Internet of Things Can Bring Smart Everything to the World

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Introduction

- From Wikipedia, Internet of Things (IoT) is the network of all kinds of things embedded with sensors, electronics, software, and etc.
Introduction (Cont.)

- Examples of sensors are shown below:
  - The first example is about the size of your finger tip

![A Sensor](http://www.libelium.com/top_50_iot_sensor_applications_ranking/)

Fig. 1. A Sensor

(Source: http://www.libelium.com/top_50_iot_sensor_applications_ranking/)
• The second example of sensor:

Fig. 2. Another Sensor

(Source: http://www.libelium.com/top_50_iot_sensor_applications_ranking/)
Introduction (Cont.)

• The third example of sensors:

Fig. 3. Sensors
(Source: http://www.libelium.com/top_50_iot_sensor_applications_ranking/)
The fourth example of sensor looks like a microchip:

Fig. 4. A Microchip Sensor

(Source: http://www.libelium.com/top_50_iot_sensor_applications_ranking/)
Introduction

• The fifth example is a collection of sensors

Fig. 5. A Collection of Sensors
(Source: http://www.societyofrobots.com/sensors_currentsensor.shtml)
Things are connected to the Internet, based on the International Telecommunication Union's Global Standards Initiative.

The term "IoT" was coined by Kevin Ashton in the year 1999, only about 17 years ago as of the year of writing this paper, i.e. the year 2016.
**KEVIN ASHTON**

Coined the term *Internet of Things* back in 1999.

“I could be wrong, but I’m fairly sure the phrase “Internet of Things” started life as the title of a presentation I made at Procter & Gamble in 1999. Linking the new idea of R&D in P&G’s supply chain to the then-red-hot topic of the Internet was more than just a good way to get executive attention.”

Fig. 6. Kevin Ashton

(Source:https://www.google.co.th/search?q=kevin+ashton&source=lnms&tbm)
Introduction (Cont.)

Fig. 7. IoT in the Year 2020
(Source: www.wordstream.com)
From www.wordstream.com, by the year 2020, IoT will have:

- 4 billion connected people,
- US$ 4 trillion revenue opportunity,
- 25 million Apps,
- 25 billion Embedded and Intelligent Systems,
- 50 trillion GBs of data.
Gartner forecasted that 4.9 billion connected things would be in use in 2015 and would reach 25 billion by 2020.
Machina Research claimed on 27 April 2015 that IoT market will increase from 900 million US$ in the year 2014 to 4.3 trillion US$ in the year 2024.
Searching Google in May 2016 for "Internet of Things Applications", over 103 million entries were found. All kinds of applications of IoT have been documented.
Introduction (Cont.)

- Two examples will be mentioned here.
- The first example is from Libelium.com which mentioned more than 50 applications.
The second example is from Beecham Research which mentioned IoT applications in 9 groups,

1) Buildings
2) Energy
3) Consumer and Home
4) Healthcare and Life Science
5) Industrial
6) Transportation
7) Retail
8) Security and Public Safety
9) IT and Networks
Supposed everything concerning yourself has been equipped with sensors and connected to the Internet.

Starting in the morning when you move yourself to get up from bed.
The mattress notices your movement and recognizes that you are getting up.

So, the mattress sends several messages, e.g. the first message to the bedroom lighting switches to turn the light on from the bedroom to the bathroom.
Introduction (Cont.)

- The second message to the bathtub to prepare water at the temperature you like.
- The third message to the television set in the bathroom to turn TV on with the channel you usually watch in the morning.
While you are in the bathtub, the fourth message is sent to the robot in the kitchen to prepare your breakfast. The Internet checks your schedule at the office and compares it with the time you are in the bathroom.
The Internet may display message on your TV screen that you will be late for the first appointment at the office and send message to your secretary to postpone the first meeting, and so on so fourth.
Introduction (Cont.)

