IOT

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- IoT : One Tiny Platform, Endless Possibility
- Case Study
- Introduction to IoT
- Conclusion

Definition

"A dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual “things” have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network.".

---------- IERC-European Research Cluster on the Internet of Things

The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.

--------Gartner

History

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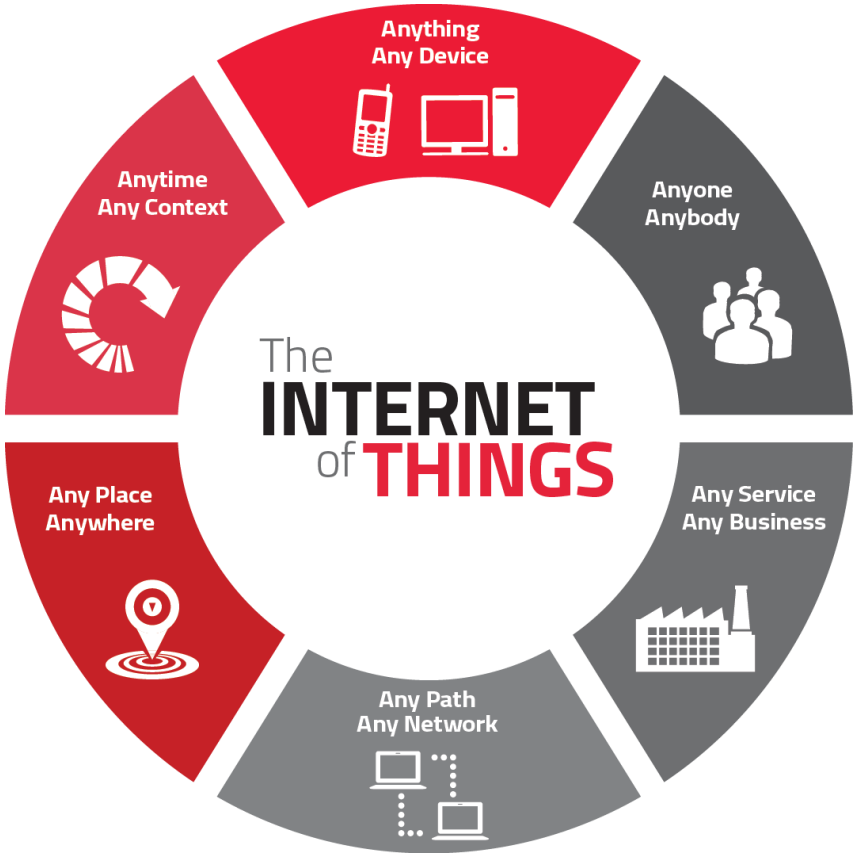
Kevin Ashton
"Father of Internet of Things"

The word "Internet of Things" was first coined by Kevin Ashton in 1999.

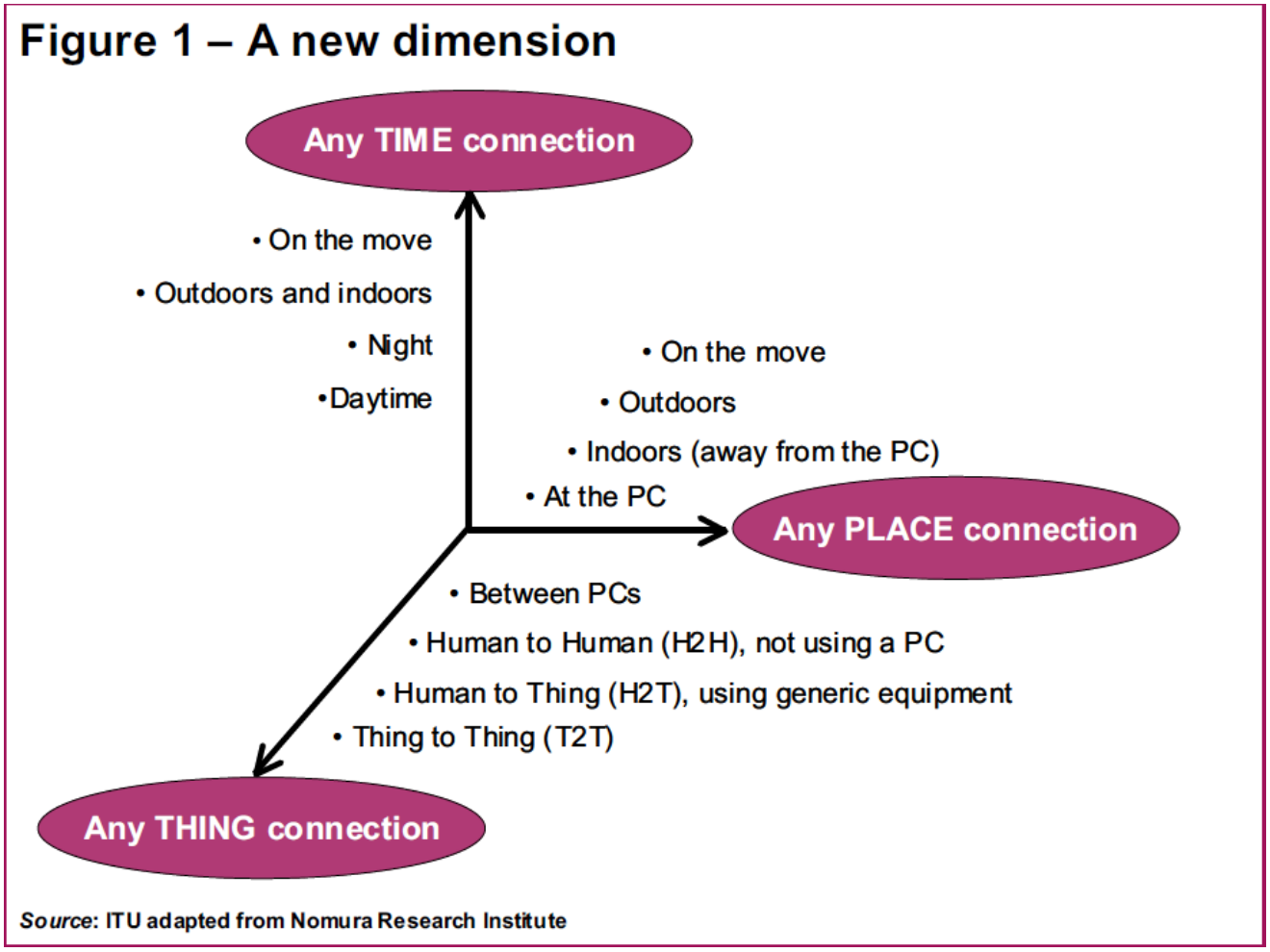
He used the word as the Title of Presentation he made at Procter & Gamble in a reference to link the idea of RFID with Supply Chain Management.

What is the Internet of Things?

- Internet that we use is also known as the "**Internet of People**" since we use it.
- Similarly, Internet of Things is the Internet working for the "**Things**".

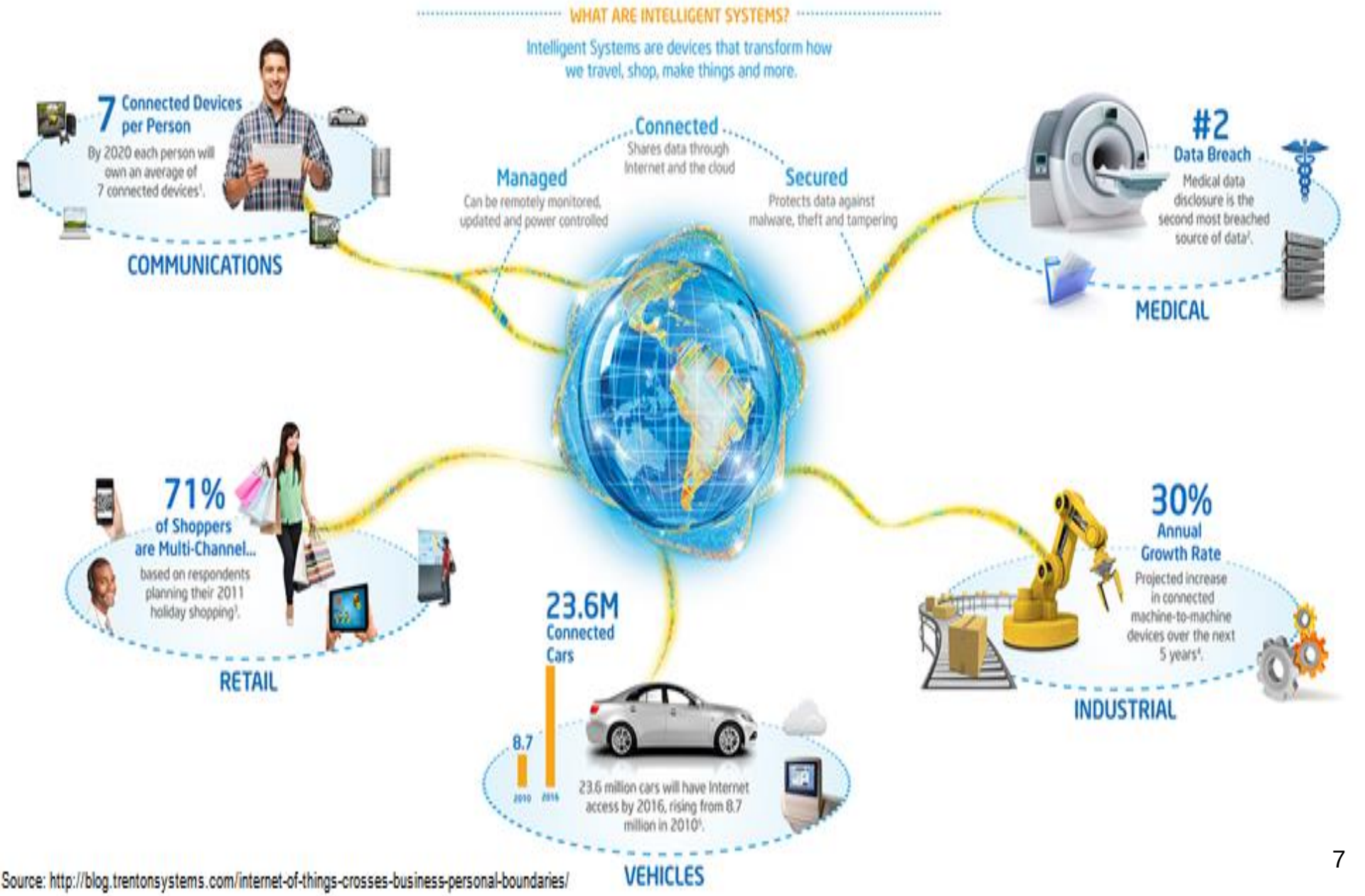


ANYTIME ←→ ANYPLACE ←→ ANYWHERE



Why Internet of Things

75 Billion by 2020



Source: http://blog.trentonsystems.com/internet-of-things-crosses-business-personal-boundaries/

General Architecture of IoT: More on Architecture

Integrated Application


Smart Logistic


Smart Grid


Green Building


Smart Transport


Env. Monitor

Information Processing


Data Center

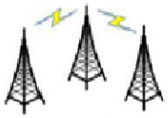

Search Engine

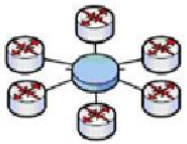

Smart Decision


Info. Security


Data Mining

Network Construction


WPAN


Internet


WLAN


WMAN

Sensing and Identification


GPS


Smart Device


RFID


Sensor


Sensor

Enabling Technologies

Internet of Things is not just a single technology rather its powered truly by various other Technologies. Some of them are:-

- IPv6
- RFID
- Wi-Fi (IEEE 802.11)
- Bluetooth
- ZigBee Etc.

