ITU Forum on Smart Sustainable Cities,
Abu Dhabi-UAE

Role of IoT in SSC : Connecting the Unconnected

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Introduction

Ibn Khaldūn (1332–1406)

Ibn Khadoun's Ideal City

- a high standard of security; excellent safety and physical health; cleanliness;
- the existence of sufficient amenities; sustainability; accessibility; meeting the demand for infrastructure and housing;
- promoting and maintaining required agricultural and industrial activities; peaceful coexistence with the natural environment;
- the creation of strong communities with sound social integration; the maintenance of political control or prestige.

Source : "*al-Muqaddimah*" (Prolegomena)

"A Smart Sustainable City (SSC) is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects".

ITU-T's Focus Group on Smart Sustainable Cities (FG-SSC)

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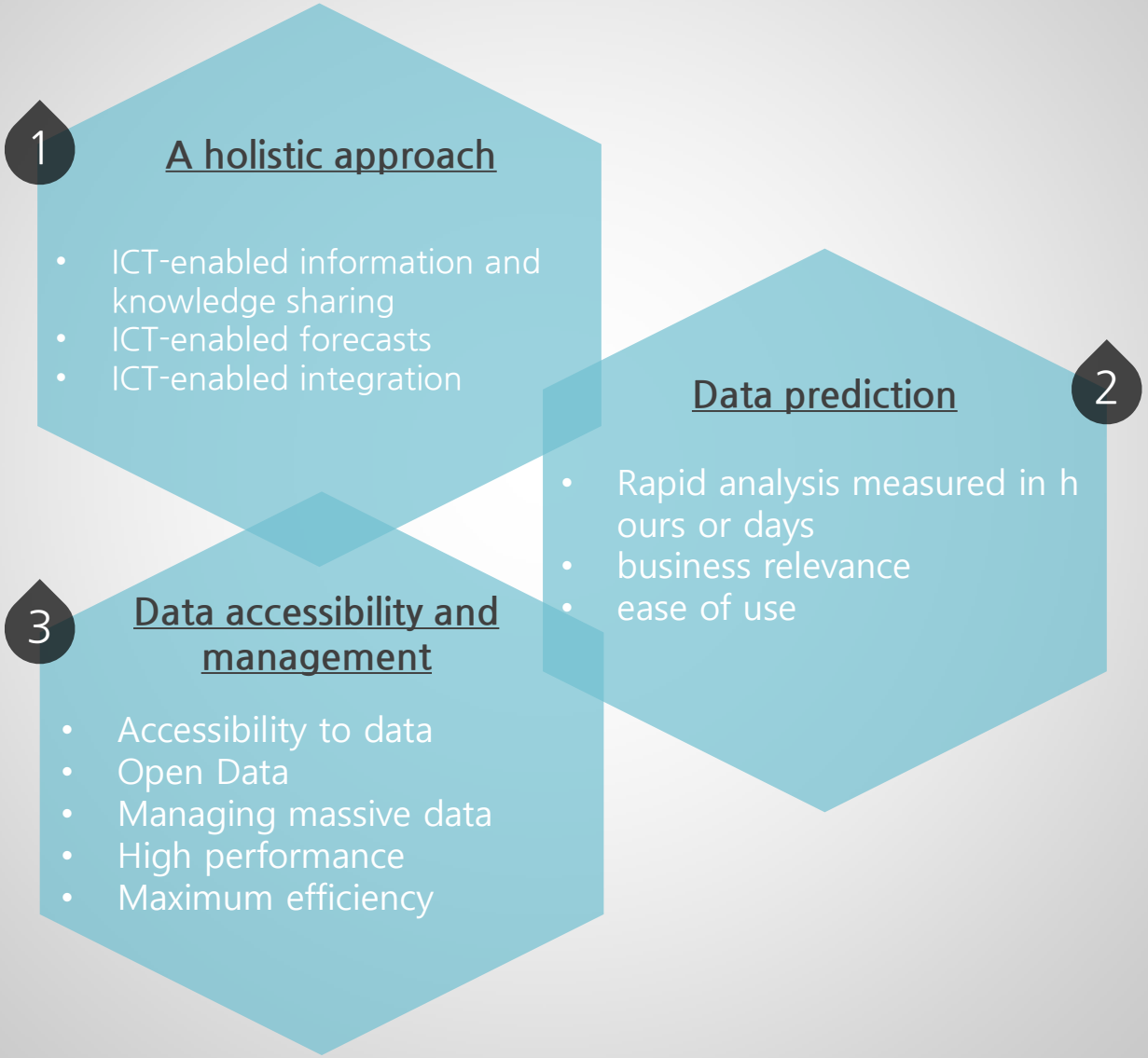
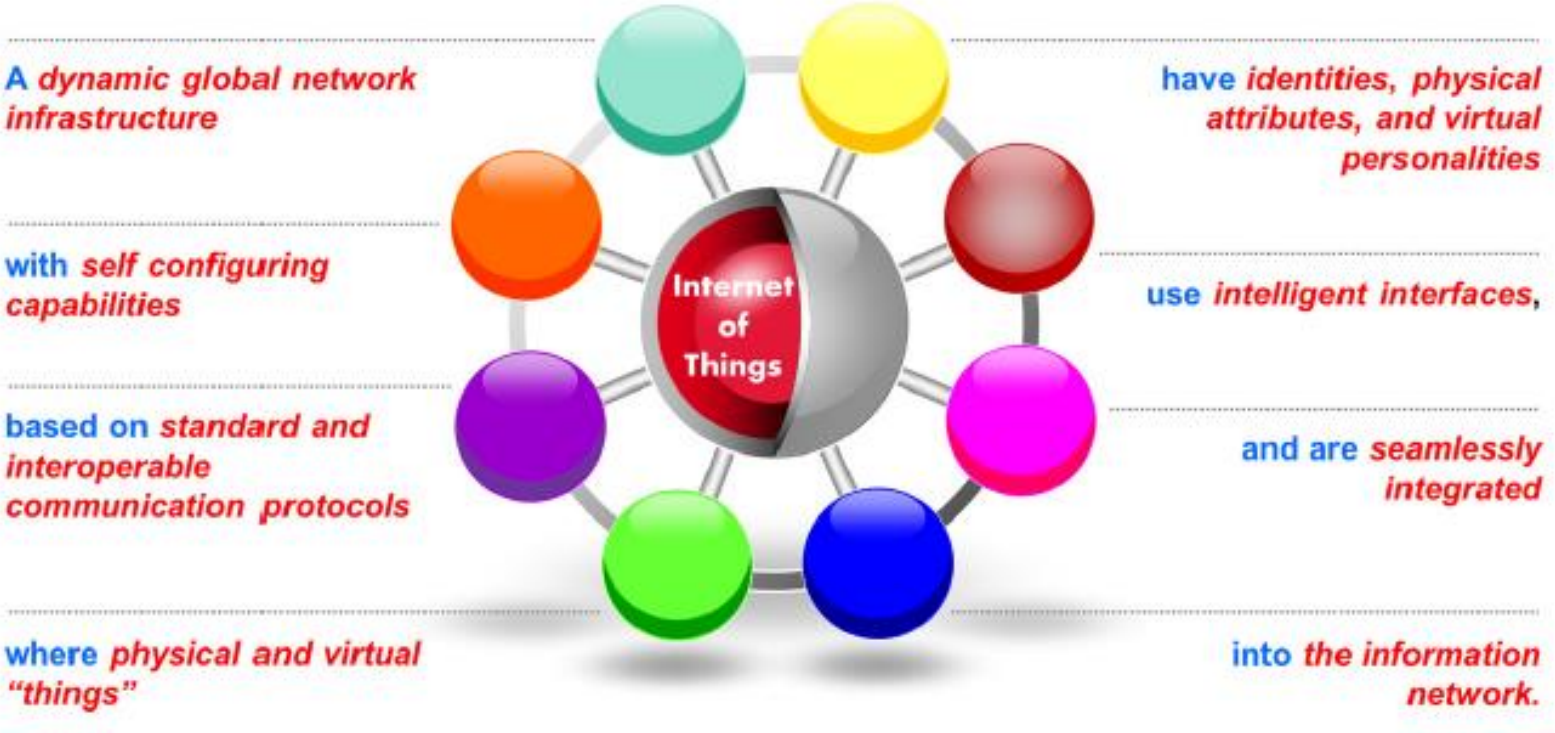
IoT Role in Smart Sustainable Cities

