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**南加州中華科工學會**

# **Internet of Things : Concepts and Technologies**

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# Agenda

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- **IoT compared to similar concepts**
- **What's Internet of things ?**
- **IoT Six Characteristics**
- **IoT Key Technologies**
- **Other IoT-related technologies**
- **Categories of IoT Applications**
- **IoT Opportunities**
- **The challenges of IoTs**
- **Conclusion**

# IoT Background

The concept of “Internet of Things (IoT)” was first mentioned in 1999 when Kenvin Ashton of Auto-ID Center at MIT in a presentation he made to Procter & Gamble and envisioned

*“a world in which all electronic devices are networked and every object, whether it is physical or electronic, is electronically tagged with information pertinent to that object.”* (Sarma et al., 2000)

In early 1980s, The Coke machine at Carnegie Mellon University demonstrated the first concept of a network of smart devices and was the first internet connected appliance. The programmer could connect to the machine over the Internet , check the status of the machine.

# IoT compared to similar concepts

- *M2M*

Communication had initially been a one-to-one connection, linking one machine to another. But today's explosion of mobile connectivity means that data can now be more easily transmitted, via a system of IP networks, to a much wider range of devices. (address IPV4 : 32 bits vs. IPV6 128 bits which has three hundred and forty trillion unique IP address.)

- *Industrial Internet (of Things)*

The term industrial internet is strongly pushed by GE. It goes beyond M2M since it not only focuses on connections between machines but also includes human interfaces.

# IoT compared to similar concepts

- *Web of Things*

The Web of Things is much narrower in scope as the other concepts as it solely focuses on software **architecture**.

- *Internet of Everything (IoE)*

Still a rather vague concept, IoE aims to include all sorts of connections that one can envision. The concept has thus the highest reach.

# IoT compared to similar concepts

## ■ *Things*

A thing, in the context of the Internet of things (IoT), is an entity or physical object that has a unique identifier, an embedded system and the ability to transfer data over a network.

## ■ *Internet of Things (IoT)*

IoT is a scenario in which objects and people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

## IoT compared to similar concepts

- *The Intelligence of Things*

"Things" (as opposed to people) have become intelligent. They can communicate and can take actions based on information gleaned from sensors, smart devices, databases, systems and information from the worldwide web. We now live in a world where "things" can interact with each other to monitor, manage and control complete systems.

# IoT compared to similar concepts

## ■ *Industry 4.0*

The term Industry 4.0 that is strongly pushed by the German government is as limited as the industrial internet it only focusses on industrial environments. However, it has the largest scope of all the concepts.

Industry 4.0 describes a set of concepts to drive the next industrial revolution. It includes all kinds of connectivity concepts but also goes further to include real changes to the physical world around us such as 3D-printing technologies, new Augmented Reality hardware, robotics, and advanced materials.



# What's the Internet of Things ?

## ■ Definition

(1) The Internet of Things, also called The Internet of Objects, refers to a wireless network between objects.

(2) By embedding short-range mobile transceivers into a wide array of additional gadgets and everyday items, enabling new forms of communication between people and things, and between things themselves.

