing the civilian value generated each year by the expected annual salary costs provides a 1 percent improvement annually. The remaining productivity growth is likely due to increased training and use of unconnected ("dark") assets.

Figure 3. \$4.6 Trillion in Value at Stake Is Equivalent to About One-third of Expected Civilian Labor Productivity Growth.



Source: Cisco Consulting Services, 2013

Combined, P2M and P2P connections will constitute 69 percent of the total IoE Value at Stake for the public sector by 2022, while M2M connections make up the remaining 31 percent.

Five Drivers of Value at Stake for the Public Sector

There are five main drivers of the \$4.6 trillion of IoE Value at Stake for the public sector. These findings allow public-sector leaders to begin planning how they can benefit from IoE. The five drivers are:

1. **Employee productivity (\$1.8 trillion):** IoE improves labor effectiveness for new and existing services.
2. **Connected militarized defense (\$1.5 trillion):** IoE generates a fourfold force-multiplier effect through improved situational awareness and connected command centers, vehicles, and supplies.
3. **Cost reductions (\$740 billion):** IoE improves labor efficiency and capital-expense utilization, leading to reduced operational costs.
4. **Citizen experience (\$412 billion):** IoE shortens “search” times, improves the environment, and produces better health outcomes.
5. **Increased revenue (\$125 billion):** IoE improves the ability to match supply with demand, while also enhancing monitoring and compliance.

These drivers illustrate how IoE can impact every aspect of public-sector processes – including both cost-cutting and revenue-raising activities.

In addition, to benefit from IoE, firms must combine technology-enabled security capabilities (both logical and physical) with policies and processes designed to protect the privacy of citizen information. IoE’s growth potential in the public sector over the next decade will rely heavily upon the success of organizations’ security and privacy efforts.¹⁹

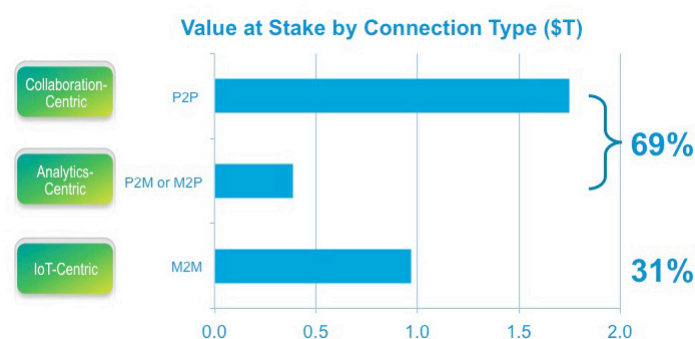
Which Connections Matter Most?

By definition, IoE includes three types of connections – machine-to-machine, person-to-machine (P2M), and person-to-person (P2P). Combined, P2M and P2P connections will constitute 69 percent of the total IoE Value at Stake for the public sector by 2022, while M2M connections make up the remaining 31 percent (see Figure 4). It is important to note that while M2M connections are fast becoming a sizable source of value, the end result of these connections is ultimately to benefit people. The bottom line is that the IoE Economy is about enabling people to be more productive and effective, make better decisions, and enjoy a better quality of life.

In the public sector, person-to-person connections include, for example, telework, BYOD, connected learning, mobile collaboration, and travel avoidance. Examples of machine-to-person/person-to-machine connections include smart parking, disaster response, and inpatient monitoring.

Cisco's research and analysis indicate that cities will generate almost two-thirds (63 percent) of IoE's civilian benefits globally over the next decade.

Figure 4. 69 Percent of IoE's Value at Stake Will Be Powered by People-Centric Connections (P2P, P2M/M2P).