The role of ICT in smart city solutions



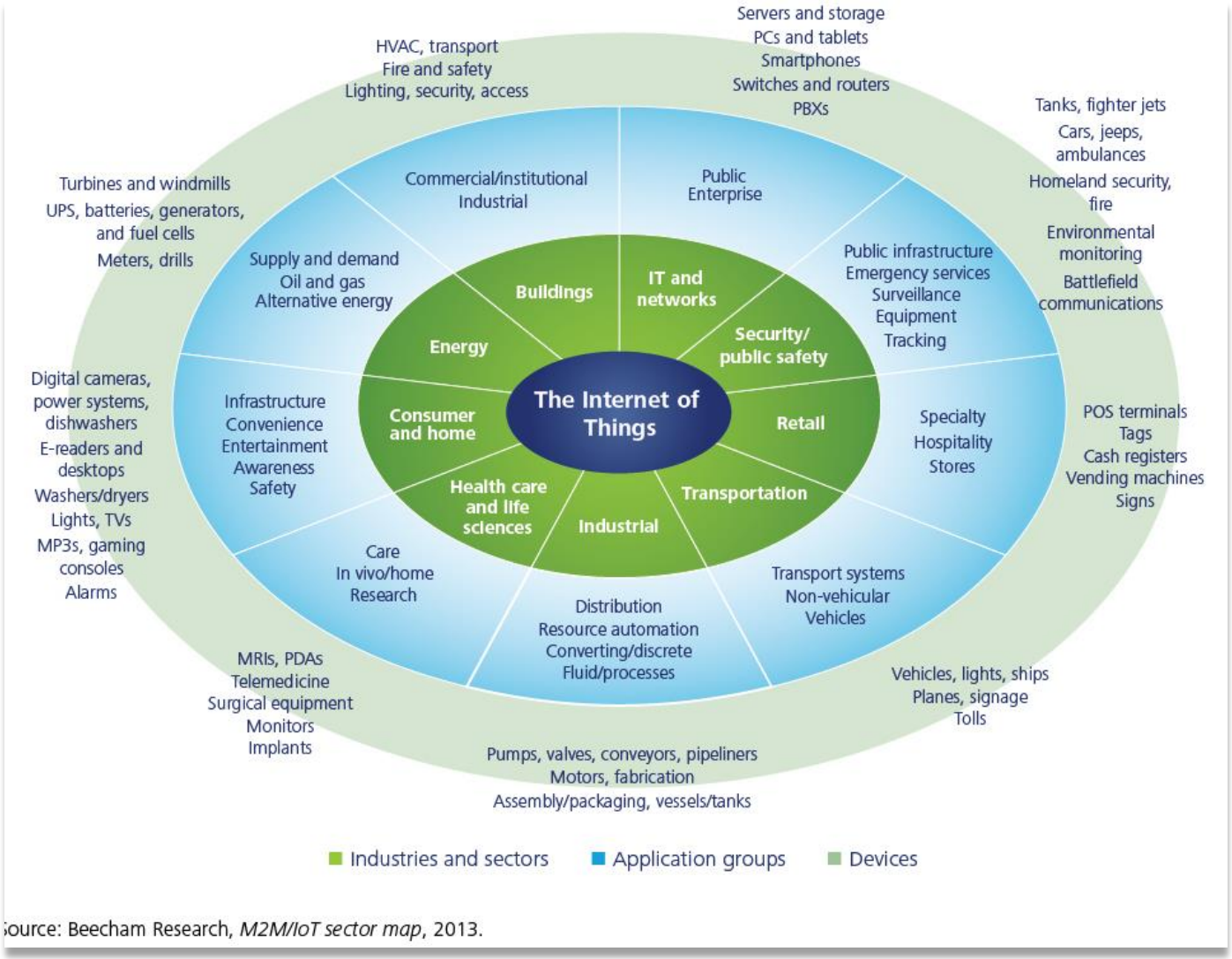
IoT Definition

Internet of things (IoT) [ITU-T Y.2060]: A global infrastructure for the information society enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving, interoperable information and communication technologies.