# What's the Internet of Things ?

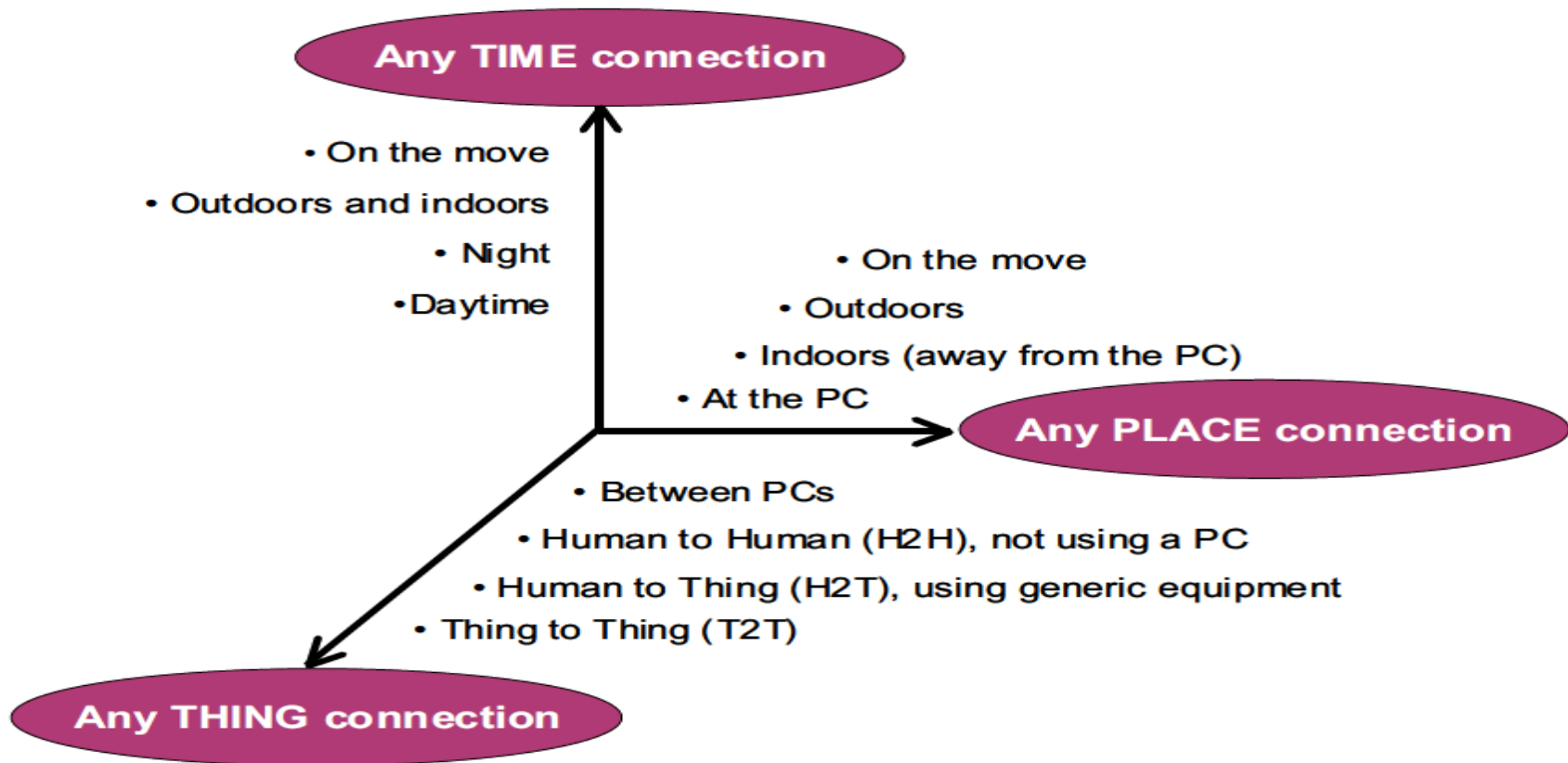
## ■ Definition

(3) The term "Internet of Things" has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects.

(4) “Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts”.