- When IoT is applied to any topic, the word “Smart” may be added to the name of that topic.
- “Smart World” is the result of application of IoT to the world.
“Smart City” is the result of application of IoT to the City

“Smart Home” is the result of application of IoT to Home

“Smart Government” is the result of application of IoT to Government
“Smart Business” is the result of application of IoT to Business

“Smart Education” is the result of application of IoT to Education

“Smart Armed Forces” is the result of application of IoT to Armed Forces
“Smart Finance” is the result of application of IoT to Finance

“Smart Industries” is the result of application of IoT to Industries

“Smart Agriculture” is the result of application of IoT to Agriculture
“Smart Health” is the result of application of IoT to Health
This paper will present IoT applications:

- IoT for Smart World
- IoT for Smart City
- IoT for Smart Home
- IoT for Smart Government
- IoT for Smart Business
- IoT for Smart Education
Introduction (Cont.)

- IoT for Smart Armed Forces
- IoT for Smart Finance
- IoT for Smart Industries
- IoT for Smart Agriculture
- IoT for Smart Health
2. IoT for Smart World

- Searching Google in May 2016 for "IoT for Smart World", over 1.4 million entries were found.
As stated in SafaribooksOnline.com and Intel.com, applications of IoT all over the world are connecting everything from A to Z, e.g. "a" for appliances, "b" for banks, "c" for cars, "d" for devices, "z" for zoo.
The global IoT applications making everything smart are changing the entire world into Smart World.

In a sense, it can be said that Smart World includes Smart City, Smart Home, Smart Government, Smart Business, Smart Education, Smart Armed Forces, Smart Finance, Smart Industries, Smart Agriculture, Smart Health, and etc.
About IoT for "a" to "z",
examples for "a", "b", "c" and "z"
will be presented here.

For "a", searching Google for "IoT for appliances",
596,000 entries were found.
From the article

"Appliance Science: The Internet of Toasters (and other things)", Samsung announced in January 2015 that 90 percent of the devices Samsung sells will connect to the Internet by 2020.
For "b", searching Google for "IoT for Banks", 615,000 entries were found.

As an example, the web BankingExchange.com, suggested "Bank of Things" which include 6 points.
They are

1) "Analytics capabilities" for each bank customer to analyze all the data he is interested in.

2) "Tailored pricing" for the bank to provide banking products designed for each and every customer’s needs.
3) "Distribution" for the bank to design and use “distribution tools, applications, and methods” to communicate with each customer.

4) "Agility" for the bank to develop its capacity for change to match with new technologies and infrastructures.
5) "Continuous Innovation" for the bank to develop the capacity to innovate rapidly and successfully in order to grow its customer base and increase customer value.

6) "Digital Risk Management" for the bank to collaborate with its customers to better understand their needs, financial position, and collateral value.
"Bank of Things" will enable the bank to refine its credit models and improve its overall risk position.
For "c", searching Google for "IoT for Cars", 768,000 entries were found.

From the article from InformationWeek, automobile manufacturers such as: BMW, Ford, GM, and Mercedes, are including IoT in their cars.
As a matter of fact, by December 2014, there were over 50.1 billions devices connected to IoT.
For "z", searching Google for "IoT for zoo", 357,000 entries were found.

From the article, "Tech Zoo: If IT vendors were animals", IT vendors would attach sensors to animals in the zoo to monitor their activities and coordinate the operation of the zoo.
3. IoT for Smart City

- Searching Google in May 2016 for "IoT for Smart City",
over 1.18 million entries were found.
IoT for Smart City (Cont.)

- From Wikipedia, a Smart City is a city which uses ICT "to enhance quality and performance of urban services, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens".
Many sample applications of IoT for Smart City have been documented.

- **Smart Parking**
  Monitoring of parking spaces availability in the city.

- **Structural Health**
  Monitoring of vibrations and material conditions in buildings, bridges and historical monuments.
IoT for Smart City (Cont.)

- Noise Urban Maps
  sound monitoring in bar areas and centric zones in real time.
- Smartphone Detection
  detect iPhone and Android devices and in general, any device which works with WiFi or Bluetooth interfaces.
IoT for Smart City (Cont.)

- Eletromagnetic Field Levels
  Measurement of the energy radiated by cell stations and WiFi routers.

- Traffic Congestion
  Monitoring of vehicles and pedestrian levels to optimize driving and walking routes.
IoT for Smart City (Cont.)

❖ Smart Lighting

Intelligent and weather adaptive lighting in street lights.

❖ Waste Management

Detection of rubbish levels in containers to optimize the trash collection routes.
IoT for Smart City (Cont.)