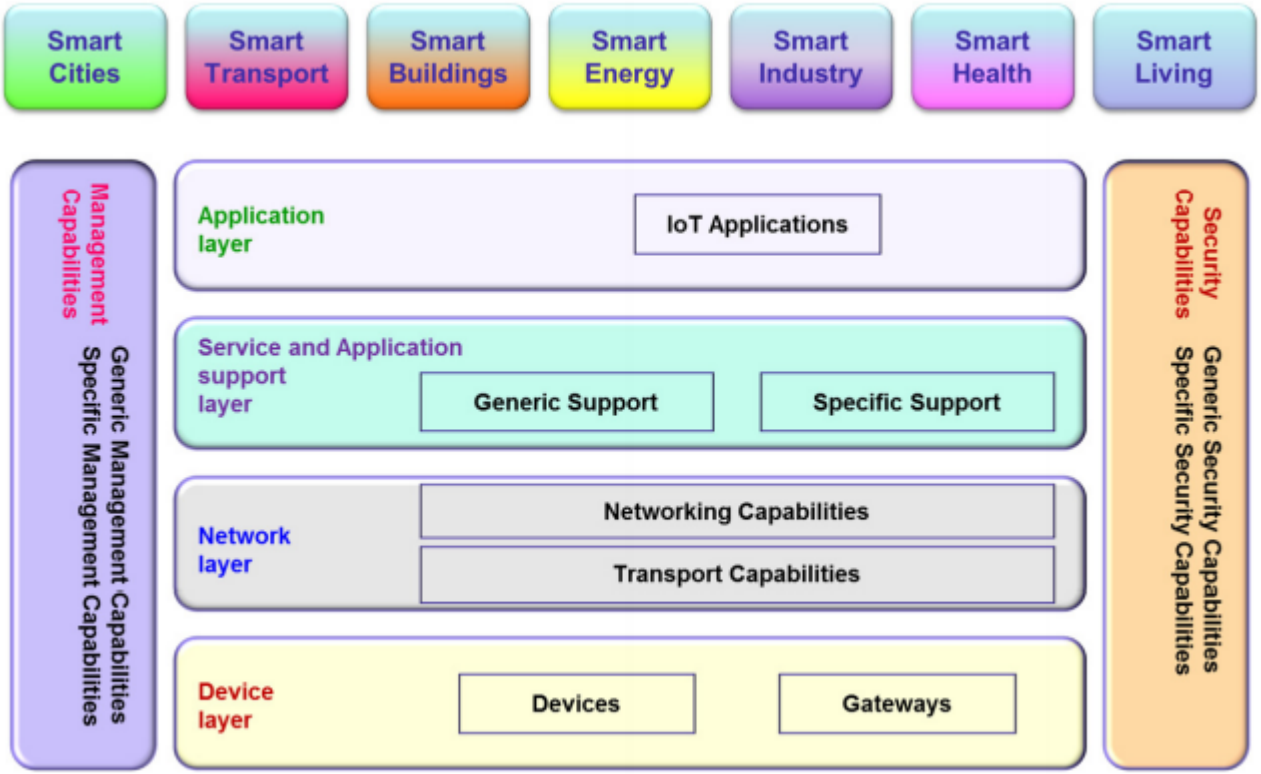
Source : O. Vermesan, P. Friess, P. Guillemin, S. Gusmeroli, et al., "Internet of Things Strategic Research Agenda", Chapter 2 in Internet o f Things - Global Technological and Societal Trends, River Publishers, 2011, ISBN 978–87-92329–67-7

Internet of Things- proliferation of connected devices across industries



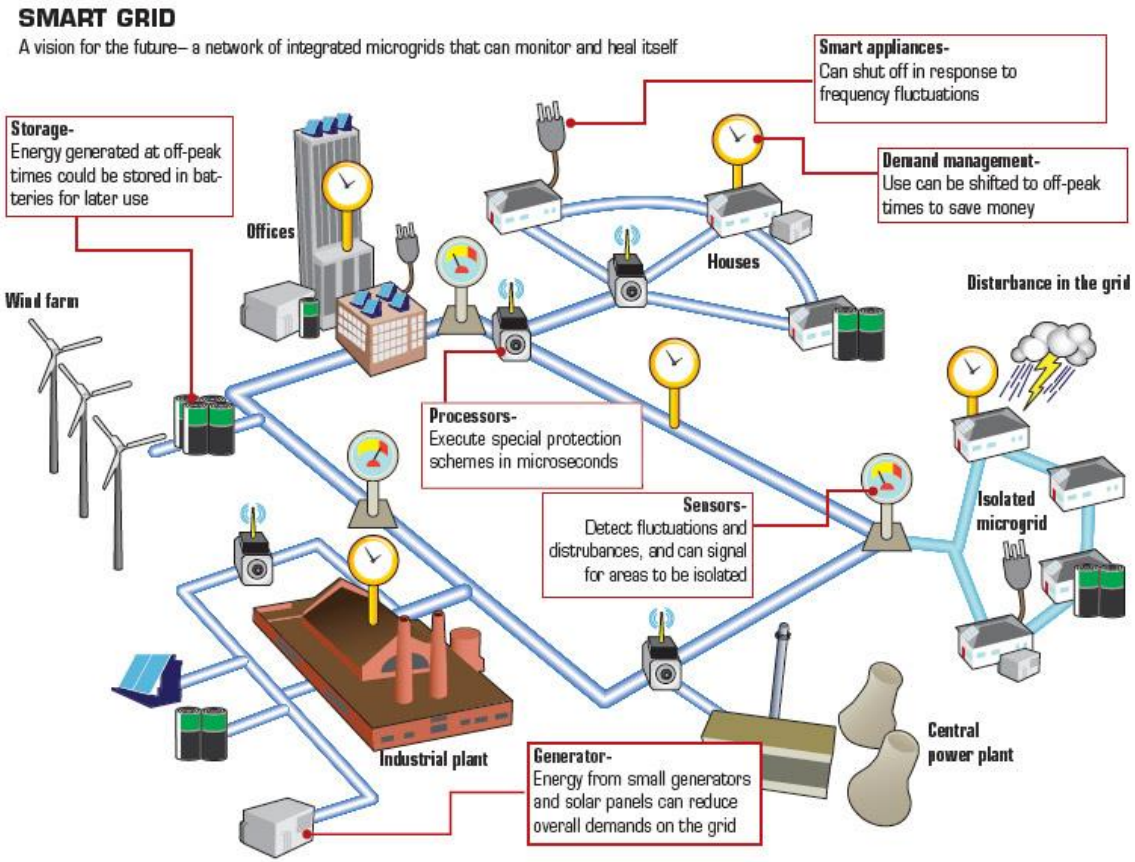
Source: Beecham Research, *M2M/IoT sector map*, 2013.