# What's the Internet of Things ?

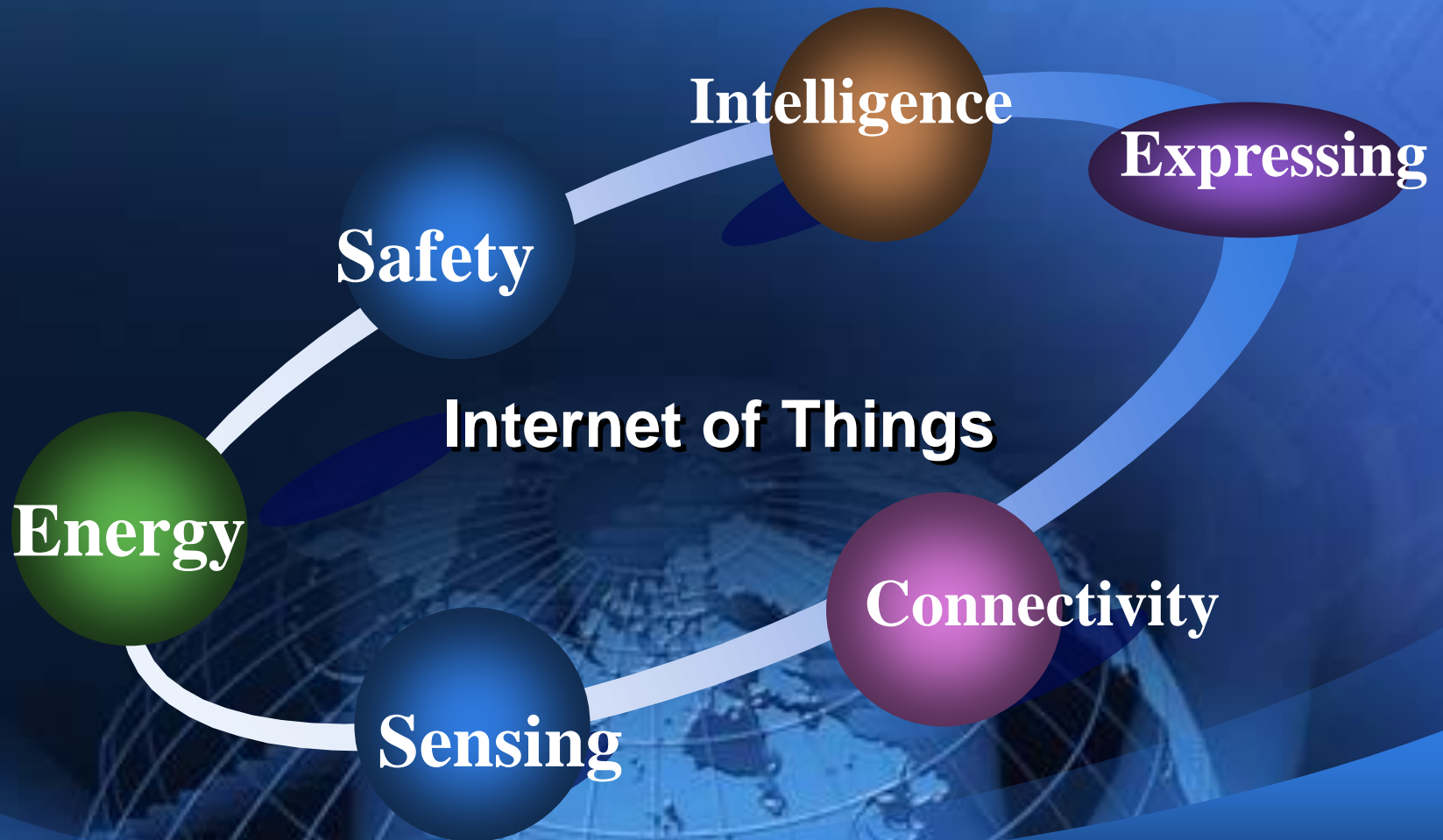
Figure 1 – A new dimension



Source: ITU adapted from Nomura Research Institute

From any time, any place connectivity for anyone,  
we will now have connectivity for anything!

# IoT Six Characteristics



# IoT Six Characteristics

## Intelligence:

*Together algorithms and compute (i.e. software & hardware) provide the “intelligent spark” that makes a product experience smart.*

## Connectivity:

*Connectivity enables network accessibility and compatibility. Accessibility is getting on a network while compatibility provides the common ability to consume and produce data*

## Sensing:

*Sensing technologies provide us with the means to create experiences that reflect a true awareness of the physical world and the people in it.*

# IoT Six Characteristics

## Expressing

*Expressing provides us with a means to create products that interact intelligently with the real world.*

## Energy

*Energy harvesting, power efficiency, and charging infrastructure are necessary parts a power intelligent ecosystem that we must design.*

## Safety

*This includes the safety of our personal data and the safety of our physical well-being.*

# IoT Key Technologies

RFID

To identify and track the data of things

RFID consists of the tag, reader and back-end

Sensor

To collect & process the data to detect the changes in the physical status of things and transmit to base station

Smart Tech

- Artificial intelligence
- Machine-human interaction signal process

Decisions based on feedback received from sensors automatically

Nano Technology

To make the smaller thing, sensors can be easier installed inside every object which has the ability to connect and interact.

