# Future of Connectivity:
## Internet of Everything
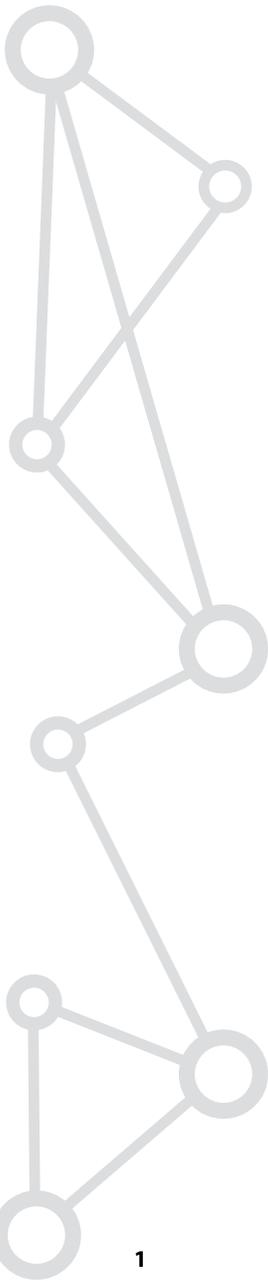
### Background

According to Nobel Prize winner, Robert Solow, technological innovation makes up at least 80 percent of a nation's economic growth and increase in living standards.[i]  The United States is responsible for every major advance in science and engineering since World War II, whether in aerospace, computing, telecommunications, and the Internet.[ii]  These feats were made possible by public policy that fostered an ecosystem where inventiveness flourished.

We live in the most innovative time in human history, with advances happening all around us. The Internet of Everything (IoE) represents a revolution in connectivity that's happening as we speak. IoE is defined by the bringing together of people, process, data, and things to make networked connections more relevant and valuable than ever before- turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries.[iii]

Right now, companies of all kinds are linking "things" as diverse as smartphones, cars, and household appliances to industrial-strength sensors, each other, and the Internet. Driven by three main factors- the mainstreaming of sensors, cloud computing, and the migration of everything to IP networks- IoE is poised to digitize society over the next decade and unleash a wave of innovation, new business formation, economic growth, and jobs creation.

Despite IoE's potential, there are potential barriers that threaten its development. As the world grows ever more connected, information collected about individuals poses serious questions about privacy and security. Furthermore, the federal government holds the largest block of spectrum and as the demand for this valuable resource grows with IoE, the tug of war for spectrum between the public and private sectors will become even more complex.
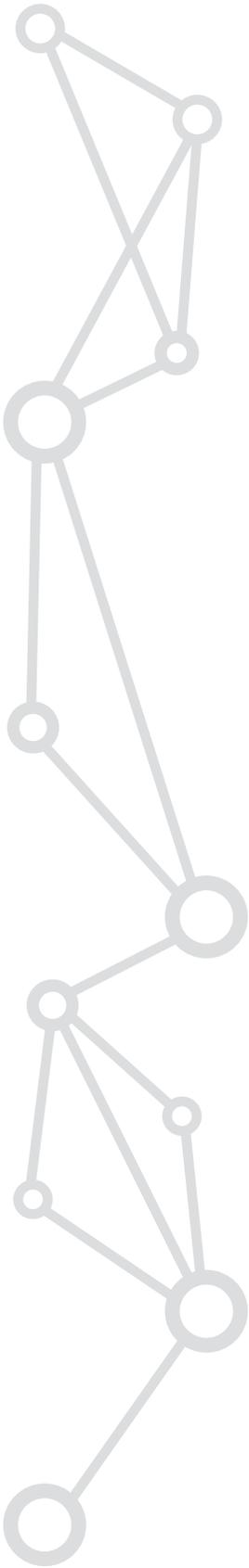
## Unprecedented Rise in Connectivity

Many are calling IoE the next evolution of the Internet, as the cost of sensors drops and more connected devices and objects become uniquely identifiable. It is predicted that within five years, most homes will have 200 devices linked to the Internet from light bulbs to washing machines.[iv] Cisco estimates that by 2015 there will be 25 billion devices connected to the Internet and 50 billion by 2020.

Currently, IoE is composed of a loose collection of disparate, purpose-built networks. As IoE evolves, these networks and more will become connected with increasing analytical and management capabilities. The next wave of growth will come through the confluence of people, process, data, and things- or the Internet of Everything.