IoT Layered Architecture (Source: ITU-T)



Physical and service infrastructure elements : Smart Energy

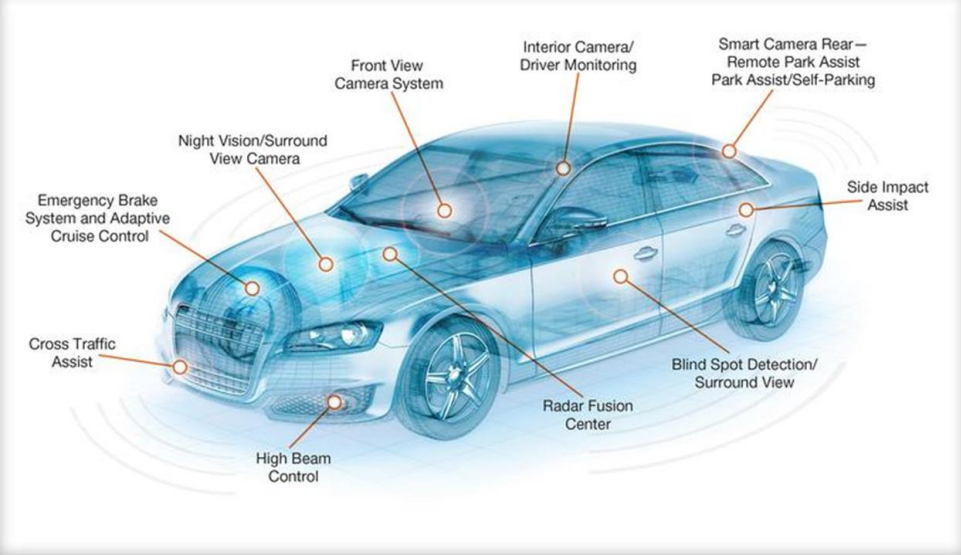
(Smart Grid to Internet of Energy)



A typical vision of a smart grid includes networks of micro-grids that can detect problems and disconnect themselves temporarily, demand-response equipment that shuts off nonessential appliances and other power drains if necessary, and sources of distributed power that can take some of the load off central power plants.

Physical and service infrastructure elements : Smart transportation

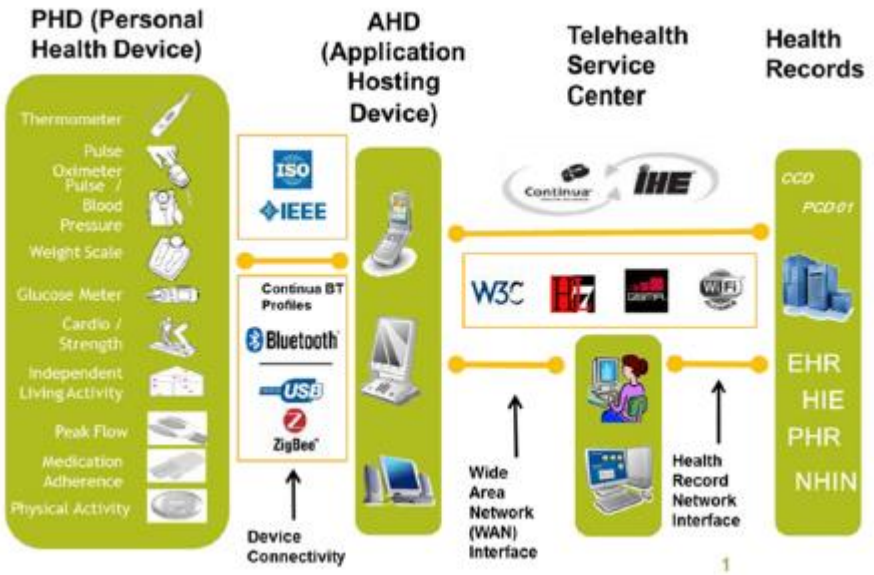
intelligent transport systems, new transport scenarios, vehicle control and management



Freescale vision chip makes self-driving cars a bit more ordinary, online at http://www.cnet.com/news/freescale-vision-chip-makes-self-drivingcars-a-bit-more-ordinary/

Physical and service infrastructure elements : Smart Health

- Fall Detection
- Physical Activity Monitoring
- Medical Fridges
- Sportsmen Care
- Patients Surveillance
- Chronic Disease Management