# Other IoT-related Technologies

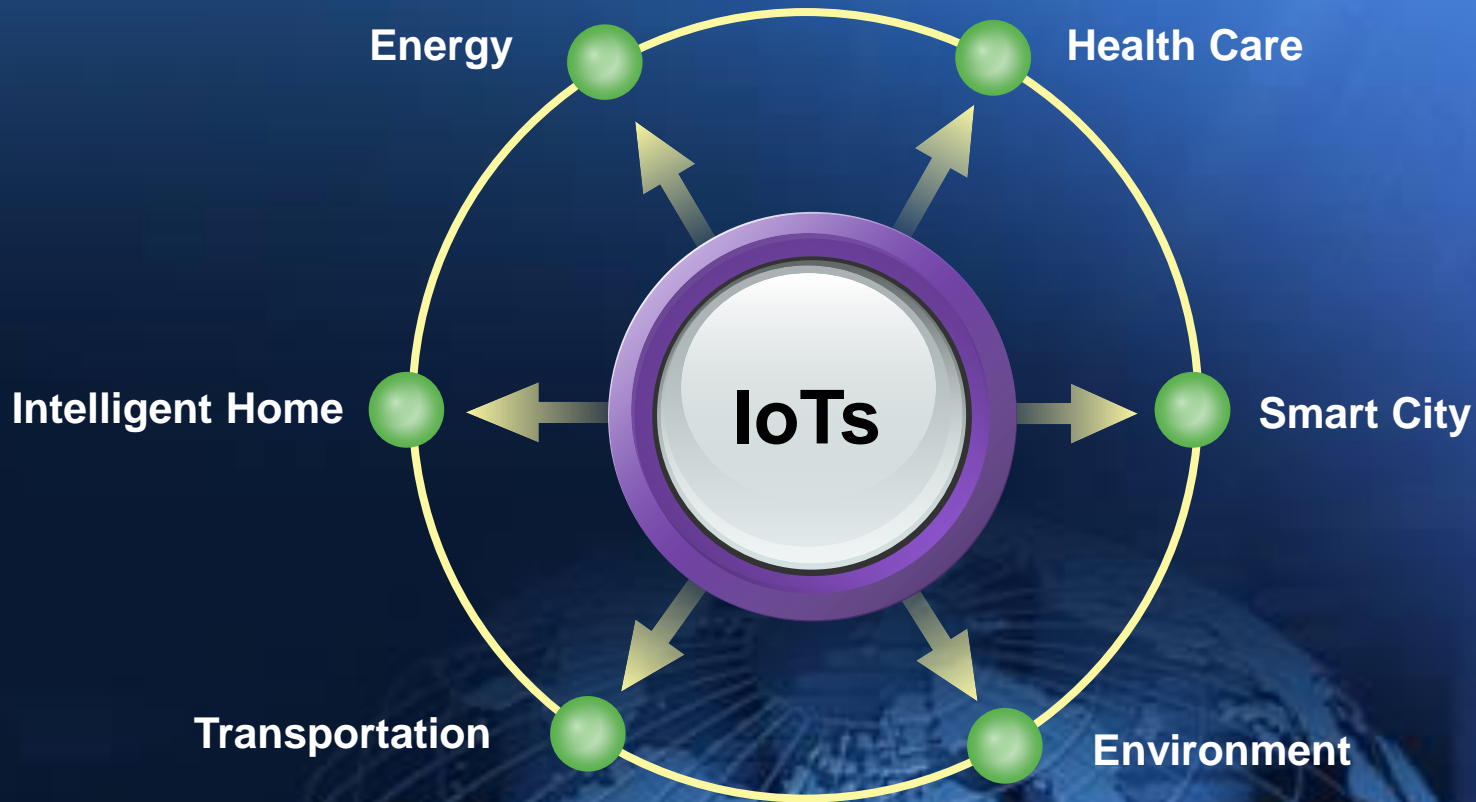
## *Big Data Analytics, Cloud computing and Mobile Computing:*

The data collected from sensors uploads to the cloud and stored in (machine) learning systems, while streaming data input triggers an analytic engine to predict the best outcome and to react accordingly.