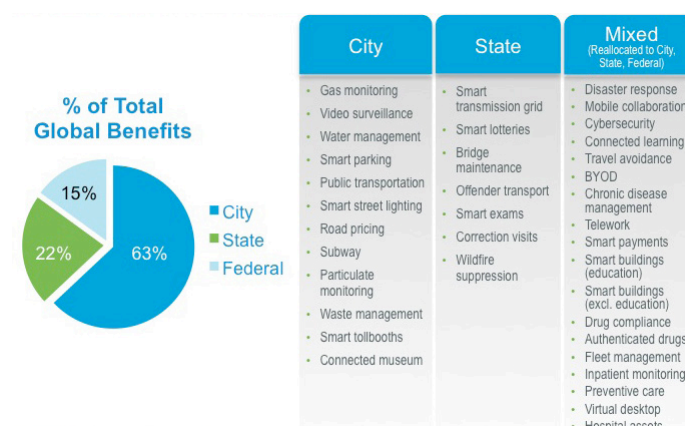
Source: Cisco Consulting Services, 2013

Connected healthcare and patient monitoring provide a great example. By enriching the connections between medical devices and both patients and doctors (M2P), and among patients and doctors themselves (P2P), better hospital-level care can be provided at patients' homes. This improves quality of life, increases positive medical outcomes, and reduces costs for both providers and patients.

Cities Stand To Benefit Most from IoE

Cisco's research and analysis indicate that cities will generate almost two-thirds (63 percent) of IoE's civilian benefits globally over the next decade (see Figure 5). By comparison, states/provinces and federal will produce 22 percent and 15 percent of the remaining benefits, respectively.

Figure 5. Cities Will Generate Almost Two-thirds of IoE's Overall Civilian Benefits.



Source: Cisco Consulting Services, 2013

Interestingly, 95 percent of IoE's total Value at Stake for the civilian public sector will be driven by just over half (23) of the 40 use cases analyzed by Cisco.

To maximize IoE value, cities should strive to combine use cases rather than approaching them individually. Cities experiencing budget constraints, for example, should focus on IoE's revenue-generating use cases, such as smart parking, water management, and gas monitoring – the “killer apps” for cities.

Cooperation across city functions and departments (including resource sharing) is essential to deriving value from IoE. In addition, public-private partnerships provide cities with an opportunity both to defray costs and increase IoE benefits for government, citizens, and industries.

City budgets vary, although transportation, public safety, and waste management often represent about half of a total budget. Based on the expected impact of IoE, a city could expect to improve services (or decrease costs) in the short term by about 5 percent.

Real-World Use Cases Show IoE's Value for the Public Sector

To receive the most value from IoE, public-sector leaders should begin transforming their organizations based on key learnings from use cases that show how IoE works in the real world. Interestingly, 95 percent of IoE's total Value at Stake for the civilian public sector will be driven by just over half (23) of the 40 use cases analyzed by Cisco.

There are 350 million public employees in the world, and the use cases that improve labor productivity are some of the largest. These, combined with opportunities in education and security, provided the main global benefits. For federal agencies, the Next-Generation Workforce use cases (mobile collaboration, BYOD, telework, virtual desktop, travel avoidance) represent the largest opportunity to realize IoE value.

The use cases featured below, which represent \$2.2 trillion of the \$4.6 trillion IoE Value at Stake for the public sector, were selected for their usefulness in helping public-sector leaders determine how to move forward with regard to their organizations.

Each of these use cases includes a general description; the amount of contribution to the total Value at Stake; the people, processes, data, and things involved in the use case; and specific areas of impact.

1. Smart parking: \$41 billion of total Value at Stake

Provides real-time visibility into the availability of parking spaces across a city. Residents can identify and reserve the closest available spaces; traffic wardens can recognize noncompliant usage; and the municipality can introduce variable pricing.

Chronic disease management provides remote monitoring of patients with three chronic diseases: congestive heart failure, chronic obstructive pulmonary disease, and type 2 diabetes.

- **New things created:** Connected parking spaces, parking meters
- **New data flows:** Space availability
- **Process innovation:** Pricing/payment; enforcement; finding spaces
- **People impact:** Traffic wardens; citizens/drivers; city planners
- **Value impact:** Increases compliance by 30 percent; enables city data sales; reduces traffic congestion/time required to park/fuel usage; dynamic pricing increases revenues

2. Water management: \$39 billion of total Value at Stake

Connects the household water meter to an IP network to provide remote information on use and status.