Enabling Technologies →IPv6

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IPv6 stands for Internet Protocol Version 6.

Typically we all use the IPv4 addressing mechanism to uniquely identify a machine over a network. But since the world is growing a lot more devices are being connected and so IPv4 addresses started depleting.

IPv6 is the next generation addressing with enough addresses.

World Population more than 7.3 Billion

IPv4, 32 bit, 3.4 Billion Device

IPv6, 128 bit, 3.4 x 1024 Billion Device

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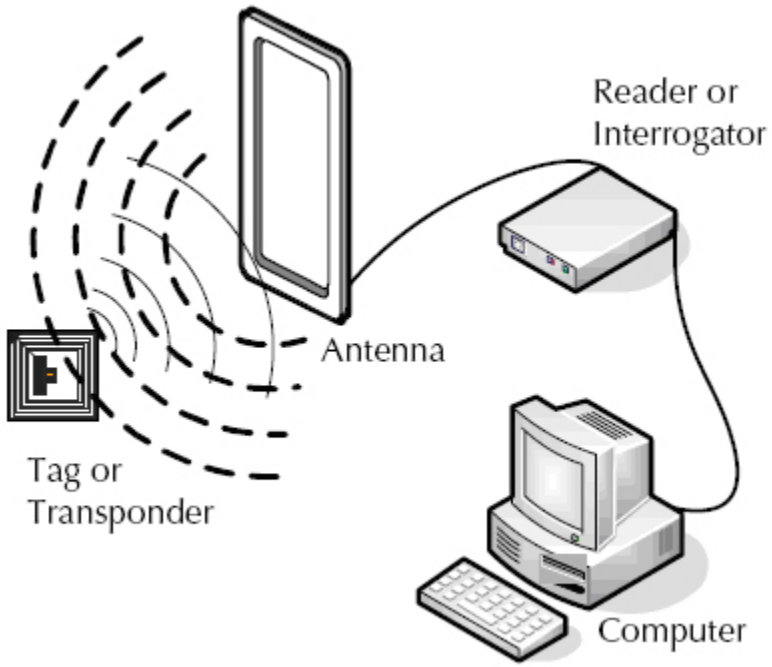
Enabling Technologies → RFID

RFID stands for Radio Frequency Identification, a technology actually devised to solve the problems of identifying friendly and enemy airplanes during the world war II.

Today RFID is widely used in supply chain management.



Enabling Technologies → Wi-Fi

Wi-Fi or Wireless Fidelity changed the way how internetworking was done.

Wi-Fi is the name of the forum and the actual standard is IEEE-802.11.

Wi-Fi will act the medium for physical devices connecting to the internet.

Enabling Technologies → Bluetooth

Bluetooth is probably the most used mobile to mobile short distance communication protocol.

Since its inception this technology has continuously evolved, currently it is in its v4.2, known as the BLE (Bluetooth Low Energy) or the Bluetooth Smart. This new standard is developed by SIG (Signal Interest Group) keeping IoT in mind as chips can run up to a year on coin cell battery and promises long ranges.

Enabling Technologies→ ZigBee

ZigBee is a low-cost, low-power, wireless mesh network standard targeted at wide development of long battery life devices in wireless control and monitoring applications.

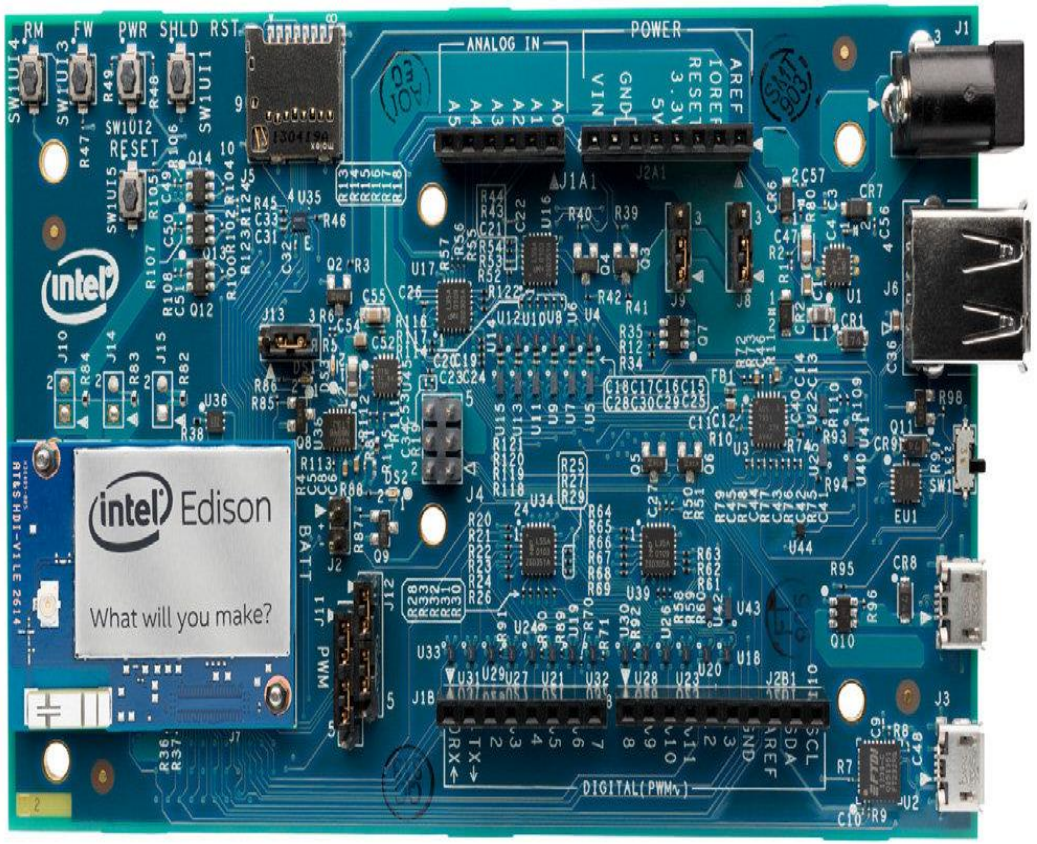
Like Wi-Fi and Bluetooth ZigBee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz

Intel® Edison - One Tiny Platform, Endless Possibility

Intel Edison is a tiny Computer made by Intel focusing on IoT and the Wearable Computing.

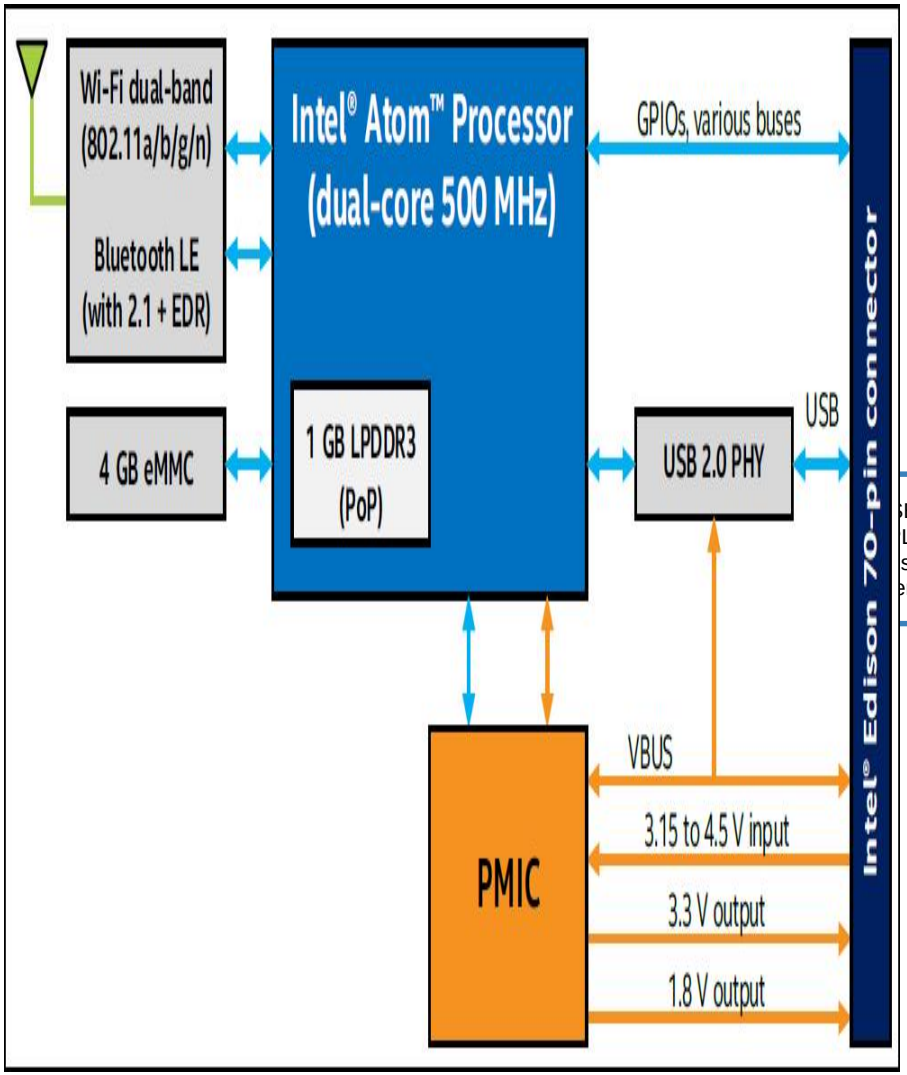
Features:- (Will Amaze You)

- Very Small Form Factor (35.5 × 25.0 × 3.9 mm).
- Inbuilt Dual Band Wi-Fi and Bluetooth (v4.0)
- 500MHz Dual Core Dual Threaded Intel Atom Processor along with 100 MHz Quark Microcontroller
- 1 GB LPDDR3 RAM
- 4 GB Inbuilt Storage
- OTG Support
- Low Power Consumption (Can be powered with single cell Lithium Ion Battery) along with charge controller.
- Etc.