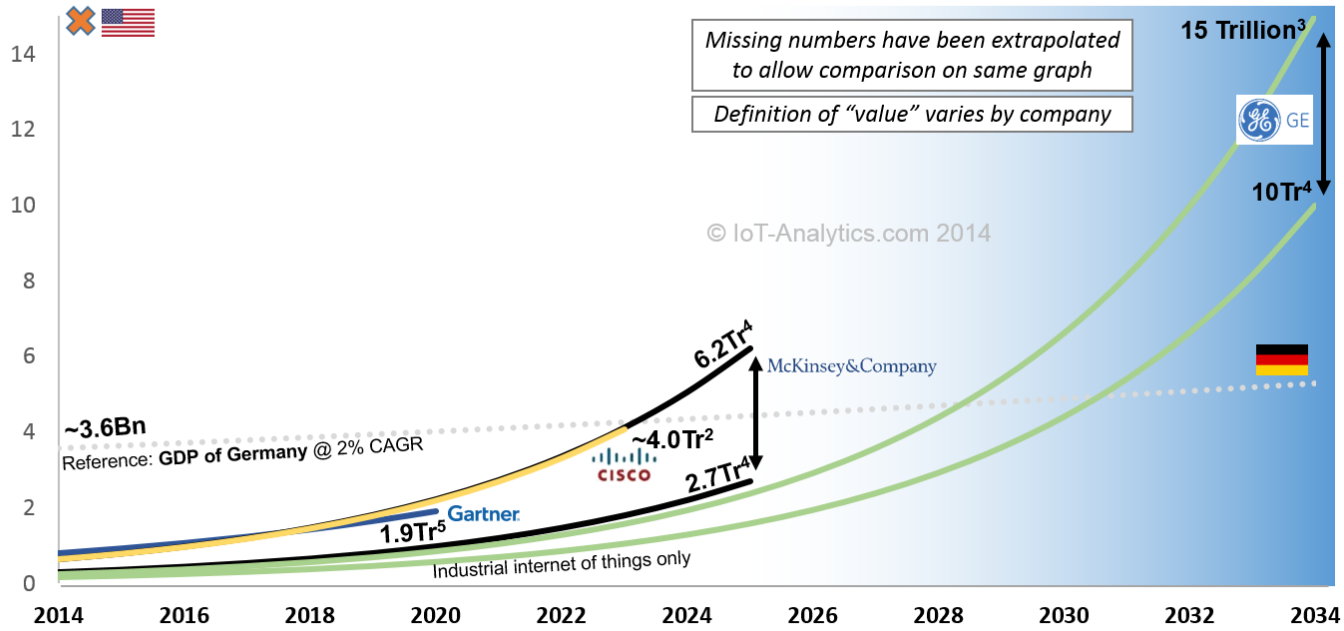
Interoperable standard interfaces in the Continua Personal Health Eco-System (Source: Continua Health Alliance)

Increasing economic value and opportunities for job creation

IoT Analytics – *Quantifying the connected world*

Global IoT/IoE economic value forecasts

Annual economic value of the IoT market (in Trillion USD)



Source	Date	Original quote[1]
McKinsey&Company (4)	2013	"IoT has the potential to create **economic impact** of **$2.7-6.2 trillion** annually **by 2025**"
GE (3) Industrial internet only	2012	"Industrial Internet could **add $10-15 trillion** to **global GDP in 20 years**"
CISCO (2)	2013	**"$19 trillion** in **IoE value is at stake** in the **next decade"**
Gartner (5)	2013	"IoT will result in **$1.9 trillion** in **global economic value-add** in **2020**"
Germany	GDP of the total economy	

1. Wording as initially published 2. Cisco "value at stake" has been forecast as $19 trillion over total decade. Value has been spread over 10 years assuming the same annual growth rate as Cisco's IoT device forecast 2014-'20 3. GE's "potential GDP impact" was forecasted as $10-15 trillion in 20 years. Value for the previous years has been assumed using the average IoT device growth rate 2014-2020 of 21% 3. McKinsey's "potential economic value-add" for the years 2014-2024 calculated taking the average IoT device growth rate 2014-2020 of 21%. 5. Gartner's numbers have been calculated using Gartner's annual IoT revenue growth 2014-2020 of 8%.
Sources: McKinsey, General Electric, Cisco, Gartner, IoT Analytics

Reference point: Total GDP of the USA in 2014

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IoT Applications in SSC

IoT Implementation Cases

- **Intelligent Operation Center of Rio de Janeiro**
  - Possibility of heavy rain can be predicted 40 hours in advance with up to 90% of accuracy based on weather data analysis, allowing early preparation for flooded roads.
  - Response time to emergencies improved by about 30%, and the death toll decreased by 10%.

- **UK's Intelligent Transport System that Reduces Traffic Congestion**
  - UK built an intelligent transport system on the M42 motorway and reduced travel time by 25% and traffic accidents by 50%.

- **IoT Application on Waste Management System in Cincinnati**
  - IoT is applied to the volume-based waste disposal program, in which the volume of waste from each household is monitored and charged.
  - The amount of waste in the city has seen a decrease of 17%, while the recycling rate has seen an increase of 49%.

- **Barcelona's Energy-Saving Smart Streetlights**
  - Sensors are installed in streetlights, enabling automatic control of brightness by analyzing the levels of noise, air pollution, and population density.
  - At least 30% energy savings per year.

IoT Implementation Cases

- **GE Improving Efficiency of Production Factories with the Industrial Internet**
  - Prompt monitoring of the production line can find the causes for quality deterioration, further reducing the defect rate.
  - Just 1% of efficiency increase in major industries will save USD 270 billion for the next 15 years.

- **Great River Medical Center Connecting Center's Medical Devices via Network**
  - IoT is applied to monitoring the dosages of controlled medicine in anesthesia workstation, tracing medicine dosages in healthcare units, automated secure cabinets, pharmacy conveyors for stock management, etc.
  - Time required for medicine delivery was reduced by 67% from an average of 90 minutes to just 30 minutes, as well as a decrease in stockpiling expenses by USD 400,000.

Great River Medical Center

- **Making Agricultural and Livestock Industries Efficient Using Topcon Tractors, GPS, and Sensors**
  - Controlling tractors not to go over sowed lines again using GPS increases work efficiency by 20% as well as the amount of production.

- **Vitality GlowCaps – Intelligent Pill Caps**
  - Sensors attached on the pill caps inform users by light, sound, SMS, or phone to take their medication on time.
  - GlowCap use increased the adherence rate to more than 98%.

04

Challenges related to IoT Role

Security, Privacy &Trust

Trust

• Decentralized and self-configuring systems as alternatives to PKI for establishing trust

• Quality of Information is a requirement for many IoT-based systems where metadata can be used to provide an assessment of the reliability of IoT data.

• Novel methods for assessing trust in people, devices and data, • Assurance methods f or trusted platforms including hardware, software, protocols, etc.

Security

• General attack detection and recovery/resilience.

• A variety of access control and associated accounting schemes to support the various aut horization and usage models

• Handle virtually all modes of operation by itself without relying on human control.

