

The Internet of Everything

Global Public Sector Economic Analysis



Cisco predicts that \$4.6 trillion of value will be “at stake” in the public sector over the next decade, driven by “connecting the unconnected” through the Internet of Everything.

How does Cisco define the Internet of Everything, and how is it different from the “Internet of Things”?

Cisco defines the Internet of Everything (IoE) as 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.

IoE is creating unprecedented opportunities for organizations, individuals, communities, and countries to realize dramatically greater value from networked connections among people, process, data, and things.

By comparison, 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).

Cisco estimates that 99.4 percent of physical objects that may one day be part of the Internet of Everything are still unconnected. Cisco predicts that **\$4.6 trillion of value will be “at stake” in the public sector over the next decade**, driven by “connecting the unconnected” through the Internet of Everything. These connections can be people-to-people (P2P), machine-to-people (M2P), and machine-to-machine (M2M). (When the estimated \$4.6 trillion in Value at Stake for the public sector is combined with the Value at Stake for the private sector – \$14.4 trillion – the overall global IoE Value at Stake reaches \$19 trillion.)

How do you define IoE “Value at Stake” for the public sector?

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).”

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

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

Why should governments focus on IoE now?

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.

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

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

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emergency responses. In safety and security, predictive modeling is already being used to help deploy policing resources for greater effectiveness in fighting crime.

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

What are the sources of the \$4.6 trillion in Value at Stake for the public sector over the next 10 years?

Cisco's analysis shows that most of the potential Value at Stake (70 percent, or \$3.2 trillion) will be agency-specific (for example, connected education, healthcare, and defense), while 30 percent (\$1.4 trillion) will be driven by cross-agency adoption of loE (such "future of work," travel avoidance, and smart buildings).

There are five main drivers of the \$4.6 trillion in loE Value at Stake for the public sector:

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

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

The \$4.6 trillion in loE 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. Worldwide public sector labor productivity increases by around 3 percent each year. 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.

How did Cisco calculate the \$4.6 trillion of public-sector Value at Stake for the next 10 years?

Cisco calculated the loE 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.

Our use cases reflect the projected result of the application of technology – in this case, public-sector transformation driven by the Internet of Everything.

IoE Value at Stake is based on net value: for each use case, we considered both the connections *benefits* and *costs*. Our use cases reflect the *projected result* of the application of technology – in this case, public-sector transformation driven by the Internet of Everything. Cisco's Value at Stake calculation encompasses both *agency-specific* and *cross-agency* use cases.

Which agency-specific and cross-agency use cases did Cisco employ to make its IoE Value at Stake calculations for the public sector?

Cisco's IoE Value at Stake calculations are based on the following 40 use cases spanning the public-sector spectrum, encompassing education, culture & entertainment, transportation, safety and justice, energy & environment, healthcare, defense, and next-generation work and operations:

AGENCY-SPECIFIC USE CASES

Education

- Connected learning
- Smart exams

Culture & Entertainment

- Smart lotteries
- Connected museum

Transportation

- Smart parking
- Public transportation
- Smart toll booths
- Road pricing
- Bridge maintenance
- Subway train control
- Smart street lighting

Safety & Justice

- Disaster response
- Wildfire suppression
- Correction visits
- Video surveillance
- Connected offender transport

Energy & Environment

- Water management
- Smart grid
- Waste management
- Particulate monitoring
- Gas monitoring

To be as accurate as possible, Cisco calculated the Value at Stake by taking a bottom-up approach considering the value created by a large number of use cases in the public-sector domain – both agency-specific and cross-agency – and consolidating them into the 40 most material, relevant, and pragmatic ones.

Healthcare

- Inpatient monitoring
- Preventive care
- Authenticated pharma
- Hospital assets
- Drug compliance
- Chronic disease monitoring

Defense

- Connected militarized defense
- Connected assets

CROSS-AGENCY USE CASES

Next-Generation Workforce

- Mobile collaboration
- BYOD
- Telework
- Virtual desktop
- Travel avoidance

Operations

- Smart buildings – schools
- Smart buildings – non-education buildings
- Fleet management
- Smart payments
- Cybersecurity

How do you know that this use-case list is complete?

To be as accurate as possible, Cisco calculated the Value at Stake by taking a bottom-up approach considering the value created by a large number of use cases in the public-sector domain – both agency-specific and cross-agency – and consolidating them into the 40 most material, relevant, and pragmatic ones. To our knowledge, Cisco is the only company to take this approach when evaluating the opportunity offered by the Internet of Everything. A 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.

Our selection of use cases is based on secondary and academic research on the Internet of Everything, systematic analysis of process and technology enablers, and Cisco's extensive thought leadership and deep vertical industry expertise.

The use cases share several common characteristics:

- Quantifiability
- Materiality (greater than \$10 billion in potential Value at Stake) and/or relevance to the public sector (based on literature search)
- Pragmatic (capable of being operationalized in the short to medium term)
- Reflect intelligence in network

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.

Which IoE public-sector use cases will drive the most Value at Stake over the next decade?