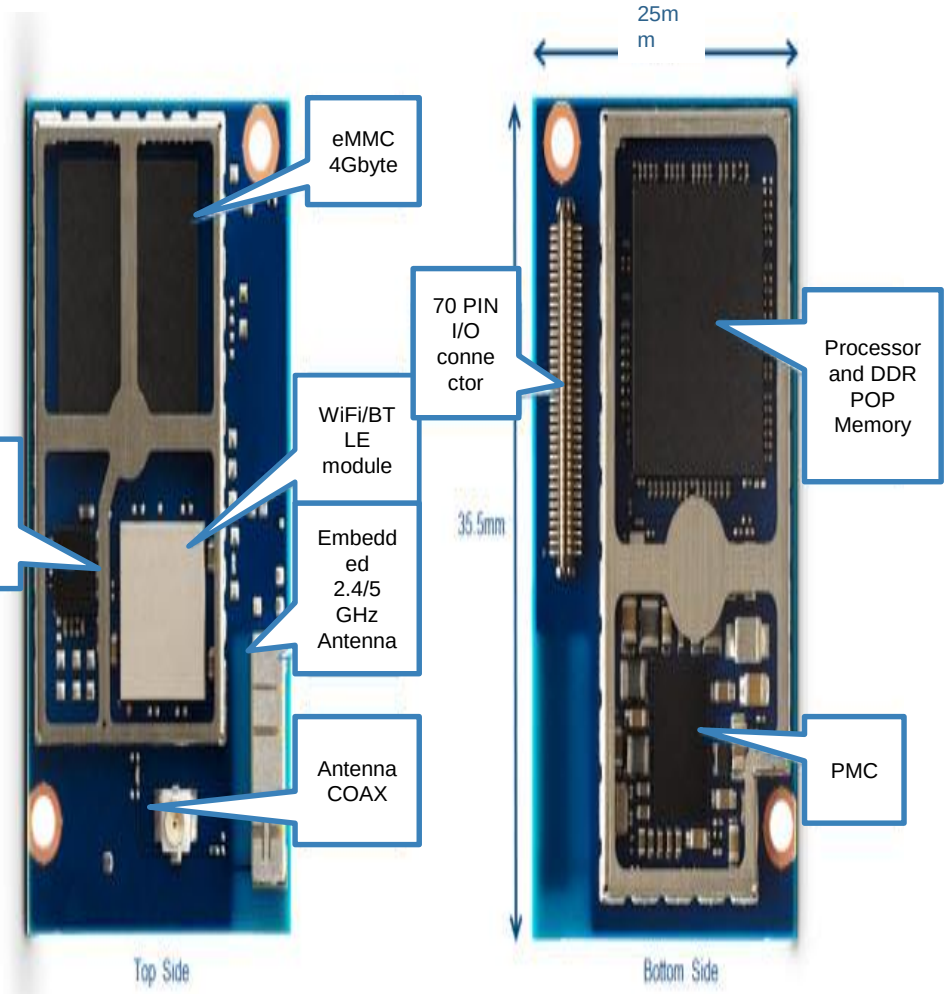


"Tiny computer used as development system for wearable devices for IoT Applications."

Intel® Edison



Intel Edison Block diagram



Edison internal detail, front and back

Other IoT Kits/Boards

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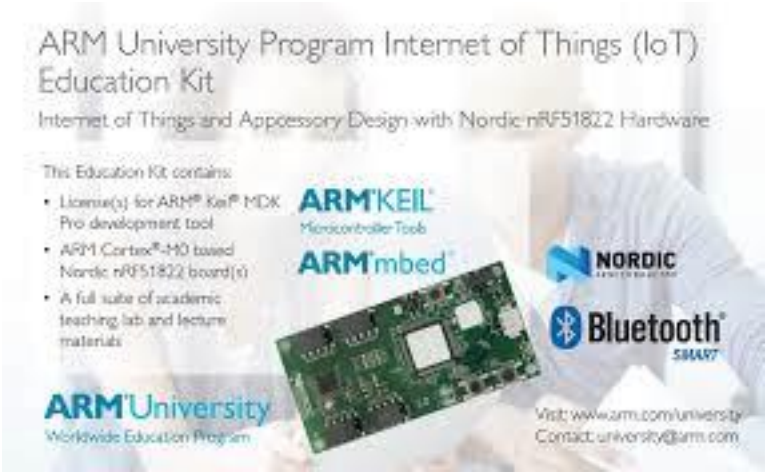
CC 3200 Launch pad TI

Raspberry Pi

Intel Galileo Gen 2



ARM

Intel® Edison- Application

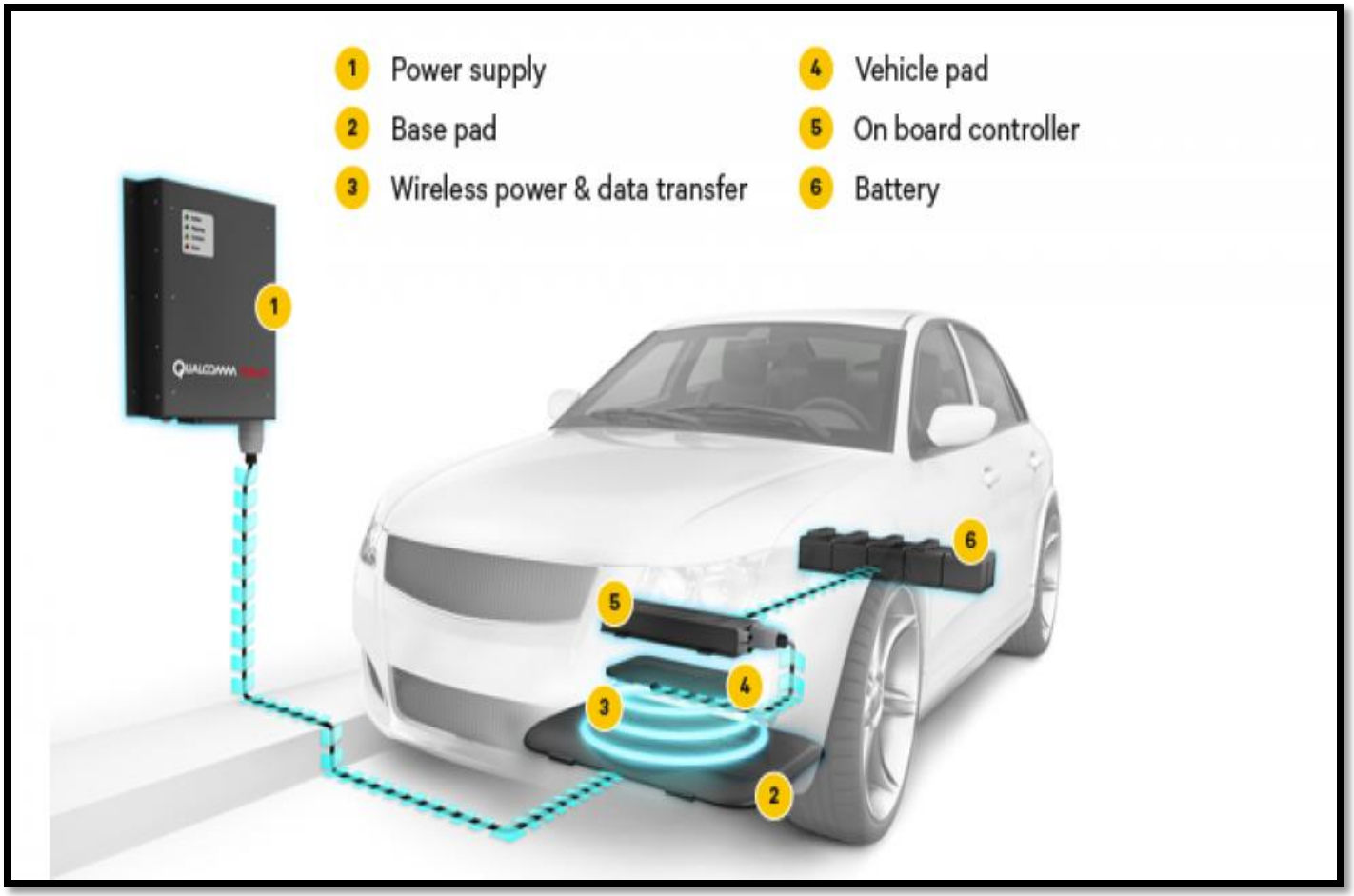
BABYBE
Soft robotics for neonatal healthcare