Privacy

Cryptographic techniques that enable protected data to be stored processed and shared,

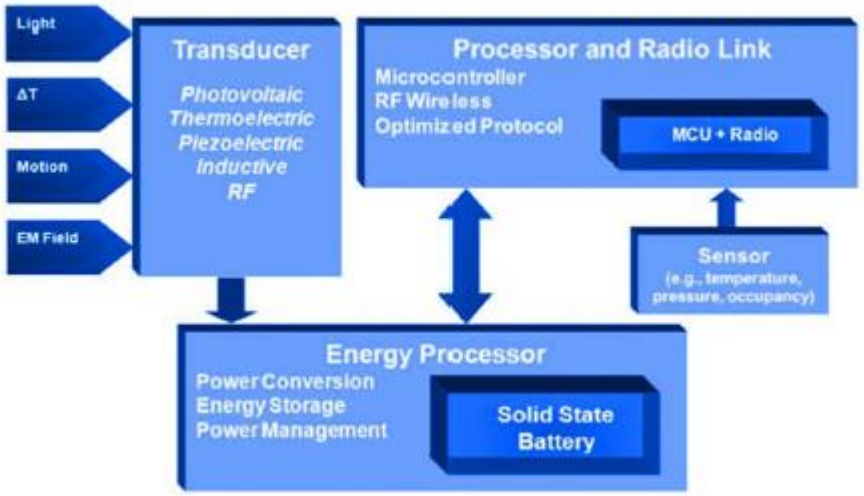
• Techniques to support Privacy by Design concepts, including data minimisation, identi fication, authentication and anonymity.

• self-configuring access control mechanism

Low Power Communication

- Several low power communication technologies have been proposed from different standardization bodies

Energy Harvesting



Energy harvesting - components of an autonomous wireless sensor (Source: Cymbet)

Standardization and Interoperability

- Standards are needed for interoperability both within and between domains.

Within a domain, standards can provide cost efficient realizations of solutions
A complexity with IoT comes from the fact that IoT intends to support a number of differ ent applications covering a wide array of disciplines that are not part of the ICT domain.

INTERNET OF THINGS IN ITU

IoT-GSI - Internet of Things Global Standards Initiative
JCA-IoT - Joint Coordination Activity on Internet of Things

ITU-T Focus Group on the M2M service layer
ITU-T Study Group 2 - Numbering, naming, addressing
ITU-T Study Group 11 - Testing architecture for tag-based identif ication
ITU-T Study Group 13 - NGN requirements and architecture for a pplications and services using tag-based identification
ITU-T Study Group 16 - Requirements and architecture for multi media information access triggered by tag-based identification
ITU-T Study Group 17 - Security and privacy of tag-based applica tions
ITU-R - Global management of the radio-frequency spectrum

Data Management and communication

Data Management

- Data Collection and Analysis
- Big Data
- Semantic Annotation of data

Communication and Networks

- Complexity of the networks of the future
- Sustained growth of wireless networks
- IPv6, Scalability
- Green networking technologies

05

Case study on policies and Strategies for IoT promotion: South Korea

Vision, Goal and Strategies

Vision

One of the leading countries in the world where citizens, businesses, and the government are actively developing and using IoT services.

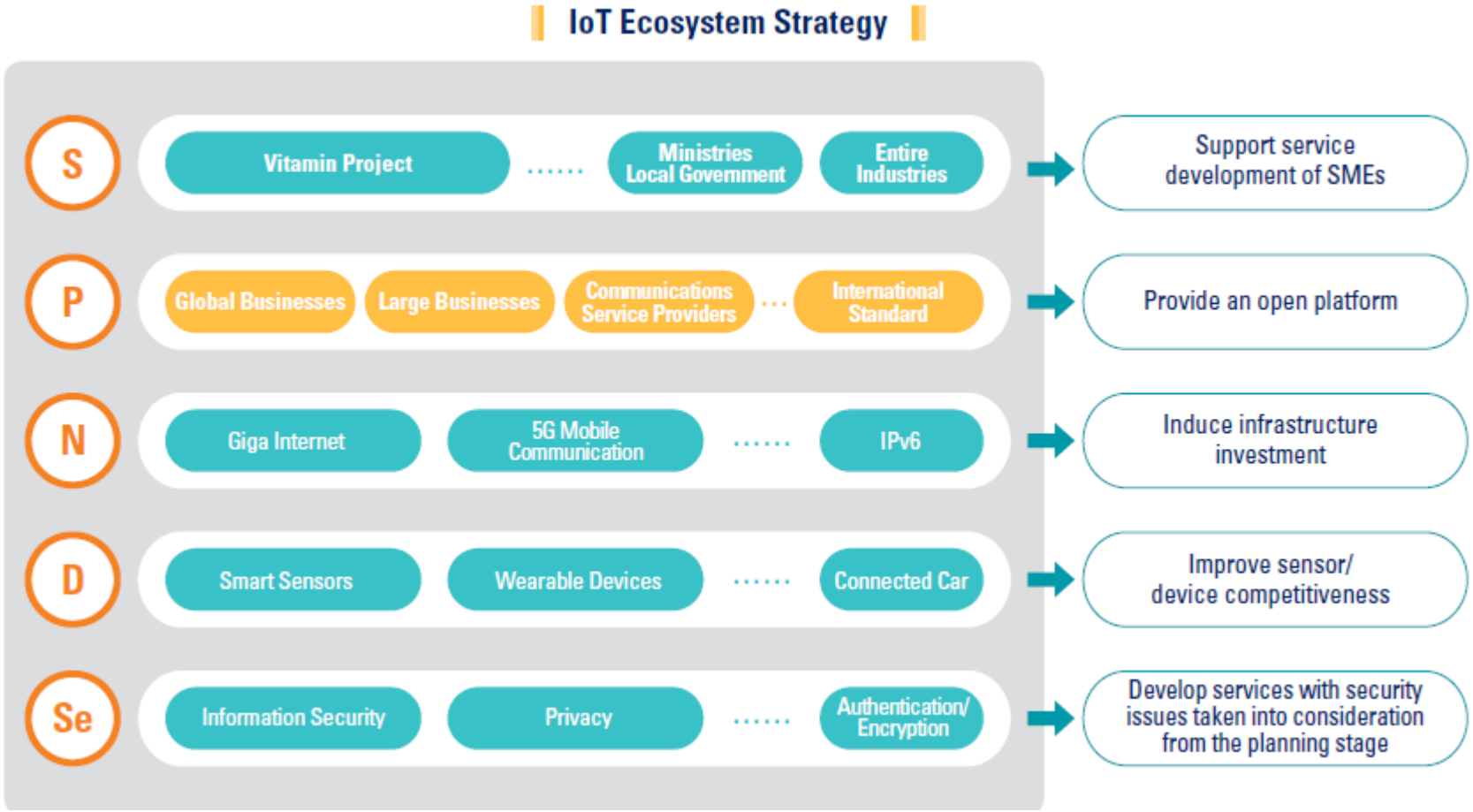
Goal

Type	2013	2020
Domestic market volume* expansion	KRW 2.3 trillion	KRW 30 trillion
No. of SMEs and mid-grade export businesses	70	350
No. of employees in SMEs and mid-grade businesses	2,700	30,000
Productivity and efficiency increase in user companies	30% increase	