IoE is driven by technological trends like dramatic increases in processing power, storage, and bandwidth at ever-lower costs; the rapid growth of cloud, social media, and mobile computing; the ability to analyze Big Data and turn it into actionable information and an improved ability to combine technologies in more powerful ways.

Meanwhile barriers to connectedness are dropping as evidenced by IPv6 overcoming the IPv4 limit by allowing more people, processes, data, and things to be connected to the Internet (IPv6 creates enough address capacity for every star in the known universe to have 4.8 trillion addresses).[v]

## Societal, Environmental, and Economic Impact of the Internet of Everything

In a recent interview, Cisco's CEO John Chambers said that the Internet of Everything will, "Dominate the IT industry over the next decade. Every sensor, every device in the world is going to be connected…This will completely transform health care and education. It will completely transform the profitability of companies." [vi]

IoE presents tremendous economic opportunity. Analysis conducted by Cisco on the potential economic impact of IoE indicates there is as much as $14.4 trillion of potential economic value at stake for global private-sector businesses over the next decade. Furthermore, Cisco estimates that IoE has the potential to increase global corporate profits by nearly 21 percent in aggregate over the next decade.[vi]

The societal and environmental benefits afforded by IoE will go beyond measure. IoE will provide the ability to gather, analyze,

and distribute data that we can turn into information and knowledge that has the potential to bridge the gap between poor and rich, improve distribution of the world's resources to those who need them most, and help us understand our planet. [vii]

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Here are some of the key applications for IoE:

• **Manufacturing:** In manufacturing, the potential for cyber-physical systems to improve productivity in the production process and the supply chain is vast. Consider processes that govern themselves, where smart products can take corrective action to avoid damages and where individual parts are automatically replenished. [ix]

• **Asset tracking:** Enterprises, hospitals, factories and other large organizations can accurately track the locations of high-value equipment, patients, vehicles, and so on.

• **Smart grid and energy management:** Utility companies can optimize delivery of energy to homes and businesses while customers can better manage energy usage.

• **Home and building automation:** Smart homes and buildings have centralized control over virtually any device or system in a home or office, from appliances to plug-in electric vehicles' security systems.

• **Health and wellness:** Doctors can remotely monitor patients' health while people can track the progress of fitness routines. [x]

• **Increased transparency:** Transparency is critical for countries to deliver services to their citizens and IoE will afford all levels of government the ability to increase the level of transparency.

• **Addressing climate change:** IoE will improve the way we sense, understand and manage our environment as billions of sensors are placed around the globe and in our atmosphere. [xi]

• **Transportation:** The IoE gives the transportation industry an opportunity to connect people, provide greater safety, communicate more effectively, and transform transportation centers into community hubs. [xii]

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## Policy Areas Surrounding the Internet of Everything

Thanks to thought leaders like **Dan Caprio**, a member of the European Commission IoE Expert Group and senior strategic advisor for international law firm McKenna Long and Aldridge, and Cisco futurist, **Dave Evans** a dialogue on IoE is beginning to take shape in the United States. Caprio penned an IoE law review article, "Fusion of the real and virtual worlds: transatlantic regulatory efforts"

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outlining the policy work needed for IoE deployment and emphasizing the international aspect of standardization. Meanwhile, Evans is spearheading Cisco's campaign on the "Internet of Everything" with regular blogs on the exciting potential IoE has to offer.

Theirs is the first step in America's road to IoE deployment, but much more work is needed in order for IoE to reach its full potential, and will require cooperation between the public and private sectors to succeed.

Since IoE is in the early phases of development, it's important to identify gaps in policy that could prohibit successful deployment. Currently, the dialogue around IoE is focused on the following issues:

**Spectrum**-First and foremost, IoE requires spectrum. As more and more devices become connected to each other and the Internet, the demand for spectrum will rise. Currently, the government owns the biggest chunk of spectrum and as IoE demands more, the tug of war between the public and private sectors over spectrum will become more complex.

**Security**-Another key component in IoE development and implementation is user trust, particularly as this technology utilizes increasing levels of personal and non-personal data. Wireless technology can be lifesaving if done right, but there are numerous security concerns.

It's important that industry mitigate risk, however, there is always a chance that the integrity or security of devices could become compromised. The public and private sectors should work together in order to clearly define guidelines and expectations for IoE operators in ensuring data confidentiality, integrity, and availability.