Qualcomm Helo

Qualcomm halo
Wireless Electric Vehicle Charging

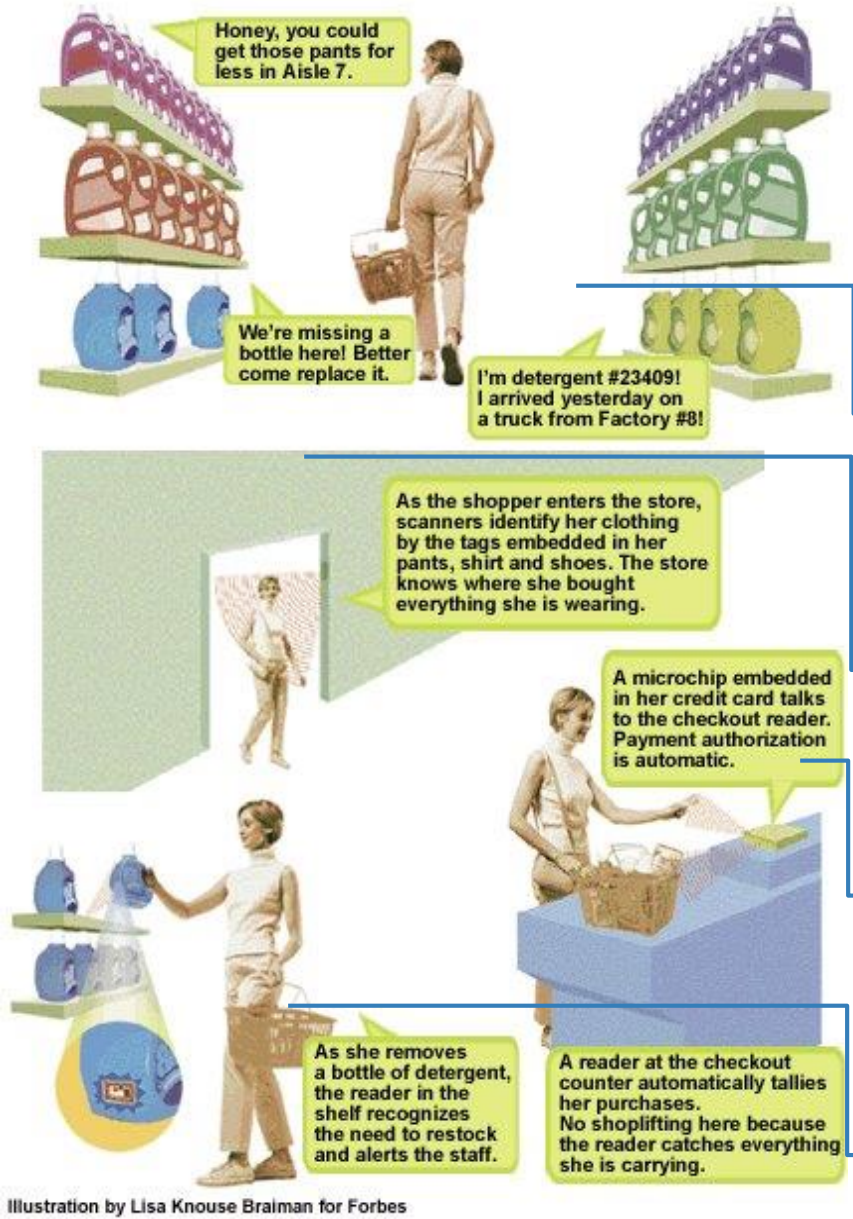
Parked = powering up

Any parking spot fitted with Qualcomm Halo™ technology is a place to recharge your electric car. It's a simple, elegant way to power up, cable-free.



The Application of IoT

Scenario: Shopping



(2) When shopping in the market, the goods will introduce themselves.

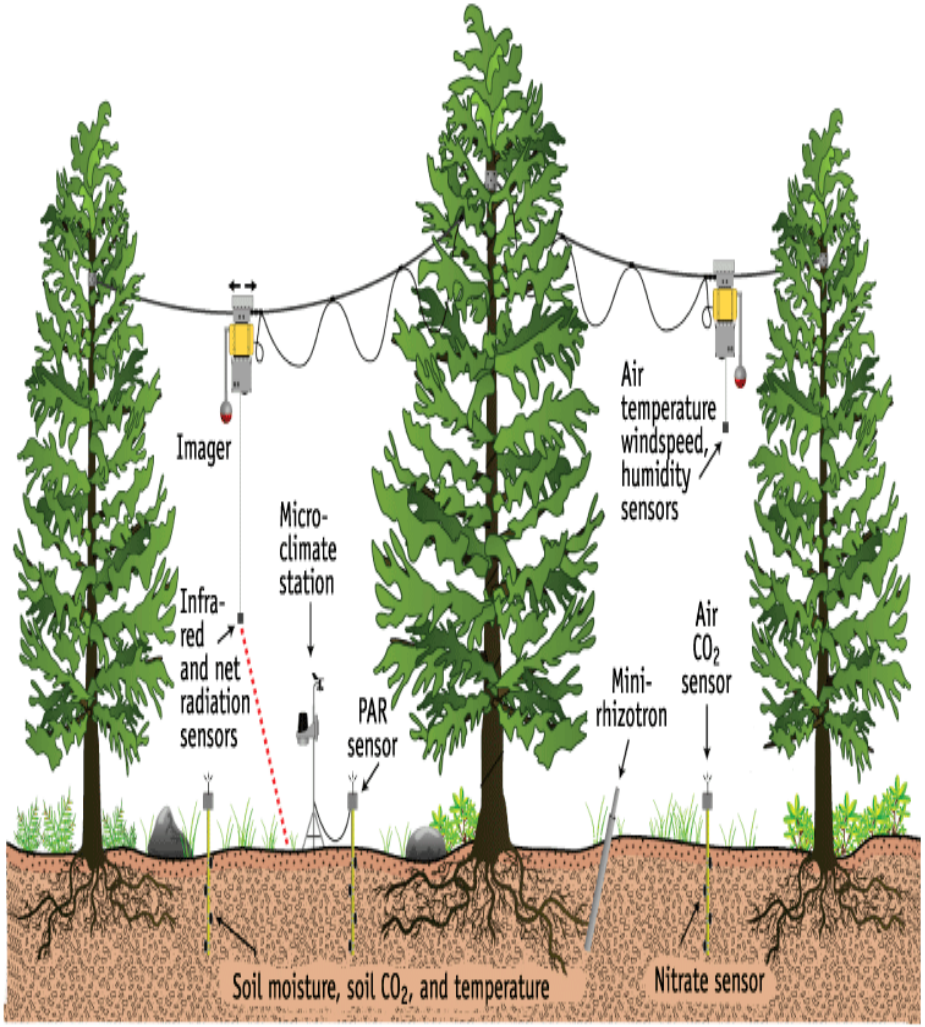
(1) When entering the doors, scanners will identify the tags on her clothing.

(4) When paying for the goods, the microchip of the credit card will communicate with checkout reader.

(3) When moving the goods, the reader will tell the staff to put a new one.

The Application of IoT

Monitoring the Environment



(1)

(2) Bigbelly Solar Trash Compactor

Case Study → Plant Monitor: Agro-Electronics

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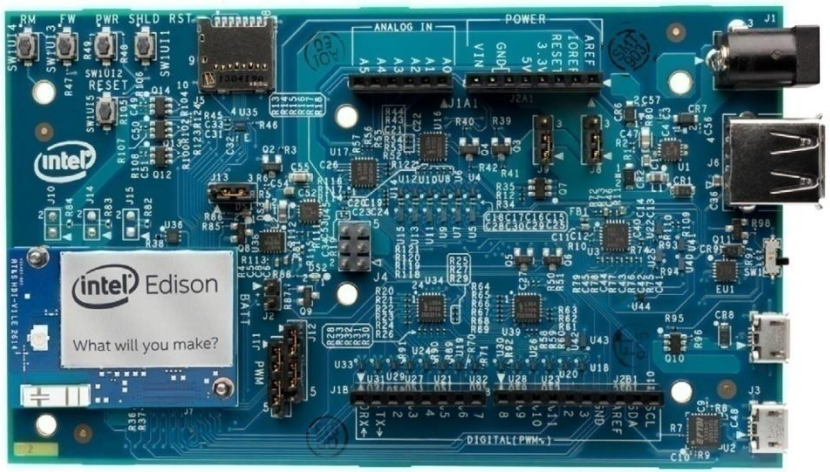
If you have done some plantation in a remote area or may be if you are a farmer then you might have an idea then you can understand how difficult it is to monitor proper moisture.

So our team Decided to come up with a solution for this problem using IoT.

For this we used the Intel Edison.



Intel Edison with Arduino Breakout Board

Smart Vending Machine

Whether Monitoring System

Case Study → Plant Monitor

Hardware Block

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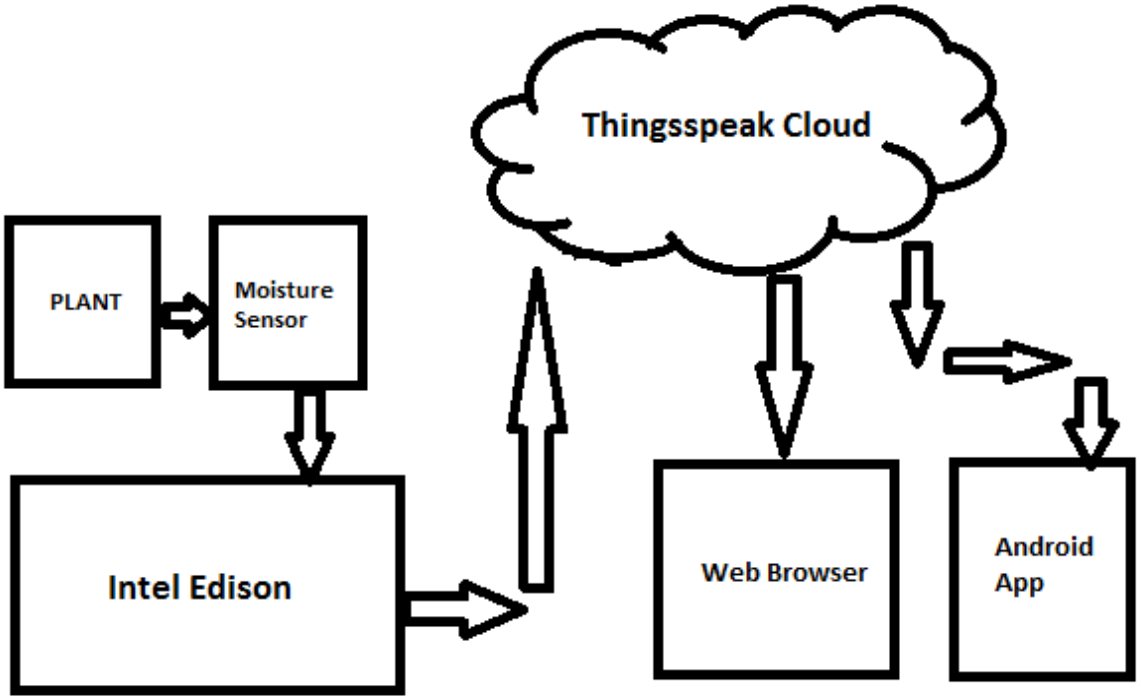