- **Smart Roads**

Intelligent Highways with warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams.
New Smart Parking by Libelium includes Double Radio with LoRaWAN and Sigfox,

New Surface Parking Device
with LoRaWAN and Sigfox featuring smaller size, higher accuracy, and faster time of detection facilitating lower installation costs.
The new device is easier and cheaper to deploy as it is mounted on the road surface.
Unlike most market versions, it does not need to dig a hole in the ground for installation, reducing installation time from 30 to 5 minutes and allowing to be replaced by another unit in case of maintenance in just 10 minutes.
The new device has a smaller size -reduced over 50%-, higher accuracy and reliability, and faster time of detection. Besides, temperature does not affect the behaviour of readings.
Fig. 8. New Smart Parking diagram

New sensor system is fully compatible with LPWAN radio technologies LoRaWAN and Sigfox to enable long range and low power consumption. It can be connected with both radios for the European 868 MHz band and for the 900-930 MHz band (US/Canada).
One unique feature of the system is that it allows to use both radio technologies at the same time or change from one to another easily from the Cloud.
With the new sensor system, one base station can give service to thousands of devices around a range of several kilometers in urban environment.
This fact provides lower costs of installation since the number of base stations can be dramatically reduced. Besides, the new sensor model has been optimized for really low-power operation, so the battery lifetime is extended up to 10 years easily.
The new parking node has been certified with the CE/FCC/IC marks and provides a robust software which works out-of-the-box.
Developers do not need to program the nodes but specify the values of key parameters in the firmware such as working cycle or night mode to be ready to work.
Remote management and bidirectional communication allows to change several parameters of the nodes from the Cloud. This means that thousands of nodes can be reprogrammed just setting the right values from our web browser in the management platform.
With Smart Parking,

Libelium Global Smart Cities Solution
covers gas and noise pollution levels,
water quality control and waste management.
Another example of Smart City is the Project in Castellón:

- a platform to control water usage
- and waste management
Castellón Smart City is a pilot project installed at the neighborhood of Pau Gumbau in Castellón de la Plana (Spain).
The deployment takes place over an area that covers 222,000 square meters, where near 8,000 citizens live and work on their daily basis, together with gardens, parks, schools, as well as private and public buildings.
Fig. 9. Castellón, Comunidad Valenciana, Spain

IoT for Smart City (Cont.)

- IoTsense, a company owned by Grupo Gimeno Holding, decided to start this project based in Libelium technology to show municipality and private companies the Smart City Platform working in real time.
There is no better way to show the potential of the sensor network platform than live, with real time data.
Another example is Castellón Smart City Project which integrates 25 different kinds of sensors to measure and control data from different sources in order to obtain organized data from a global perspective.
Fig. 10. Skyline of Jena, Germany, in dusty morning
(http://www.libelium.com/particle-matter-dust-sensor-pm1-pm25-pm10-air-quality-smart-cities/)
Some particles are emitted directly; others are formed in the atmosphere when other pollutants react. Particles come in a wide range of sizes.
Those less than 10 micrometers in diameter (PM10) are so small that they can get into the lungs, potentially causing serious health problems. Ten micrometers is smaller than the width of a single human hair.
IoT for Smart City (Cont.)

- Fine particles (PM2.5) Particles less than 2.5 micrometers in diameter are called "fine" particles. Sources of fine particles include all types of combustion, also motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.
PM2.5 contains more toxic heavy metals and hazardous organic pollutants and can go directly to the lungs. It is more easily attached to bacteria and viruses in the environment, so the particles have greater impact on ecology and human health.
IoT for Smart City (Cont.)

- Coarse dust particles.

  Particles between 2.5 and 10 micrometers in diameter are referred to as "coarse."

  Sources of coarse particles include crushing or grinding operations, and dust stirred up by vehicles traveling on roads.
How can particles affect your health?

Long-term exposure is associated with problems such as reduced lung function and the development of chronic bronchitis and even premature death.
Short-term exposure to particles (hours or days) can aggravate lung disease, cause asthma attacks and acute bronchitis, and may also increase susceptibility to respiratory infections.
In people with heart disease, short-term exposure is linked to heart attacks and arrhythmias. Healthy children and adults may experience temporary minor irritation when particle levels are elevated.
The new particle matter sensor uses light scattering theory and particle counting technology and can accurately detect the number of particles in its surroundings to provide useful reference data for environmental improvement.
With the new dust sensor we can obtain information about particle size and density ranging from 1um to 10um (PM1 / PM2.5 / PM10).
The next example is Urban Resilience in the Smart City: River Flood and Forest Fire Early Detection.