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. The following nine use cases will constitute 86 percent of the total IoE Value at Stake for the public sector over the next 10 years:

- Connected militarized defense (\$1.5T)
- Mobile collaboration (\$951B)
- Cybersecurity (\$363B)
- Connected learning (\$258B)
- Travel avoidance (\$245B)
- Smart grid (\$216B)
- BYOD (\$168B)
- Chronic disease management (\$146B)
- Telework (\$125B)

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.

From a non-defense (civilian) public-sector perspective, which countries have the most to gain from IoE over the next decade?

Cisco estimates that local, state/province, and non-defense federal agencies in the United States (\$585.6B), China (\$291.5B), and France (\$177.8B) have the most to gain by embracing IoE over the next 10 years. Here is the ranking of the 12 countries analyzed:

1. United States (\$585.6B)
2. China (\$291.5B)
3. France (\$182.6B)
4. Germany (\$177.8B)
5. United Kingdom (\$173.4B)
6. India (\$116.2B)
7. Japan (\$109.2B)
8. Canada (\$92.8B)
9. Brazil (\$70.3B)
10. Russia (\$56.3B)
11. Mexico (\$34.4B)
12. Australia (\$25.9B)

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

Which types of connections matter most in the public sector?

By definition, IoE includes three types of connections – machine-to-machine, person-to-machine, and person-to-person. 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. 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.

What are the specific implications of IoE for cities?

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

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 (\$41 billion of Value at Stake), water management (\$39 billion of Value at Stake), and gas monitoring (\$69 billion of Value at Stake) – 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.

Do you have specific examples of how IoE is impacting the public sector right now?

Around the globe, forward-looking governments and agencies are reaping the benefits of IoE *today*:

- A municipal waste management company in Finland reports a 40 percent savings in waste collection costs by adding sensors to garbage cans that signal when they are full and pickup is needed. (Source: <http://bit.ly/1kmWNVu>)
- Early projections from pilot tests of smart parking services in the City of Nice, France have shown the potential for a 30 percent reduction in traffic

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.

congestion and significant air pollution benefits. Nice also has the potential to increase parking revenues because it is able to adjust pricing with demand. (Source: <http://bit.ly/1kmVTrW>)

- City24/7 and New York City have partnered to use interactive smart screens to inform, protect, and revitalize neighborhoods throughout the city. New revenues are generated through advertising on the screens, which also serve to inform residents of local information and act as a citywide sensing, communications, and response network for emergency services. (Source: <http://bit.ly/1dpyi4y>)
- In Songdo, South Korea, a central building management network monitors and optimizes energy use, reducing energy consumption by 30 percent. (Source: <http://bit.ly/19AQRDX>)
- In Barcelona, Spain, a smart bus network tracks new bus routes in the city and provides real-time bus information to citizens. (Source: <http://bit.ly/1bTsmOD>)

Where should governments focus to begin their IoE journey?

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, 2) service delivery and efficiency, and 3) policy and regulation.

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?

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

- How can we ensure that all citizens benefit?
- How can we create an open-standards system that supports a dynamic and competitive market?

What are the first steps governments can take?

To capture more value in the loE Economy, organizations must take a strategic approach that involves: 1) investing in high-quality technology infrastructure and tools, 2) adopting and following inclusive practices, and 3) developing effective information-management practices. Please refer to Cisco’s related paper on the loE Value Index (<http://www.internetofeverything.com>) for additional context on how organizations can go about extracting value from loE.

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

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

Cisco Consulting Services is helping governments and enterprises worldwide capture the value loE can generate for their organizations, customers, and citizens. To learn more, send an email to ioeconsulting@cisco.com or visit http://cs.co/loE_ciscoconsulting

How will loE impact Cisco’s business?

loE is a great opportunity for Cisco and its customers. Cisco stands to benefit from loE because, in the context of loE, organizations will extend the network into every aspect of their operations. Cisco’s unmatched expertise in using network technology to capture market transitions makes it uniquely positioned to help customers capture the value of loE. Only Cisco has the ability to build, manage, and secure an IP-based platform with open standards – from cloud to end devices.

Will Cisco provide loE services for customers?

Yes. We have aligned much of our Cisco Consulting Services organization to help businesses capture more value in the loE economy, and Cisco uses business and IT consulting together to drive the people and process changes necessary to implement loE.

Cisco Consulting Services is leading the charge by helping organizations make the right technology bets and pursue the strategies that will enable breakthrough products and services. Cisco Consulting also developed the groundbreaking

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research and insights that sized the loE opportunity and showed how organizations across the world and in various industries are benefiting from loE.

The loE Value Index (<http://bit.ly/1cezlCz>), for example, is used as a benchmark to identify the required loE capabilities to drive increased business value for enterprise customers. It's the only piece of primary research of its kind in existence today, and it helps our customers understand where to start their loE transformation. We are now engaging with customers to estimate the value each organization can generate from loE and provide a specific roadmap for unlocking that value.