Case Study → Plant Monitor

Monitoring Block

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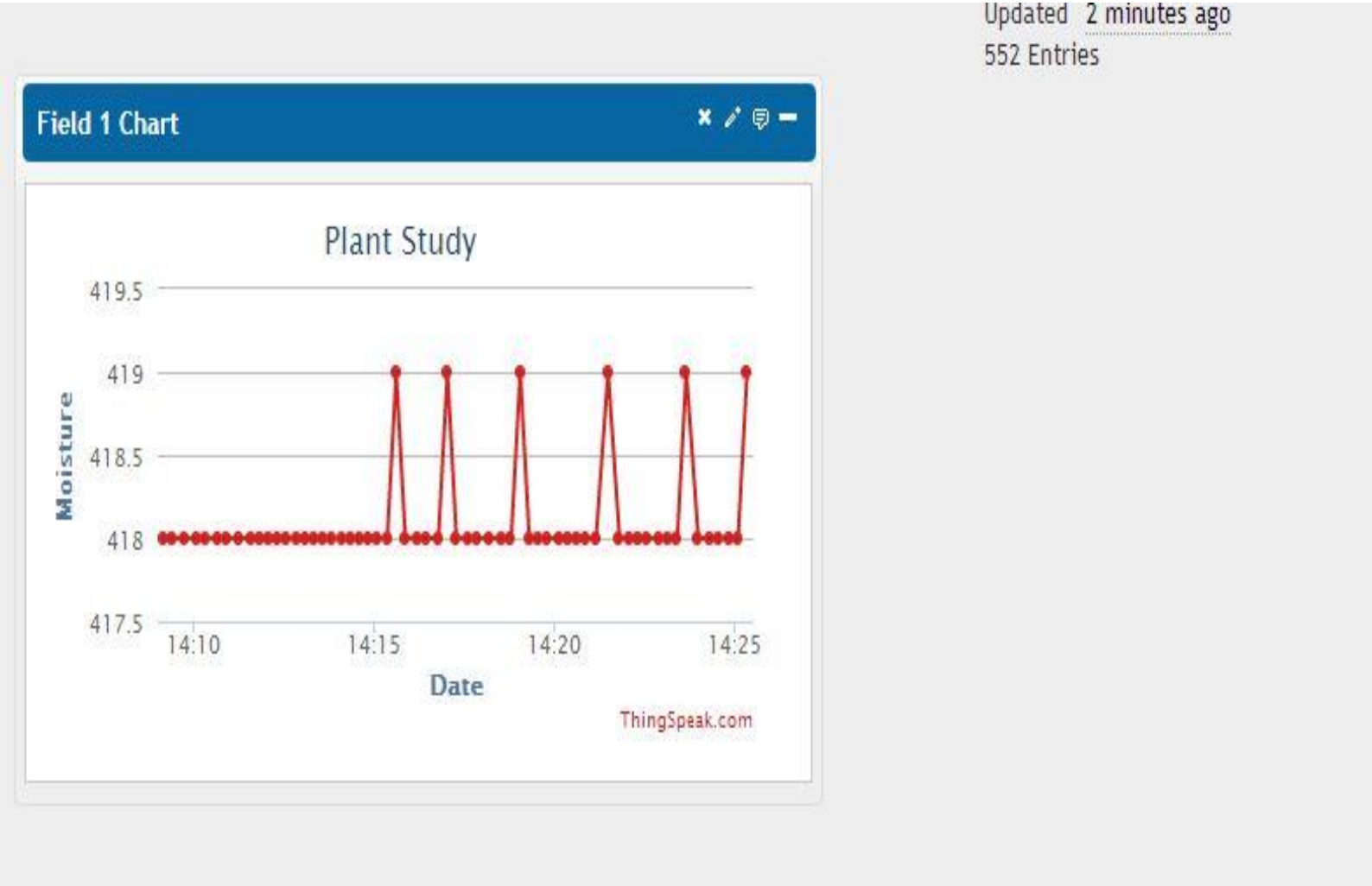
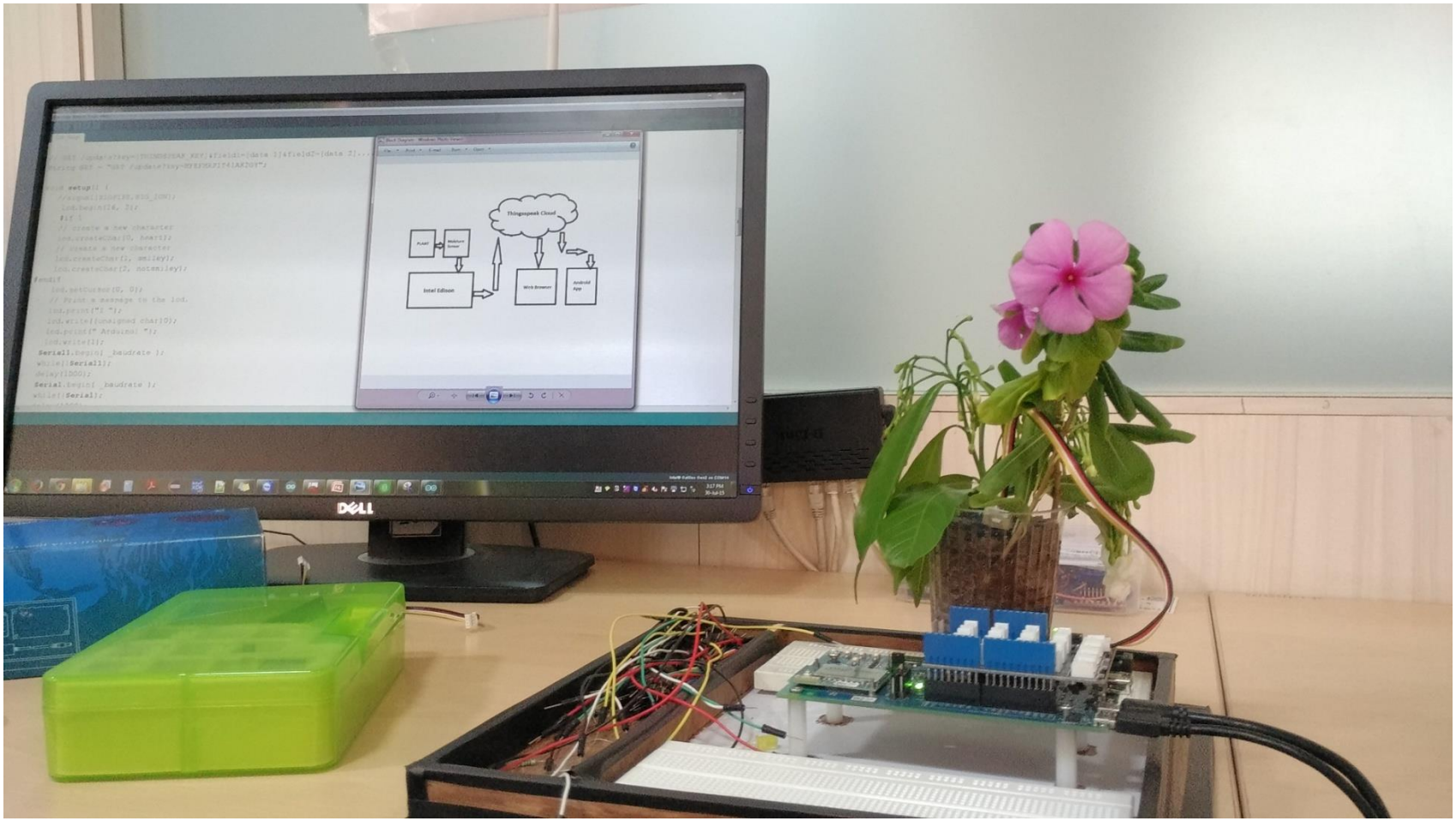
Thingsspeak Channel Data