Urban and territorial management systems based on wireless sensor networks already maintain and prevent the disruption of essential city services, in Smart City installations across the globe.
By linking the physical world to the Internet, Internet of Things (IoT) wireless sensor technology can improve resilience in such areas as civil protection; telecommunications; energy, electricity; water supply; urban maintenance; traffic management.
Cities adapt for resilience

Pioneered by the Rockefeller Foundation, the 100 Resilient Cities (100RC) organization supports a view of resilience that includes not just the shocks—earthquakes, fires, floods—but also the stresses that weaken the fabric of a city on a day-to-day basis.
By addressing both factors, a city can improve its response to adverse events, and is overall better able to deliver basic functions in good times and bad, to all populations.
Fig. 11. Cities in La Garrotxa Span a Region Comprising Protected Lands, Urban Areas and Industry

(Source: http://www.libelium.comsmart-city-urban-resilience-smart-environment/)
Urban resilience through city management

This key idea motivated Opticits, a Barcelona startup from the IQS-University of Ramon Llull, to work with Sigma, a public municipal organization in charge of environment and services, to create and deploy a City Resilience Management platform that integrates Libelium’s WaspMote Plug & Sense! sensor nodes and Meshlium gateways.
Opticits’ experience in the industrial and petrochemical sectors led it to develop an IT and management solution that makes cities urban resilient, more efficient and sustainable.
Based on collaboration among local authorities, the system guides urban planning decision makers and city managers.
In Spain, Opticits’ initial urban resilience assessment project in Barcelona (1.621.000 inhabitants and 102 sq.km) was reproduced at laboratory scale in Tremp (6.200 inhabitants and 310 km2).
IoT for Smart City (Cont.)

- The next example is "Hello" in the city of "Bristol" in the UK where public infrastructure has a unique identifier attached to it.
- For example, postal boxes have a six digit code, benches have seven digit code, and storm drain has fourteen digit code.
Sample public infrastructures such as "Hello Bus Stop" "Hello Boat",
and as shown in Fig. 12.
Fig. 12. Hello in the City of Bristol
(Source: http://postscapes.com/internet-of-things-award/smart-city-application/)
As an example, a person activates "Hello Bus Stop", then he can ask "which bus number to go from this bus stop to... ?" and the reply will appear on the screen of his mobile phone.
Another example is "Point" as shown in Fig. 13.
It looks like a street sign at the corner of the intersection of two streets with three pointers in three directions.
IoT for Smart City (Cont.)

Fig. 13. Point in the City of Bristol
(Source: http://postscapes.com/internet-of-things-award/smart-city-application/)
IoT for Smart City (Cont.)

- If a person does not find the name of the designation on the three pointers, he may SMS for another designation.
- Then one of the pointer will display the name of the designation the person asks for as well as pointing to the new direction.
"Point" may be programmed to access data from:

- Foursquare
- Transportation APIs
- Twitter
- RSS feeds
- and many other online sources.
There are many lists of Smart Cities. For example, Forbes presented on 9 March 2014, the top five based on 5 criteria, namely, Technologies, Buildings, Utilities, Transportation & road infrastructure, and the smart city itself.
The first in the list is Barcelona in Spain, noted for smart environment and smart parking.

The second is New York City in the US noted for Smart Street Lighting and Smart Traffic Management.
The third is London in the UK noted for Technology and Open Data.

The fourth is Nice in France noted for Environment and Agency Cohesion.

The fifth is Singapore noted for Smart Traffic Management and Creative Use of Technology.
As another example of lists of Smart Cities, the Times of India published on Aug 27, 2015, a list of 98 cities in India to be developed into Smart Cities.

The list includes 24 State Capitals.
4. IoT for Smart Home

- Searching Google in May 2016 for "IoT for Smart Home", over 1.49 million entries were found.
IoT for Smart Home (Cont.)

