

The Internet of Things

What is the Internet of Things and how important is it?

- **Computing technology** is rapidly entering another disruptive phase. In the same way that the Internet revolutionized access to ideas and information, advances in networked sensing and hardware has revolutionized the way computers can observe and interact with the physical world.
- **Sensing and sensor information processing** will have a profound impact. Coupling these systems with advances in machine learning brings dramatic new capabilities including the ability to capture and process tremendous amounts of data, predict behaviors, activities, and the future and manipulate the physical world in response.
- **Physical interaction with “smart systems”** will become a common way to manipulate the world around us. Dialog systems like Siri or Cortana will grow arms and eyes, and be able to respond to commands that will move cars, instruct appliances, or control other devices.
- **Applications of IoT** include creating Smart Cities and Smart Homes, in which existing “dumb” infrastructure like roads and buildings becomes intelligent, greatly increasing efficiency and productivity. IoT will transform health care, providing improved, pervasive, and cost-effective health care to millions, including our increasing population of the elderly.
- **The Economic impact of these transformations** will be enormous: a recent McKinsey report estimates the impact of IoT to be between \$3.9 and \$11 trillion by 2025.
- This is an area the **U.S. cannot afford to cede leadership**, and our leadership in this area is not assured. Competition from Asia and the European Union is significant with advances in Smart Cities and Smart Homes outpacing the U.S.

What is transformative about the Internet of Things?

- (Intelligence) Big data and machine learning allow IoT systems to **know more than humans**. Even now, personal assistants like Siri can answer questions about the weather, navigation, history, etc. In the future, such systems will have access to far more data and a greater ability to reason about it.
- (Action) Cyber-physical systems, such as self-driving cars, will be able to do **many things that humans cannot** or do not want to do. Combining intelligence with the ability to take action results in dramatic new opportunities for increasing efficiency and improving people’s lives.
- (Interaction) The deep embedding of computing into the physical world around us results in an unprecedented degree of **new forms of human to computer and human to human interaction**. Computers will know us intimately and we will depend on them even more in our daily lives.
- (Trust) Technology that is so capable and so interconnected with our lives **requires an unprecedented amount of trust** based on a rigorous understanding of their design. Without this trust, such systems cannot reach their full potential.

What’s the Federal role in advancing the Internet of Things?

- The transformations discussed above are already evolving at a rapid pace
- There are **numerous unanswered questions** regarding security, privacy, networking, robust software development, and cyber-physical-human systems that will impact how quickly US industry is able to build on these technologies.
- We will be unable to unlock the full promise of IoT without a robust and sustained investment in key areas of computing and related disciplines, including social and behavioral science.
- The **Federal government must be proactive** in driving the necessary research, standards, and public/private partnerships to ensure that the greatest benefit is reached with the least negative consequences. Efforts like the Smart Cities and Connected Communities framework developed by NITRD and the recently announced NSF/ Intel partnership to secure the IoT should be supported and buttressed where possible.