Case Study → Plant Monitor



Android App

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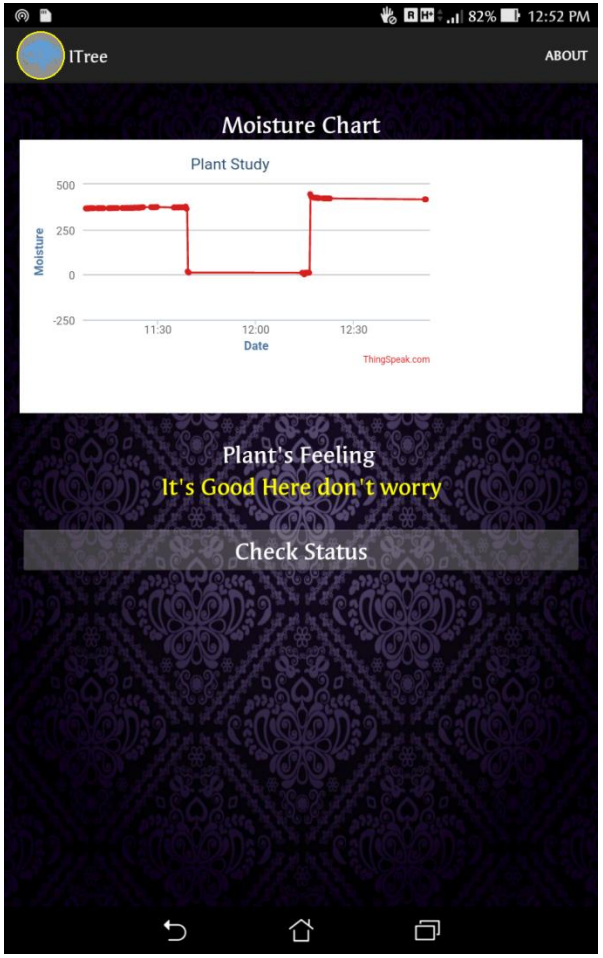
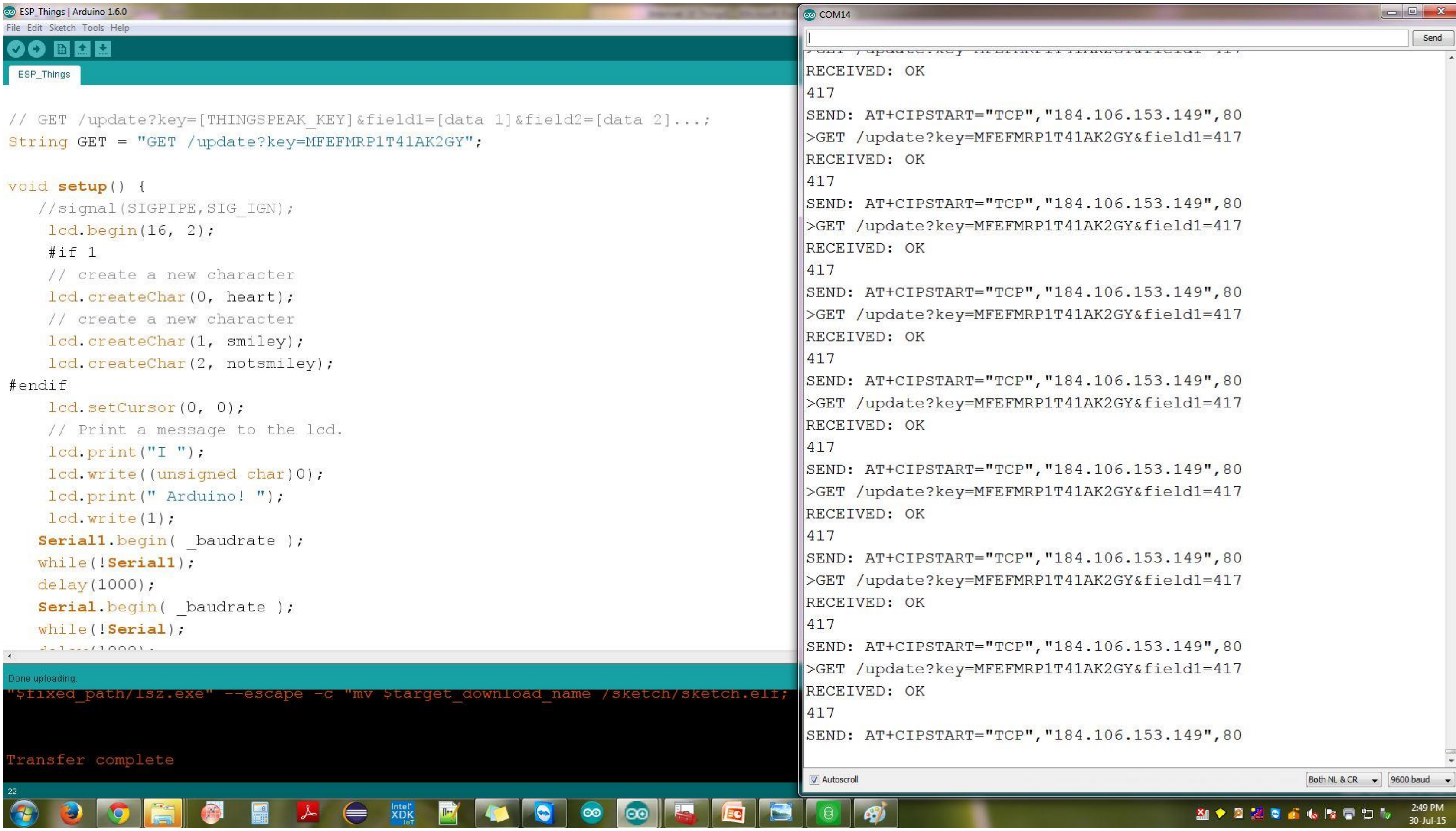


Programming



Future, Challenges and Opportunities

Internet of Things is a truly interdisciplinary field.

Big Firms like Forbes and Gartner have already predicted that there will be at least 75 billion devices connected to Internet by 2020.

The Area of IoT is in its very beginning yet its getting such a huge attention, so it can be easily said that in future we are going to see a lot of Internet of Things.

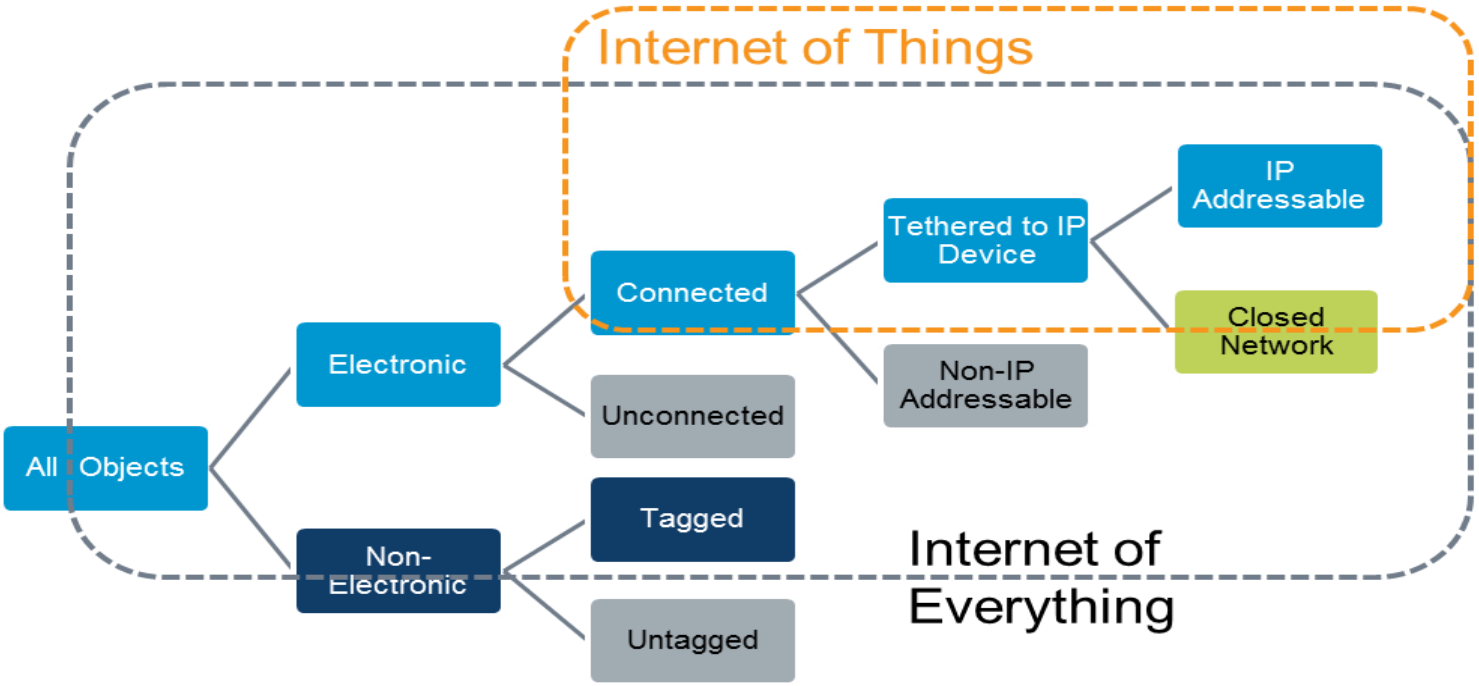
Security, Trust and Privacy, Integration, Architecture and Protocols etc.

Startups, Entrepreneur, Enterprises

What is the “Internet of Things”?

- IoT is a conceptual framework
- It’s about enabling connectivity and embedded intelligence in devices
- Some of these devices are connected today, but **MANY** are not…
- Not strictly machine-to-machine (M2M) – also machine-to-people, people-to-machine, machine-to-objects, people-to-objects
- Creates the ability to collect data from a broad range of devices
- Data can be accessed via the cloud and analyzed using “big data” techniques
- ***IoT can be used to provide unique value propositions and create complex information systems which are greater than the sum of the individual components.***

Internet of Things Hierarchy



- **Unconnected Objects:** Desk, chair, soda can, fire hydrant, animal collar, shipping pallet, buildings, etc.
- **Unconnected Electronic Devices:** Calculator, streetlight, vending machine, coffee maker, blood pressure monitor, etc.
- **Connected/Tethered Electronic Devices:** Audio headset, printer, computer monitor, DVD player, licensed mobile radio unit, etc.
- **IP-addressable Devices:** Tablet PC, smartphone, Infotainment head unit, smart meter, EV charging station, home health hub, etc.

IoT Application Segments

Automotive
- Infotainment
- Under-the-hood

Communications
- Consumer CPE
- Enterprise CPE
- Last-mile Access
- Backbone
- Mobile Handsets and Infrastructure

Information Technology
- Desktop
- Server
- Portable Computing (Netbook, Notebook & Tablet)

Medical
- Consumer Medical
- Imaging
- Other Medical

Industrial
- Building Automation
- Commercial Transportation
- Retail Electronics
- Industrial Automation
- Lighting
- Power & Energy
- Security
- Test & Measurement
- Other Industrial & Commercial