- From Greenpeak.com,

  Smart Home Applications include

  1) Home security - Access control
  2) Lighting control
  3) Home health care
  4) Fire detection - Leak detection
5) Energy efficiency

6) Solar panel monitoring and control

7) Temperature monitoring and HVAC control

8) Automated meter reading
Fig. 14. Smart Home
(Source: http://www.greenpeak.com/Application/SmartHome.html)
Everything in Fig. 14, namely, "security", "lights", "security and alarm", etc. are embedded with sensors and wirelessly connected to "Internet Gateway".

The home owner can monitor and control everything by using smart phone from anywhere in the world.
From TheInquirer posted 14 August 2015, 11 favorite gadgets were listed for Smart Home.

Two examples will be presented here.

The first example is "Philips Hue and Hue Tap" that allows a user to use smart phone to control the color of light in a room as shown in Fig.15.
Fig. 15. Light Bulbs with Color Controllable thru Smart Phone
(Source: http://www.theinquirer.net/inquirer/feature/2421020/best-iot-devices-for-the-connected-home)
The second example is "MyFox Security" which includes:
- "MyFox Home Alarm",
- "MyFox Security Camera",
- "MyFox IntelliTAG",
- and "MyFox Key Fob".
In summary, "MyFox Security" helps in:

- preventing a potential break-in before it happens,
- providing personal privacy for those living at home with "MyFox Security".
Searching Google in May 2016 for "IoT for Smart Government", over 598,000 entries were found.
From the article "The Internet of Things: Smart Government with Speed",

Government Chief Information Officers (CIO) use Internet of Things to

1) Manage and optimize utilization of government services
2) Manage pay-per-use of government services
3) Operate and perform remote operation of government services

4) Extend digital services and provide contents from government
It may be said that "Digital Government" has developed in three phases.

Phase 1 started in the Year 2000 and called "E-government" with online services and multiple websites.
Phase 2 started in the year 2010 and called "Open Government" with transparency, participation, collaboration, and community engagement.

Phase 3 started in the year 2015 and called "Smart Government" with sustainability, affordability, and crossing boundaries.
It can also be said that the Internet of Things has contributed to Digital Government in:

1) Reducing the number of staff at Government Service Center from a lot to only one
2) Reducing the number of people waiting in the lines for government services from a lot to very few
IoT for Smart Government (Cont.)

3) Reducing the waiting time to get government service from very long to "no waiting" by allowing everyone to use mobile App to get service right away.

4) Changing the place for customers to get service from government office to more convenient places like shopping centers.
6. IoT for Smart Business

- Searching Google in May 2016 for "IoT for Smart business", over 1.076 million entries were found.
IoT for Smart Business (Cont.)

- From the paper "Internet of Things in e-Business"
  - IoT has been used in Inventory Management to manage inventory real-time,
IoT for Smart Business (Cont.)

- Logistics Management and Delivery Tracking to manage route and speed that logistics crew are allowed to handle in:
  * Personalization for customized offers and customized delivery times,
  * After-sales Service to update purchase date and warranty period.
From the article "Smart Business Design In The Age of The Internet of Things" posted on August 14, 2015, the five main things CEO have to consider are

1) understand the impact of IoT such as that IoT allows organizations to make better and faster decisions
2) Cloud computing is the backbone of the connected world of IoT

3) Responding to customer's needs almost in real time is the key to a successful IoT business and security and privacy must be implemented
4) New software for IoT in business must be installed,

5) Collaboration must be made to create one big seamless system to allow smarter decision.
7. IoT for Smart Education

- Searching Google in May 2016 for "IoT for Smart Education", 927,000 entries were found.
From the paper "The Internet of Everything: Fueling Educational Innovation",
Learning@Cisco stated that the number of Internet-connected device will be 50 billion by the year 2020, and that in the IoT era, the number of skills have to be increased from four to six.
The previous four skills were reading, writing, arithmetic, and computer.