Big data accumulates the background knowledge while small data evokes intelligence in-place.



# Categories of Iot applications



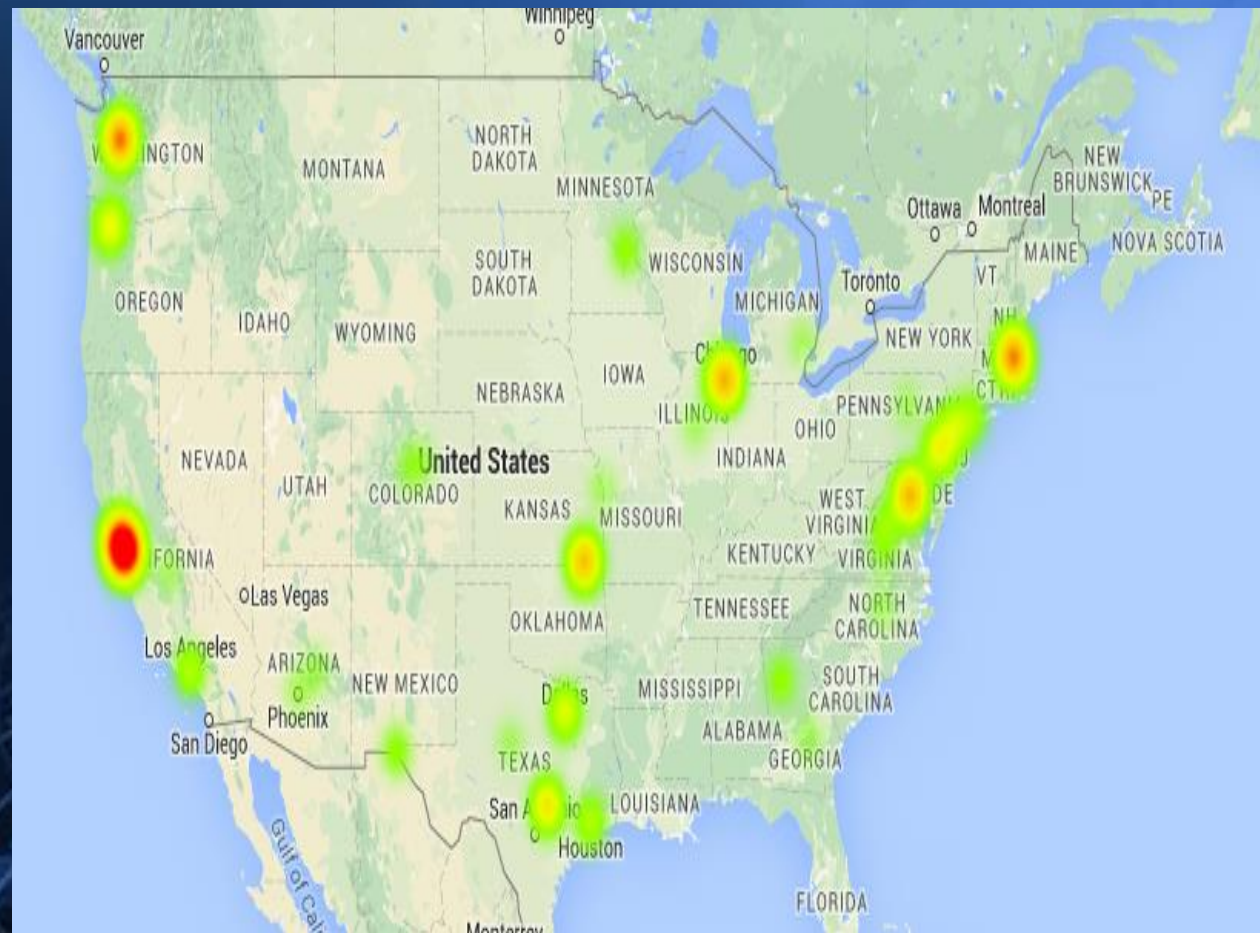
# IoT Opportunities

- Number of devices will be connected
- 2014, We already had 7.2 Billion active mobile connections.
- By 2020, we are expected to have 53 Billion connected devices.
- By 2025, 95 Billion devices could be connected.
- Source: IHS Technology

# IoT Job Opportunities

- Top locations that companies are hiring for IoT positions

1	Santa Clara, CA
2	Seattle, WA
3	Chicago, IL
4	Boston, MA
5	Austin, TX
6	Washington, DC
7	Alexandria, VA
8	San Francisco, CA
9	Sunnyvale, CA
10	Glendale, CA



# IoT Job Opportunities

- **IoT related Jobs / positions (Data / Architect level jobs)**

## Architect level positions

Big Data Lead (IoT)

Data Scientist - IoT

Data Engineer -  
Sensors and IoT

Data Engineer Sensors  
and IoT Applications

Azure Cloud Architect (IoT)

Digital Operations - IoT Consultant/Architect

Internet of Things (IoT) / Cloud Architect

IoT Fog Architect

IoT Software Architect "Internet of Things" Cloud

IoT Solutions Architect

Senior Electrical Architect for IoT

System Architect / IoT/Emerging Technologies

# IoT Job Opportunities

- IoT related Jobs / positions (Software Developer level jobs)
- **Java Developer Positions**
  - Java Developer for Internet of Things (IoT)
  - Java Developer (IoT & M2M)
  - Java Developer Consultant - IoT
- **Mobile Developer Positions**
  - IoT Mobile Application Engineer
  - Senior Mobile QA Engineer (IoT, PaaS)
  - IoT Android Engineer
  - Senior Android Developer - IoT
- **Test Engineer Positions**
  - IOT Test Engineer with QXDM
  - LTE IOT Test Engineer
  - Senior SW Test Engineer-IoT
  - Sr Test Engineer III (IOT)

# IoT Job Opportunities

- IoT related Jobs (Business / Marketing level jobs)