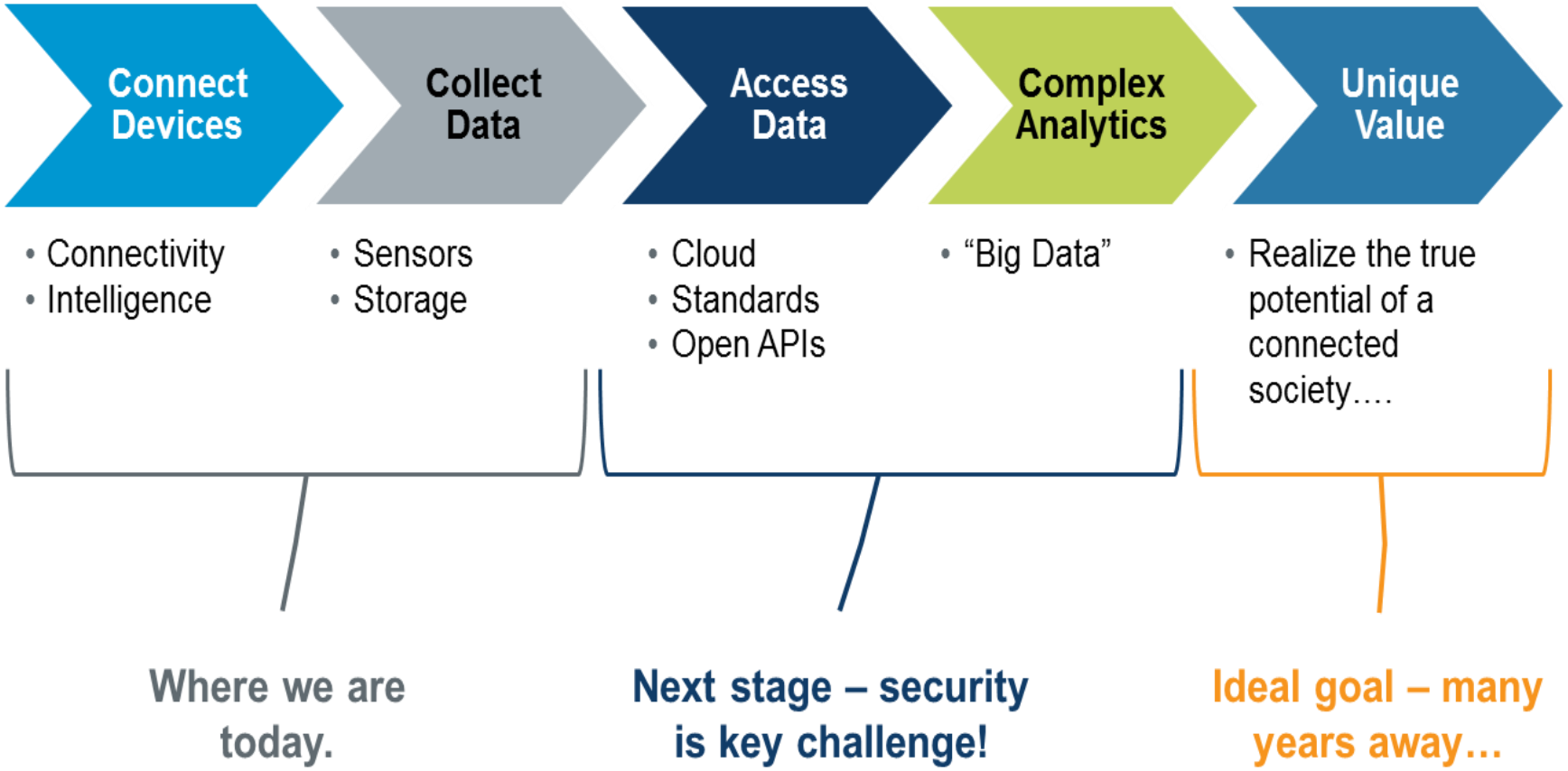
Consumer
- Home Appliance
- Home Automation
- Home Consumer Electronics
- PC Peripherals & Office Equipment
- Portable CE
- Smart Toys
- Sports & Fitness
- Other Consumer

Military & Aerospace
- Commercial aerospace
- Military equipment

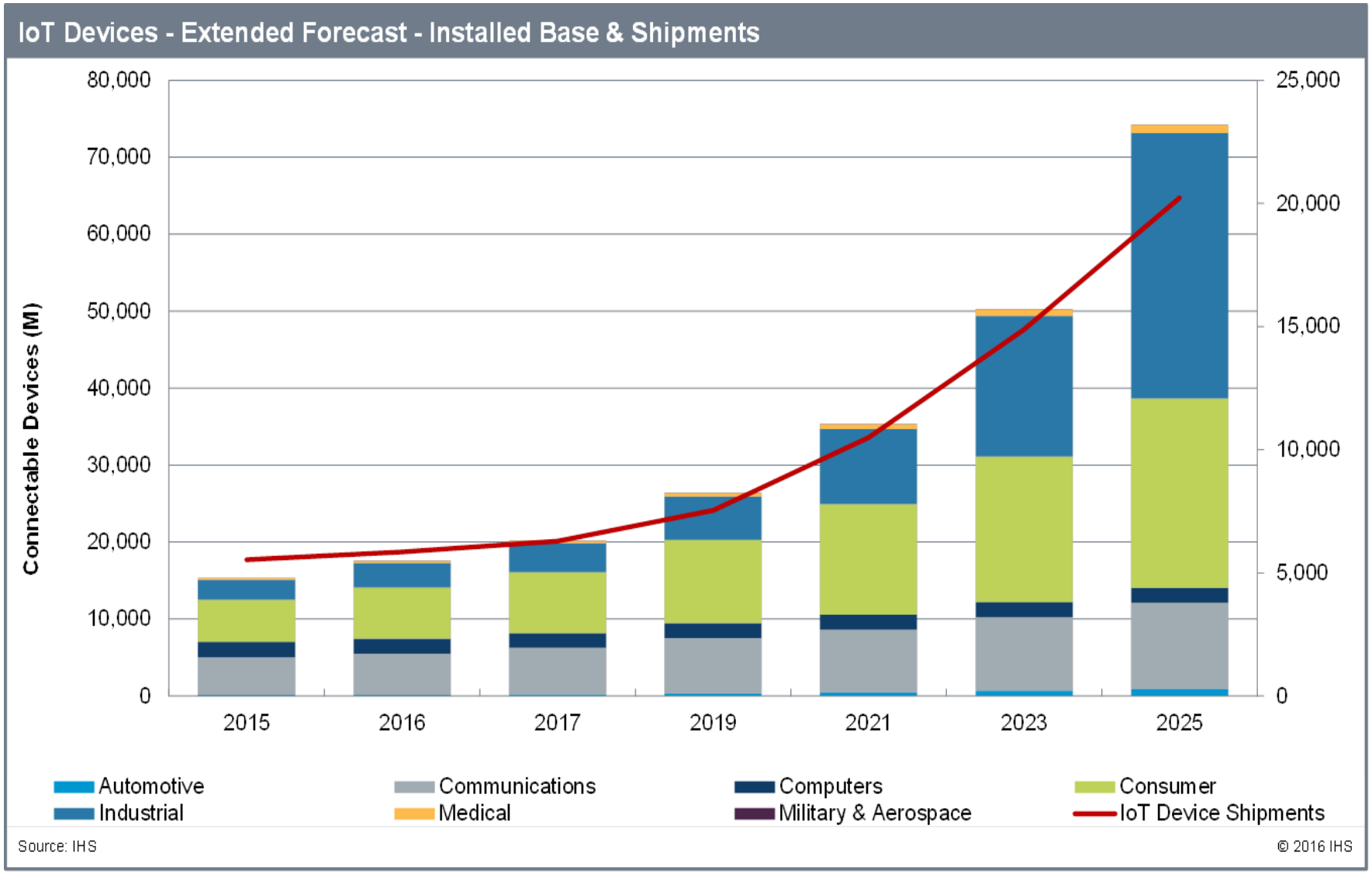
IoT Technologies

Wired	WPAN	W-Mesh	WLAN	WWAN
• Ethernet, Coax, Fiber, etc. considered as a single category	• ANT+ • *Bluetooth* ® – Classic & Smart Ready • *Bluetooth* ® Smart	• ZigBee PRO • ZigBee RF4CE • ZigBee Multi-Protocol • EnOcean • ISA100.11a • WirelessHART • Z-Wave • Other 802.15.4	• 802.11a/b/g • 802.11n • 802.11ac • 802.11ad • Other 802.11 • DECT ULE • Other 2.4GHz • Other Sub-GHz	• 2G Cellular • 3G Cellular • 4G Cellular

Internet of Things Evolution

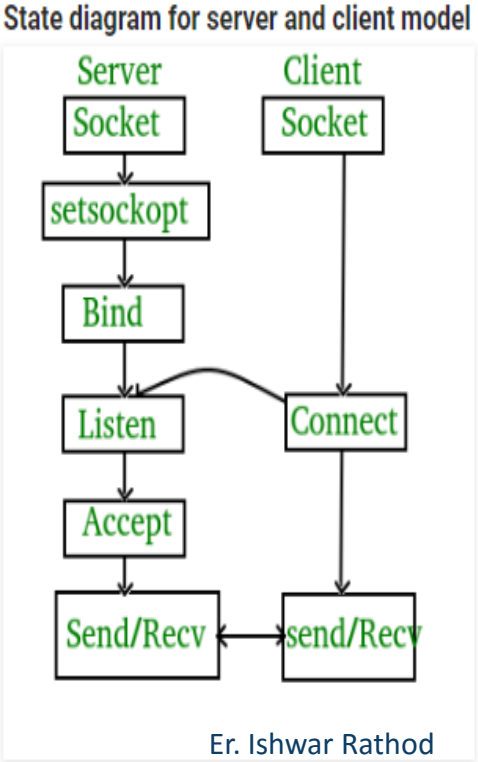


Internet of Things Evolution



Socket Programming

- Socket programming is a way of connecting two nodes on a network to communicate with each other. One socket(node) listens on a particular port at an IP, while other socket reaches out to the other to form a connection. Server forms the ile client reaches out to the server.



Stages of Socket Programming

- Socket Creation

```
int sockfd = socket(domain, type, protocol)
```

sockfd: socket descriptor, an integer (like a file-handle)

domain: integer, communication domain e.g., AF_INET (IPv4 protocol) , AF_INET6 (IPv6 protocol)

type: communication type

SOCK_STREAM: TCP(reliable, connection oriented)

SOCK_DGRAM: UDP(unreliable, connectionless)

protocol: Protocol value for Internet Protocol(IP), which is 0. This is the same number which appears on protocol field in the IP header of a packet.(man protocols for more details)

- Setsockopt

```
int setsockopt(int sockfd, int level, int optname,
                  const void *optval, socklen_t optlen);
```

This helps in manipulating options for the socket referred by the file descriptor sockfd. This is completely optional, but it helps in reuse of address and port. Prevents error such as: "address already in use".

```
int bind(int sockfd, const struct sockaddr *addr,
                         socklen_t addrlen);
```

IEEE 802.11 Architecture

- Wireless LANs are those Local Area Networks that use high frequency radio waves instead of cables for connecting the devices in LAN.
- Users connected by WLANs can move around within the area of network coverage.

Components of IEEE 802.11

1. **Station (STA):** Stations comprise all devices and equipments that are connected to the wireless LAN. A station can be of two types:
   - **Wireless Access Pointz (WAP):** WAPs or simply access points (AP) are generally wireless routers that form the base stations or access.
   - **Client. :** Clients are workstations, computers, laptops, printers, smartphones, etc.

   Each station has a wireless network interface controller.

2. Basic Service Set (BSS): A basic service set is a group of stations communicating at physical layer level. BSS can be of two categories depending upon mode of operation:

- **Infrastructure BSS:** Here, the devices communicate with other devices through access points.
- **Independent BSS:** Here, the devices communicate in peer-to-peer basis in an ad hoc manner.