Furthermore, lawmakers should work with industry in addressing some of the major issues, while avoiding prescriptive legislative security initiatives that stand to lose relevance because of technology's pace of advancement. Caprio suggests that companies be encouraged to determine appropriate security requirements for specific applications up-front when designing architectures along with security requirements and consensus based interoperable standards.[xii]

## Privacy must be approached in a real world context, and should avoid focusing on "hypothetical harms."

**Privacy**-For IoE to succeed there must also be user trust in terms of privacy. While there is a push by the White House and others to implement a consumer privacy Bill of Rights, a larger shift is already under way that will radically alter the security and privacy debate. In the future, you may own the data that exists about you or that you create online, rather than it being owned by the companies that collect it.

According to Evans, today, privacy policies, agreed to by most people without even reading them, govern the power (or lack thereof) we have over our "own" information. When you have legal rights over your information, you have more control over how it is collected and used. This view that data about you is property, and that you own it, is gaining momentum, such as in the United Kingdom, the World Economic Forum, and the European Union's recognition of personal data protection as a fundamental human right.[xiv]

At the same time, experts like Caprio warn that, "IoE-focused policy initiatives would not only be over-burdensome and confusing, but also run the real risk of not keeping pace and becoming quickly outdated, given the evolving nature of technologies within this digital information society."[xv]  Caprio also notes that privacy must be approached in a real world context, and should avoid focusing on "hypothetical harms."

**Interoperability and Standardization-** To facilitate IoE innovation and deployment, interoperability and standards are necessary. "Open standards among IoE devices and technology must be driven by industry experts, utilizing the effectiveness of current global standards-setting organizations that involve industry and government collaboration," writes Caprio.
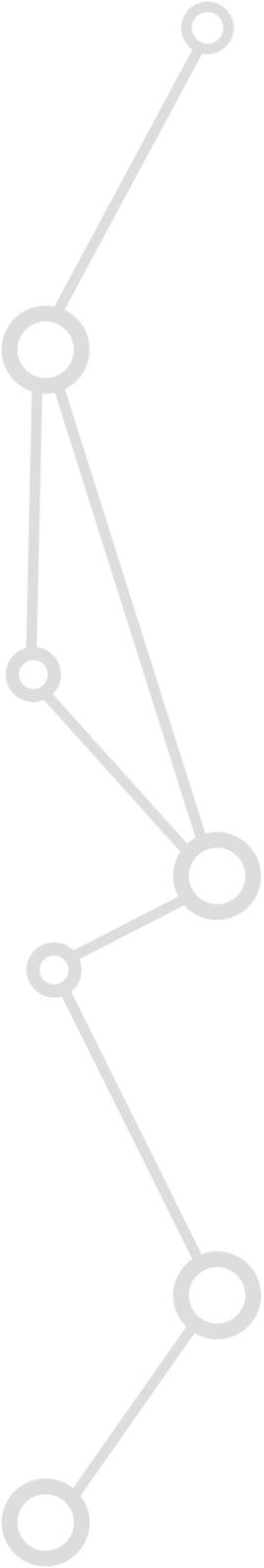
## Education Needed for Internet of Everything to Succeed

Although IoE offers limitless promise, its potential will not be fully realized unless policymakers understand what the Internet of Everything is, and just as importantly, what it is not.

While the European Union has embraced the notion of IoE and is busy preparing for the technology's ubiquitous deployment, the United States has yet to embark on such a comprehensive approach.

The Federal Trade Commission (FTC) plans to hold an IoE workshop on November 19, 2013 to better grasp the opportunities and challenges to IoE adoption in the United States. IoE expert, Dan Caprio applauds this move as a fact finding exercise for the FTC to educate itself, rather than the beginning of a regulatory inquiry.

By engaging lawmakers and their staff on the economic, societal, and environmental importance of IoE, this next iteration of the Internet can be met with enlightened public policy that fosters technological advancement. IoE will give rise to the next wave of extraordinary innovation and economic opportunity, and the United States needs to be at the forefront of this transformational technology.

## About CPPI

The Center for Public Policy Innovation (CPPI) is a 501(c)(3) not-for-profit educational think tank whose mission is to assist government officials in addressing the many challenging issues brought on by the rapid advancement of Information Technology.

CPPI provides policy makers with groundbreaking thought leadership on transformational technology to ensure American competitiveness in the global economy and comprehensive security on the home front. CPPI convenes educational symposiums, site visits, and other forums that bring together stakeholders from government, industry, academia, and the civic sector to discuss policy issues in a collaborative environment.

**Visit CPPI at www.cppionline.org.**

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