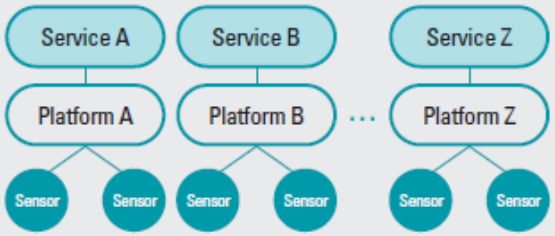
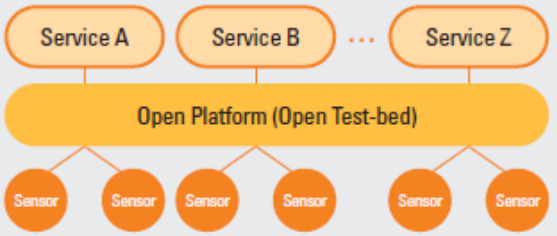
* Market volume does not include the value-added impact of IoT applications to other industries.

Source: IoT Master Plan 2014

Strategy 1. Increase Collaboration Among Players in the Ecosystem (SPNDSe)



Strategy 2. Promote Open Innovation

Category	As-Is	To-Be
Method	Closed Innovation	Open Innovation
Concept		
Stages	• Government: Government selects pilot services to be led by the government (decision-making on requirements, functions, methods, etc.) → Secure budget and order projects • Private sector: Private sector obtains order for each project (SI provider – small and medium-sized subcontractor) → Develop/ construct according to the requirements of government pilot projects • Government: Each government institution builds and uses systems separately	• Government: Government provides an open platform environment for service development and provision (under collaboration with global/large businesses and communication service providers) • Private sector: Private sector transforms ideas into services and provides them (supporting service development of small and medium-sized venture companies) • Government: Government purchases and uses private-sector services
Features	• There is a lack of interoperability between each system as well as redundant system development • There is a burden of expenses for development, construction, and operation • It is difficult to respond to environmental changes	• Interoperability is improved and data can be connected and used • Realization of economies of scale and scope can minimize the cost burden • Flexible responses are ensured when there are environmental changes

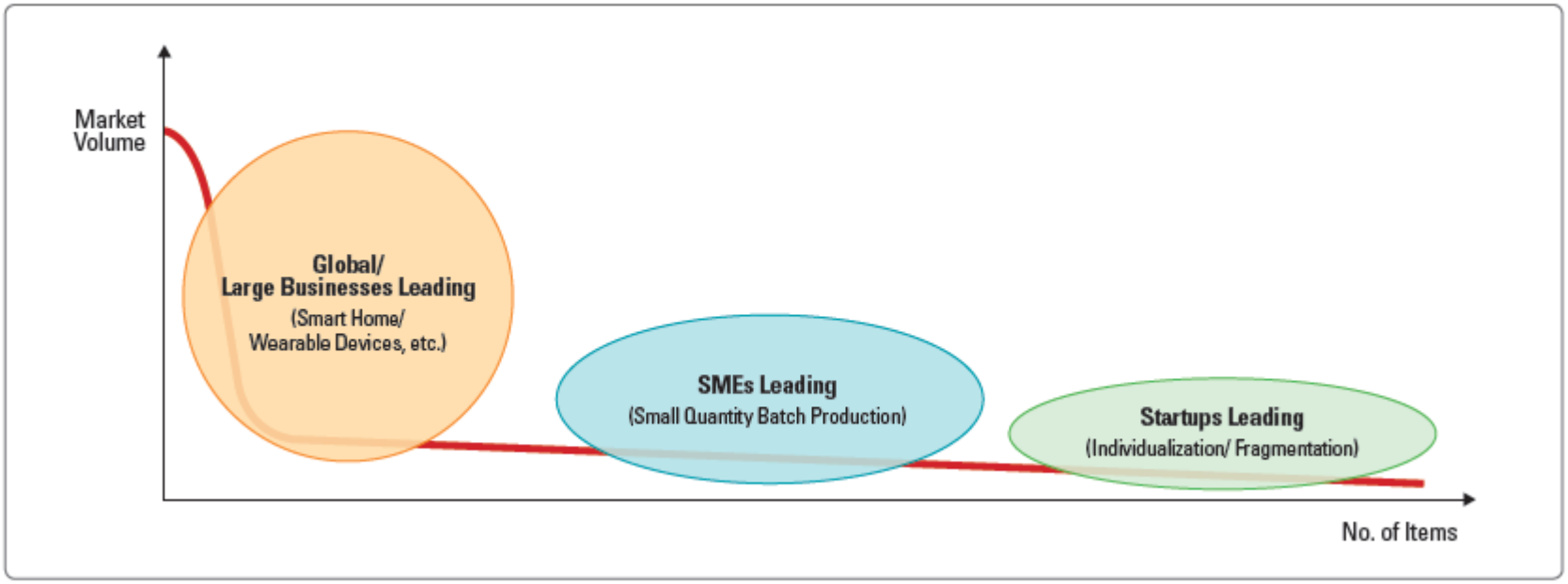
Strategy 3. Develop and Expand Services Targeted Toward the Global Market

→ The government will develop products and services under cooperation with global businesses, and step up partnerships and cooperation so that both can enter the global market together.

→ Application of new software services that are based on an advanced manufacturing industrial sector will innovate the added-value of products and increase productivity and efficiency, further enabling mutual growth of both the traditional industries and new software service industries.