No company in the world understands the loE market transition better than Cisco, or is more uniquely positioned to help its customers take advantage of it.

Which products has Cisco announced that support loE?

Networking is fundamentally changing as the Internet of Everything comes online. For instance, IP traffic is estimated to grow to 1.4 zettabytes by 2017; cloud traffic is growing by six times; approximately two years' worth of video is streamed every second; and 4G mobile will bring entirely new capabilities everywhere.

In September, as an example, we announced the Network Convergence System (NCS), which ushers in a new era of Internet capabilities while enabling new revenue opportunities for SPs. This flagship networking fabric family joins the industry-leading CRS and ASR families and acts as a central nervous system for the architecture.

How important are security and privacy to the Internet of Everything Economy?

Robust security capabilities (both logical and physical) and privacy policies are critical enablers of the Internet of Everything Economy. The loE Value at Stake projections are based on increasingly broad adoption of loE by public- and private-sector companies over the next decade. This growth could be inhibited if technology-driven security capabilities are not combined with policies and processes designed to protect the privacy of both company and citizen/customer information.

loE security will be addressed through network-powered technology: devices connecting to the network will take advantage of the inherent security that the network provides (rather than trying to ensure security at the device level). Privacy, on the other hand, will require that companies combine technology with effective processes and policies. To benefit from loE, organizations will need to identify new privacy models that meet company/agency and customer/citizen expectations.

Governments should not mandate the use of specific technologies or business models.

Does Cisco have a specific point of view regarding privacy and security in the Internet of Everything economy?

In the coming years, the Internet of Everything economy will create new opportunities to transform the world around us – in education, healthcare, manufacturing, commerce, transportation, and other sectors. With those new opportunities will come new challenges, especially with respect to the data privacy and security. To help ensure consumer confidence, it will be incumbent upon IT companies to continue to demonstrate leadership by example in the use and protection of personal information, especially as new technologies and applications are developed. Ultimately, the means by which personal information is protected will be a function of global standards, norms, laws, and the privacy policies of individual organizations, but Cisco strongly believes that several principles will help guide policymakers to achieve an effective balance among economic, privacy, security, and other societal interests:

- Organizations should be encouraged to inform customers/citizens about their privacy practices and to provide choices that help ensure that customers/citizens can control how data that relate to them are used.
- Any national laws and regulations should be consistent with internationally recognized principles to ensure that trade and cross-border flows of information are not hindered.
- At every level – whether state, provincial, national, or regional – governments should develop and adopt data protection policies that meet the needs of a global economy. While cultural and geographic differences exist and will continue to exist, an efficient and thriving global economy requires the mutual recognition of different approaches to data protection.
- Governments should not mandate the use of specific technologies or business models. Overly burdensome policies can become barriers to trade and hinder new technology development and innovations in areas such as education, healthcare, finance, commerce, and entertainment.
- In addition to any legal frameworks in place, industry should adopt voluntary, self-regulatory measures to protect consumer data, strengthened by innovative tools to provide consumers with choices to protect their personal data and understand how it is collected and used, and meaningful penalties should be applied to companies that violate their obligations. Several successful industry-led initiatives, such as the Online Privacy Alliance and TRUSTe, have achieved a reasonable balance between consumer protection and business requirements.

In addition, cybersecurity has become a critical issue. Cisco believes that governments can help decrease cybersecurity threats by:

- Raising consumer and industry awareness of the importance of network security
- Deepening public-private partnerships to secure critical infrastructure
- Removing legal and operational barriers to information sharing in order to enable collective response by public- and private-sector actors

Developing sound approaches to privacy and security will ultimately require a balance between consumer protection and business requirements.

- Educating users about best practices
- Using best practices to secure their own systems and strengthening coordination among public-sector security institutions
- Funding long-term research and development
- Adhering to the global standard for product assurance, the Common Criteria
- Aggressively enforcing the laws against cybercrime and prosecuting criminals that use or attempt to use the network for theft, fraud, extortion, or other crimes
- Increasing cooperation at an international level with other governments, law enforcement agencies, and the private sector on the socialization of best practices, conduct of cyber-incident exercises, and international prosecution of cybercrime

Cisco does not believe that governments should regulate security technologies. In general, regulation:

- Stifles innovation by picking and choosing specific technology, rather than letting market competition develop the best and most advanced solutions
- Does not advance quickly enough to keep pace with current industry needs and newly posed threats
- May actually decrease Internet security by slowing innovation where security threats are constantly evolving

Additionally, Cisco believes that country-specific product regulation undermines the global product assurance regime, the Common Criteria, and the global standards that promote interoperability and security.

In the coming years, issues around data protection are going to become more prominent, not less. Developing sound approaches to privacy and security will ultimately require a balance between consumer protection and business requirements. Cisco will continue to work with policymakers at all levels to ensure that the personal information of customers is protected and that privacy-enhancing innovation is not stunted.

Where can I learn more about IoE?

You can learn more about this analysis, and the opportunities presented by IoE, at: <http://www.internetofeverything.com>.

Frequently Asked Questions




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