- **Marketing Manager positions**
  - Product Marketing Manager, IoT Solutions
  - Strategic Marketing Manager, IoT
  - Segment Marketing Manager - IoT Technologies
  - Marketing Manager, Demand Generation (IoT - PaaS)
  - Staff Product Marketing Manager - IoT Content Specialist
- **Business Development Manager level positions**
  - Business Development Manager (IoT)
  - Embedded and IoT Market Development Manager
  - Integrated Operations Team (IOT) Business Manager
  - IoT Strategic Business Development Manager
  - Product Business Manager - Wearables - IoT
  - Strategic Business Development Manager - IoT

# The challenges of IoT

## 1. Lack of standardization.

Technological Standardization in most areas are still remain fragmented.

## 2. New Communications Frontier.

The network must be able to support diverse equipment and sensors that try to connect simultaneously.

## 3. Geographic Challenges.

Company must be able to access data within various geographies, and run their analysis locally.

## 4. Data security and Privacy.


Consumer concerns their privacy and the data they share.

## 5. Managing Innovation.

Managing and fostering rapid innovation is a challenge for governments.

# Conclusion

The Internet of Things is much more than just the number of connections – it's all about the Data and the intelligence that can be gleaned from the Data to make a smart decision on the devices.





# Conclusion

Two IT Products of Data-Driven Innovation Economy:

## Big Data and Internet of Things

Big Data helps us to solve the business problems while the Internet of Things creates the Smart Environment which makes our life simplified with connected million of intelligent devices.

數據主導的兩大創新經濟產業：大數據與物聯網

大數據幫助企業解決問題，物聯網打造智慧生活

# Internet of Things

Thank You !

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