- **New things created:** Connected water meters
- **New data flows:** Water meters
- **Process innovation:** Water usage
- **People impact:** Citizens, city planners
- **Value impact:** Reduces labor and maintenance costs; improves accuracy of readings; decreases water consumption by citizens; lowers meter-reading costs

3. Gas monitoring: \$69 billion of total Value at Stake

Connects the household gas meter to an IP network to provide remote information on usage and status.

- **New things created:** Connected gas meters
- **New data flows:** Gas meters
- **Process innovation:** Gas usage
- **People impact:** Citizens, city planners
- **Value impact:** Reduces labor and maintenance costs; improves accuracy of readings; decreases gas consumption by citizens; lowers meter-reading costs

4. Chronic disease management: \$146 billion of total Value at Stake

Provides remote monitoring of patients with three chronic diseases: congestive heart failure, chronic obstructive pulmonary disease, and type 2 diabetes. All care aspects are consolidated and coordinated in a less-expensive home setting.

- **New things created:** Patient-monitoring systems
- **New data flows:** Patient statistics
- **Process innovation:** Treatment protocol, admissions, discharge
- **People impact:** Patients, clinicians
- **Value impact:** Reduces admissions; enables shorter hospital stays due to home-monitoring systems; promotes usage of standardized treatments that conform to best practices

Connected learning delivers an authentic, relevant, collaborative experience through scaling of instruction, use of electronic resources, and data-driven decisions.

5. Road pricing: \$18 billion of total Value at Stake

Provides automatic payments as vehicles enter “priced” areas in busy zones of cities, improving traffic conditions and revenues.

- **New things created:** Vehicle payment system
- **New data flows:** Vehicle records, payment prices
- **Process innovation:** Pricing, payment
- **People impact:** Citizens/drivers; city planners; traffic wardens
- **Value impact:** Increases revenue; reduces traffic congestion, leading to savings in road expansion; reduces CO2 emissions

6. Telework: \$125 billion of total Value at Stake

Eliminates the daily commute to the office by enabling employees to work from home or remote locations.

- **New things (capabilities) created:** Traveling employees
- **New data flows:** Information and communication
- **Process innovation:** Connectivity, collaboration
- **People impact:** Employees, employers
- **Value impact:** Reduces the real-estate requirement for employers; lowers janitorial and printing costs; improves employee retention and productivity; provides additional employment opportunities

7. Connected learning: \$258 billion of total Value at Stake

Delivers an authentic, relevant, collaborative learning experience through scaling of instruction, use of electronic resources, and data-driven decisions.

- **New things (capabilities) created:** Connected students, teachers, campuses
- **New data flows:** Study modules, lectures
- **Process innovation:** Instruction, learning techniques
- **People impact:** Students, teachers
- **Value impact:** 40 percent improvement in teacher utilization through recorded lessons; 50 percent reduction in instructional supplies

8. Connected militarized defense: \$1.5 trillion of total Value at Stake

Provides real-time situational awareness to combat personnel in theater by connecting command-center tents, vehicles, and special forces. Enables the ability to visualize the location of allied and enemy personnel and material.

- **New things created:** Connected command centers, vehicles, supplies
- **New data flows:** Location of allied and other forces
- **Process innovation:** Situational awareness
- **People impact:** Combat personnel
- **Value impact:** Multiplier effect – fourfold increase in combat-mission effectiveness

As with the Internet itself, IoE's technologies will transcend national boundaries, so it will be important for governments to work together to promote international collaboration and governance.

What Should Governments Do?