Strategy 4. Develop Customized Strategies for Large Businesses, SMEs, and Startups

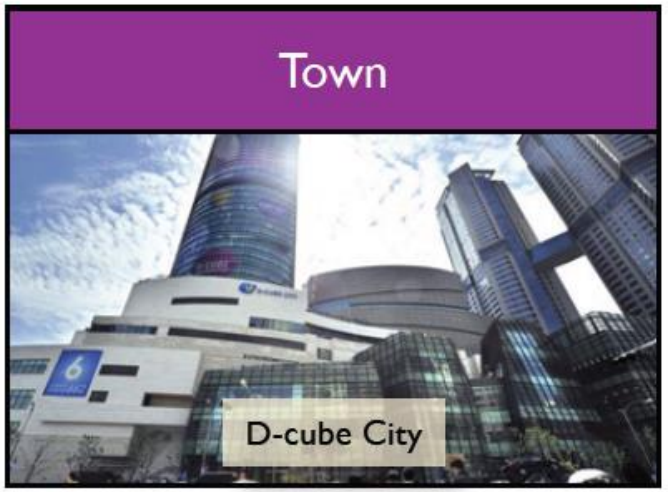
IoT Market Volume and Features



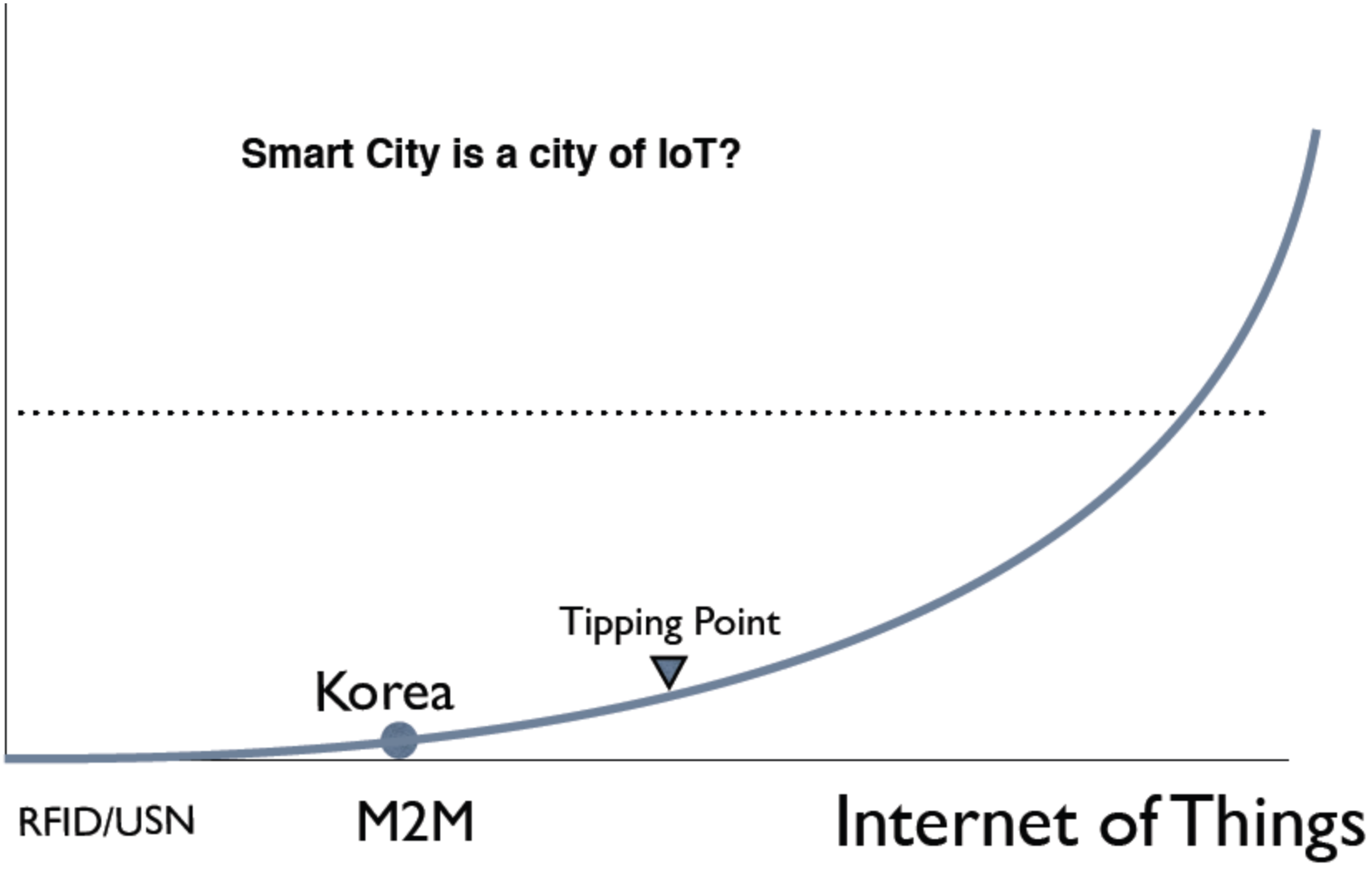
Smart Cities in Korea : 12 Cities

City Type

Scope



Smart Cities in Korea : IoT Penetration



Smart Cities in Korea : IoT Applications

- **UrinCare – Smart Phone-based Urine and Feces Management System**
  - Manufacturer: IT Health, Korea
  - As a smart phone-based urine and feces management system, UrinCare consists of a diaper embedded with a ZigBee sensor and a detection system.
  - For the elderly or patients who have difficulties in disposing of their urine or feces, the system automatically sends data to healthcare givers or nurses

- **Connected Bike – Measuring Speed, Mileage, and Amount of Exercise**
  - Manufacturer: Samsung Electronics, Korea
  - Together with the US bike manufacturer Trek, Samsung Electronics developed the 'Connected Bike' that is linked to Galaxy Note 3.
  - The sensor installed in the bike measures speed and miles on a real-time basis, and the rider can check the amount of exercise or distance on the smart phone mounted in the middle of the bicycle handlebars.

- **Lifeband Touch – A Wristband Measuring the Amount of Physical Activity**
  - Manufacturer: LG Electronics, Korea
  - Lifeband Touch is a wearable device in form of a wristband that measures the amount of physical activities such as calorie consumption, step counts, and distance traveled by tracing the user's movement.
  - Only by a touch on the OLED screen, the user can check the time and received calls on the smart phone and even play music on the smart phone that may be placed in his/her bag.
  - The band can be linked to both iOS and Android-based smart devices and supports Bluetooth 4.0.

THANK YOU