The new six skills are Critical thinking, Collaboration, Communication, Creativity, Problem solving, and ICT proficiency.
From the article

"How Do We Integrate IoT Skills into the Classroom?"
posted January 28, 2015,
three methods were proposed
for students to get new required skills.
They are

1) let students do IoT projects sponsored by industries
2) establish IoT laboratories on campus
3) organize "Hack-a-thon" and "make-a-thon"
   for students to compete with one another
   to solve IoT problems.
As a matter of fact, hack-a-thon has been organized at various universities such as: Cornell, MIT, UC Berkeley, UCLA, and Yale University.
8. IoT for Smart Armed Forces

- Searching Google in May 2016 for "IoT for Smart Armed Forces", over 162,000 entries were found.
From the article "Report: Military lagging in IoT adoption" posted September 25, 2015, and the report "Leveraging the Internet of Things for a More Efficient and Effective Military" posted September 2015,
IoT for Smart Armed Forces (Cont.)

- It was stated that
  the U.S. military
  is failing to sufficiently equip
  its civilians and war fighters
  with the basic functions
  provided by commercial smart phones.
IoT for Smart Armed Forces (Cont.)

- DoD continues to drive innovation in advanced sensors and control systems, but fails to use IoT technologies for everyday operations.
From the report

"Continuing the March:
The past, present, and future of the IoT in the military", posted August 6, 2015, stated that while the US Armed Forces has been a major driver in the Internet and M2M communications,
The US Armed Forces has been slow to adopt real IoT applications because of the complex regulatory requirements.
While the military has been a driver in connected and machine-to-machine communications such as radio frequency identification, more commonly known as RFID, it has been slow to adopt true IoT applications that knit these communications into interoperable, automated cycles.
Communications remain within their given channels, not easily shared or aggregated.

The challenge is that defense leaders wishing to take advantage of the IoT face a complex technological and regulatory landscape that threatens to deter their efforts in endless choices and challenges.
That article aims to help leaders navigate complex IoT decisions by pointing out which applications may be better suited for their goals related to cost efficiency and/or war fighter effectiveness.
In each case, Deloitte’s Information Value Loop we will use as an analytical framework to identify the key investments necessary to realize the IoT’s potential benefits.
9. IoT for Smart Finance

- Searching Google in May 2016 for "IoT for Smart Finance",
  over 762,000 entries were found.
- From the article "Internet of things in Financial Industry"
  posted April 2, 2015,
Six examples of IoT benefits to insurance and financial industries were given.

The first example is "wearables and smart monitoring devices for preventive health management" which would facilitate better collaboration between payers and providers thru financial institutes.
The second example is "smart home appliances" like water leakage detector, air purifiers and etc. which would reduce insurance claims.

The third example is "sensors that monitor electricity, gas and fuel usage“ which could help a customer monitor and cut down the monthly bills on utilities.
The fourth example is "air pressure monitoring equipment" which could help prevent accidents and causalities.

The fifth example is "fire safety sensors" which could detect a short circuit in a house and reduce the number of claims.
The sixth example is about "notification of weather conditions"
which could help reduce medical claims.
From another article

"The “Fin-ternet of Things: How IoT affects Financial Services"
posted on Aug 3, 2015,
PriceWaterhouseCoopers (PWC)’s 6th annual digital IQ survey stated that financial services was one of the top 10 industries that has been investing in sensors for potential IoT innovations.
Potential customers will pick the brand that is easiest to work with, before they will consider price or brand loyalty.
Retail banks should use IoT in retail banking environment to increase the adoption rate of extra lines of services dramatically with personalized, contextual messages.

Application of ToT in financial industry may be called “Fin-ternet of Things” which many financial services institutions have adopted.
Searching Google in May 2016 for "IoT for Smart Industries",
over 841,000 entries were found.
IoT for Smart Industries (Cont.)

- From the article "Forget smart fridges: the Industrial Internet of Things is the real revolution" posted March 10, 2015, another term was introduced.

- It is "IIoT = Industrial IoT".
IoT for Smart Industries (Cont.)

Fig. 16. Sample IIoT

In Fig. 16, the robot arms look like in any ordinary factory but the differences are that all other things in and outside the factory are equipped with sensors and connected to the Internet.
The IIoT includes "Big Data" to facilitate automated buildings, lighting, security, energy production, transportation, and etc.
Big Data is a broad term for data sets so large or complex that traditional data processing applications are inadequate.

Challenges include analysis, capture, data curation, search, sharing, storage, transfer, visualization, and information privacy."
In summary, IIoT provides improvement of efficiency, safety, and productivity in the factory as well as integration of supply chain activities.