Governments have a role in maximizing IoE's benefits for all citizens, while at the same time minimizing potential negative effects. As with the Internet itself, IoE's technologies will transcend national boundaries, so it will be important for governments to work together to promote international collaboration and governance. Governments will need to focus on three key areas:

- 1. Economic development:** IoE's growth in the public sector will rely on governments making it part of their broader economic development strategies. This is likely to include promoting a business environment that encourages innovation in the development and use of IoE, including IoE-related R&D, cultivation of IoE-related specialist skills through the education system, and actions necessary to foster development of the required infrastructure. Governments will also wish to encourage private-sector implementation of IoE-based solutions to advance wider program goals, such as environmental sustainability, infrastructure resilience, effective transportation, and public safety and protection.
- 2. Service delivery and efficiency:** Public-sector bodies will have similar opportunities to create new services and capabilities and/or to improve existing ones. At the city level, these include applications such as improved building management, traffic flow, street lighting, water or waste management, and policing. At the state/provincial level, these will encompass highway infrastructure (such as pavement and bridge conditions), highway traffic management, health and education applications, and agricultural programs (such as irrigation). At the national level, applications will include border protection, tax collection, and critical infrastructure protection (such as airports, railways, and ports).
- 3. Policy and regulation:** Governments will continue to have a policymaking and regulatory role in relation to IoE. They will need to devise policies for the allocation of resources, such as radio spectrum, as well as support the openness and efficient operation of markets. The pervasive nature of IoE – and the potential for it to be used extensively for management of critical infrastructure – means that governments will need to help ensure the safety and security of the systems themselves, while also protecting users' personal information and privacy. As an increasing number of the societal systems become "smart" through IoE technologies, government will be responsible for ensuring social cohesion and inclusion as part of the process. The development of new technologies across all sectors – driverless cars, food testing, or health monitoring, for example – will also call for new regulations in the interests of protecting public safety. Other IoE applications may lead to policy and/or regulatory actions to support environmental sustainability (such as a requirement to use smart meters) or access (for example, ensuring all schools can use IoE-related technologies for collecting and analyzing data about students' learning behaviors).

Governments also need to consider the way that loE-based systems are planned and implemented, and, in particular, how citizens' expectations of openness and accountability can be met.

The growth of the Internet of Everything will also have implications for the role and *modus operandi* of government itself. These considerations arise principally from the explosion of data generated about individuals, processes, and systems. The potential (if not the desirability) of governments greatly to increase their surveillance capability is a stark fact. Set against this backdrop, other organizations will hold massive stores of data that are not necessarily accessible to the authorities. Governments may wish to reconceptualize whole areas of their current business – for example, redefining taxation in a world in which the movement and ownership of goods (and information) can be known much more precisely. The potential of these loE-driven changes prompted the U.S. Federal Trade Commission to issue a call for input on the privacy and security implications of the Internet of Things/loE.²⁰

Governments also need to consider the way that loE-based systems are planned and implemented, and, in particular, how citizens' expectations of openness and accountability can be met. loE programs are complex and involve relationships with private-sector businesses. In areas of technological innovation, government organizations will need to equip themselves with technical and business expertise if they are to maximize public benefits. They will need, for example, to have a good understanding of issues such as the ownership of intellectual property, liability, and rights to the data created by loE applications, while leveraging education systems to ensure public awareness and understanding of loE's implications.

The Internet has led citizens to demand greater transparency and accountability as information has become more freely available about governments and the activities of government agencies and their employees. This will not diminish with the deployment of loE applications. The principles of the reverse *panopticon*²¹ and surveillance – citizens surveilling the authorities – will continue to apply. Citizens will demand access to information collected about themselves, and they will want large data sets to be accessible in accordance with open-data principles. This movement is already underway. As part of the Miami Dade Smart City project, for example, the county plans to consolidate data analytics about finance, human resources, budgeting, and planning, and to provide users with access the government's financial information online.²²

The fundamentals of developing a strategy for the Internet of Everything are not very different from those of any other technology-related strategy, whether at a city, regional, or national level. The questions to ask relate to the benefits that are sought, and how to obtain and manage the resources – whether financial, technical, or human – to achieve them. At a governmental level, these questions are complicated by the need to consider broader social impact and the regulatory responsibility, and by the dual governmental roles of “promoter of economic development” and “provider of public services.”