It can also be said that the concept of M2M (machine to machine) is a subset of IIoT.
From the article

"How Smart, Connected Products Are Transforming Competition",
there have been three waves
of IT revolutions of industry.
The first wave was in the year 1960 to 1970 when IT was used to automate activities such as order processing, bill paying, computer-aided design, and computer-aided manufacturing.
The second wave was in the year 1980 to 1990 when IT, especially the Internet, was used to coordinate and integrate internal activities with outside suppliers, channels, and customers.
In the third wave now, IT becomes an integral part of the product, i.e. the product is embedded with sensors, processors, software, and connectivity.

Massive amount of data and software are also available thru cloud computing.
IoT for Smart Industries (Cont.)

- It has been said that the IIoT has changed everything.
- The products are now "Smart Connected Products".
11. IoT for Smart Agriculture

- Searching Google in May 2016 for "IoT for Smart Agriculture",
  over 560,000 entries were found.
The article "Solving IoT Challenges for Smart Agriculture", stated that IoT would help the agriculture industry and enabling farmers to contend with the enormous challenges they face.
The Agriculture Industry must overcome
- increasing water shortages,
- limited availability of lands,
- difficult to manage costs,
while meeting the increasing consumption
needs of a global population that is expected
to grow by 70% by 2050.
IoT for Smart Agriculture (Cont.)

- IoT application in Smart Agriculture will allow farms to detect soil moisture, crop growth and livestock feed levels, as well as remotely manage and control their smartly connected harvesters and irrigation equipments,
Utilize artificial intelligence to analyze operational data, such as weather forecast, to provide new insights and improve decision making.
From the article "Towards Smart Farming: Agriculture Embracing the IoT Vision",
seven application areas are proposed.
They are:

1) tracking of farm vehicles,
2) livestock monitoring,
3) large and small field farming,
4) indoor and greenhouse farming,
5) fish farming,
6) Forestry, and
7) Storage monitoring of water tank and fuel tank.
12. IoT for Smart Health

- Searching Google in May 2016 for "IoT for Smart Health", over 1.44 million entries were found.
- From the article "$117 Billion Market for Internet of Things In Healthcare By 2020" posted April 22, 2015
IoT for Smart Health (Cont.)

- Smart sensors can protect your family members, especially an elderly who stays at home alone while you are working at your office.
From the article "Smart drugs: where IoT meets healthcare, a market snapshot" posted June 30, 2015

There are enormous opportunities for the expansion of the Industrial IoT into the healthcare industry.
IoT for Smart Health (Cont.)

- MarketResearch.com stated that big data and the healthcare Internet of Things will expand at a 15.1 percent compound annual growth rate to hit $117 billion by 2020.
Shown in Fig. 17 is "Sensor-enabled pills" named "Proteus Discover" to provide better insights for the patient as well as the healthcare professionals involved.
The pill sends a signal to the Patch that the patient is wearing and the Patch will send all the information to both the patient and the healthcare professional.
IoT for Smart Health (Cont.)

Fig. 17. Smart Pill
(Source: http://siliconangle.com/blog/2015/06/30/smart-drugs-where-iot-meets-healthcare-a-market-snapshot/)
IoT for Smart Health (Cont.)

- MarketResearch.com, stated that big data and the healthcare Internet of Things will expand at a 15.1 percent compound annual growth rate to hit $117 billion by 2020.
13. Concluding Remarks

- It is generally agreed that Internet of Things (IoT) is now one of the most important topics as shown by the facts that by the year 2020, IoT will have 4 billion connected people, US$ 4 trillion revenue opportunity, 25 billion Embedded and Intelligent Systems, and 50 trillion GBs of data.
Concluding Remarks (Cont.)

This paper presented IoT applications starting from:

- IoT for Smart World
- IoT for Smart Home
- IoT for Smart Business
- IoT for Smart Armed Forces
- IoT for Smart Industries
- IoT for Smart Health
- IoT for Smart City,
- IoT for Smart Government
- IoT for Smart Education
- IoT for Smart Finance
- IoT for Smart Agriculture
Concluding Remarks (Cont.)

- All parties should search Google regularly to follow new IoT development for the benefits of himself, his organization, and his country.
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Thank You