Public-sector leaders have a unique opportunity to “act” rather than “react.”

At the most general level, governments might begin by asking these questions:

As promoter of economic development

- Is the economic environment in the country/city/region/sector conducive to innovative investment?
- Do we have the necessary infrastructure – technology, markets, and skills?
- Are there effective relationships among government, industry, and the research community?

As provider of services

- How does the public want services delivered, and how can we enable citizens to share in leading change?
- How can we develop incremental programs for IoE so that we gain the necessary experience in implementing innovative programs?
- How can we acquire the skills and knowledge necessary for success?
- Which new governance or business models may be required in an IoE environment?

As policymaker and regulator

- How can we promote open debate about the acceptability of new systems, particularly in relation to privacy, safety and security, and resilience?
- How can we ensure that all citizens benefit?
- How can we create an open-standards system that supports a dynamic and competitive market?

How To Get Started

Public-sector leaders have a unique opportunity to “act” rather than “react.” To get started, public-sector leaders should:

- Determine which IoE capabilities their organizations have today
- Harness the complementary insights of both service and IT leaders
- Identify major IoE opportunity areas and establish an IoE vision
- Reach out to other organizations to share the benefits of IoE platforms
- Build an “IoE culture” by helping employees imagine the possibilities of connecting the unconnected

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Endnotes

1. See, for example, the development of these techniques by Greater Manchester Police in collaboration with University College London's Crime Science department, <http://bit.ly/1bf6VYh>
2. Source: <http://nyti.ms/1hoU4Z1>
3. The Digital Hometeads program, which is under development by CSIRO (Commonwealth Scientific and Industrial Research Organisation), James Cook University (JCU), Queensland Department Agriculture, Fisheries and Forestry (DAFF Queensland), and Queensland University of Technology.
4. Source: IDC, February 2013.
5. The "Internet of Things" (IoT) refers simply to the networked connection of physical objects (doesn't include the "people" and "process" components of IoE). IoT is a single technology transition, while IoE comprises many technology transitions (including IoT).
6. Source: <http://bit.ly/19fPKeX>
7. Source: <http://bit.ly/1dSWHzV>
8. Source: <http://bit.ly/1dpAwRu>
9. Source: <http://bit.ly/1kmZc2c>
10. Source: <http://bit.ly/1errskk>
11. Source: <http://bit.ly/1kZ09vd>
12. Source: <http://bit.ly/19VGSpj>
13. Source: <http://bit.ly/1kZ0f6b>. Note: The Dudley Project example shows a crime reduction of 23 percent through improved street lighting. Cisco's estimate uses one-third of this value to preserve the conservative bias of its analysis and the differences in impact of standard street lighting and smart lighting.
14. Note: Any level of travel savings can be achieved by managerial fiat. Estimate is based on practical Cisco experience.
15. Source: <http://www.enevo.com/>. This figure is the likely maximum and has been reduced to take into account different waste management contingencies.
16. Source: <http://bit.ly/1gJ11XB>. Website provides market rates for prisoner transport in the United States.
17. See "Embracing the Internet of Everything To Capture Your Share of \$14.4 Trillion," Cisco, <http://bit.ly/19VH4F1>

18. Source: <http://bit.ly/1gJ18IS>. The Conference Board “2011 Productivity Brief: Key Findings” measured labor productivity growth at 3.3 percent in 2010. Cisco used 3 percent as the long-term estimate in its analysis.
19. The critical need for security and privacy in IoE is underlined by U.S. President Barack Obama’s executive order on cybersecurity, signed on February 12, 2013, which encourages all network operators, companies, and consumers to be cybersmart and cybersecure.
20. Source: <http://1.usa.gov/1hoUG0K>
21. The Free Dictionary (<http://www.thefreedictionary.com>) defines “panopticon” as “a building ... so arranged that all parts of the interior are visible from a single point.”
22. Source: *Government Technology*, March 2013.



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