3. **Extended Service Set (ESS):** It is a set of all connected BSS.
4. **Distribution System (DS):** It connects access points in ESS.

Advantages of WLANs

- They provide clutter free homes, offices and other networked places.
- The LANs are scalable in nature, i.e. devices may be added or removed from the network at a greater ease than wired LANs.
- The system is portable within the network coverage and access to the network is not bounded by the length of the cables.
- Installation and setup is much easier than wired counterparts.
- The equipment and setup costs are reduced.

Disadvantages of WLANs

- Since radio waves are used for communications, the signals are noisier with more interference from nearby systems.
- Greater care is needed for encrypting information. Also, they are more prone to errors. So, they require greater bandwidth than the wired LANs.
- WLANs are slower than wired LANs.

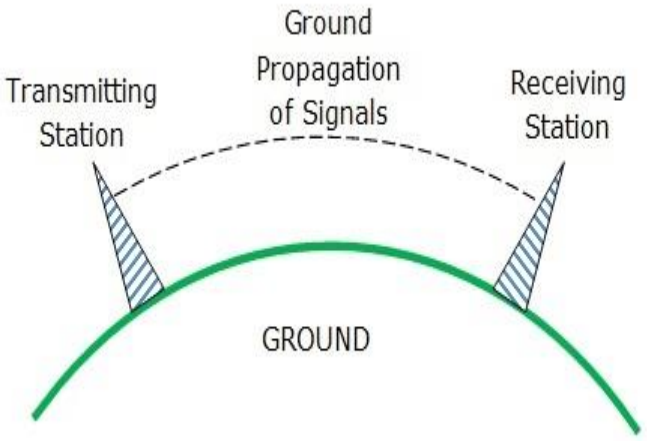
Wireless Transmission

In wireless transmission media, data is transmitted in the form of electromagnetic waves that do not require any physical conductors for transmission. The waves are broadcast through free space and any device who has permission to connect can receive them.

The three ways in which unguided signals travel are –

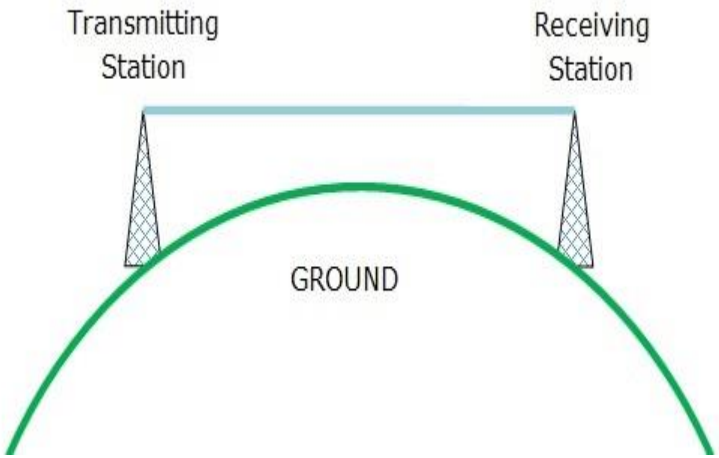
- **Ground Propagation**

It is a method of propagation, in which radio waves travel through the lowest layers of the atmosphere along the earth's surface, following the earth's curvature. The frequency of these signals is low (< 2MHz), and the distance they travel is directly propo



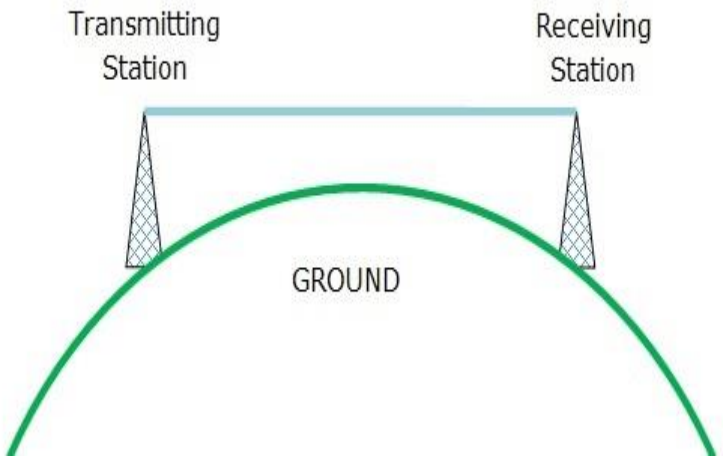
- **Sky Propagation**

In sky propagation, high frequency radio waves (2–30 MHz) are reflected back from the ionosphere towards the earth's surface. They can be used to transmit signals over a large geographical area since their distance is not bounded by the earth's curvatu



- **Line – of – Sight Propagation**

In line – of – sight propagation, very high frequency waves (> 30 MHz) travel at straight lines from the source antenna (transmitter) to the destination antenna (receiver). These waves are easily disrupted by present of objects in their path. So the antennas are placed tall enough above obstructions. They are unidire



Bluetooth

- Bluetooth wireless technology is a short range communications technology intended to replace the cables connecting portable unit and maintaining high levels of security.
- Bluetooth technology is based on **Ad-hoc technology** also known as **Ad-hoc Pico nets**, which is a local area network with a very limited coverage.

Bluetooth

- WLAN technology enables device connectivity to infrastructure based services through a wireless carrier provider. The need for personal devices to communicate wirelessly with one another without an established infrastructure has led to the emergence of **Personal Area Networks (PANs)**.
- **Bluetooth** specification details the entire protocol stack. Bluetooth employs Radio Frequency (RF) for communication. It makes use of **frequency modulation** to generate radio waves in the **ISM** band.(industrial, scientific, and medical radio **band)**

The usage of Bluetooth has widely increased for its special features.

- Bluetooth offers a uniform structure for a wide range of devices to connect and communicate with each other.
- Bluetooth technology has achieved global acceptance such that any Bluetooth enabled device, almost everywhere in the world, can be connected with Bluetooth enabled devices.
- Low power consumption of Bluetooth technology and an offered range of up to ten meters has paved the way for several usage models.
- Bluetooth offers interactive conference by establishing an adhoc network of laptops.
- Bluetooth usage model includes cordless computer, intercom, cordless phone and mobile phones.

Piconets

- Bluetooth enabled electronic devices connect and communicate wirelessly through shortrange devices known as **Piconets**.
- Bluetooth devices exist in small ad-hoc configurations with the ability to act either as master or slave the specification allows a mechanism for **master** and **slave** to switch their roles.
- Point to point configuration with one master and one slave is the simplest configuration.
- When more than two Bluetooth devices communicate with one another, this is called a **PICONET**.

Piconets

- A Piconet can contain up to seven slaves clustered around a single master. The device that initializes establishment of the Piconet becomes the **master**.
- The master is responsible for transmission control by dividing the network into a series of time slots amongst the network members, as a part of **time division multiplexing** scheme

Scatternet

- Devices resident in adjacent piconets provide a bridge to support inner-piconet connections, allowing assemblies of linked piconets to form a physically extensible communication infrastructure known as **Scatternet**.

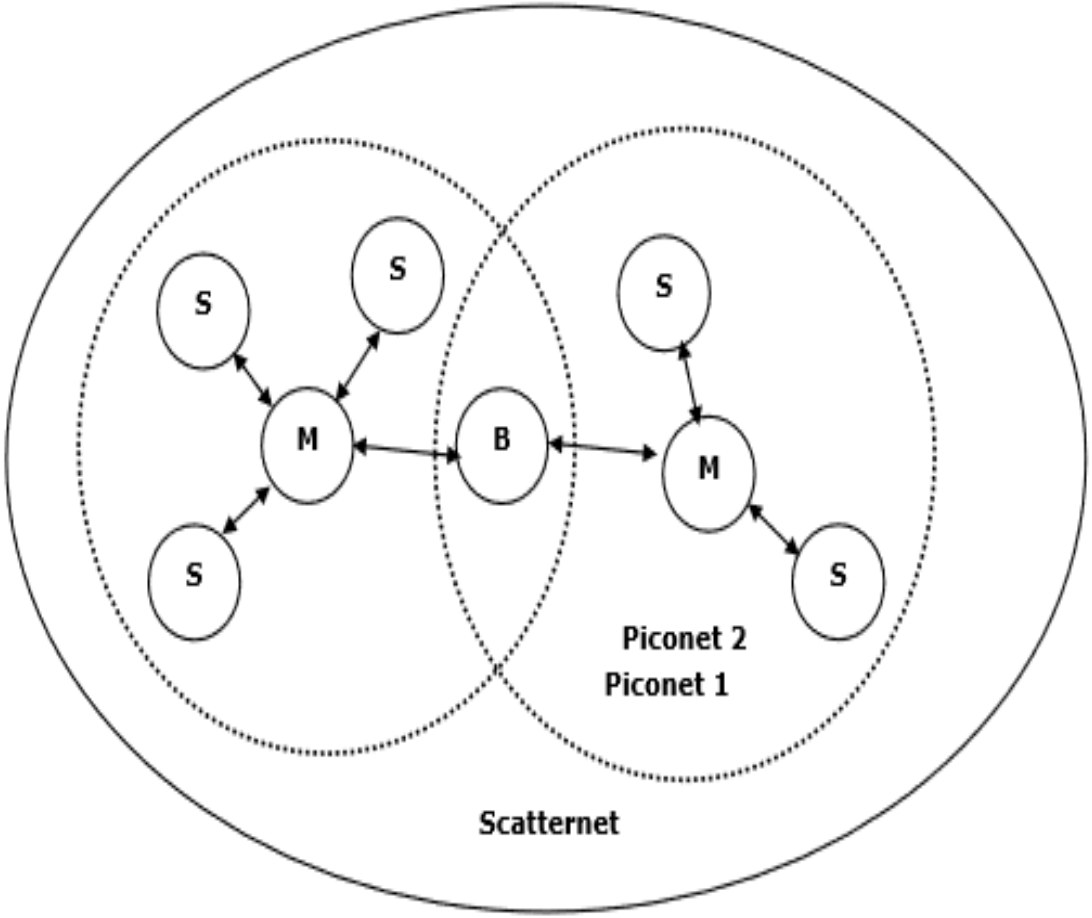


Figure: Piconets and Scatternets

RFID

Radio frequency identification (RFID) is a general term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object wirelessly, using radio waves.

RFID technologies are grouped under the more generic Automatic Identification(Auto ID) technologies.

The barcode labels that triggered a revolution in identification systems long time ago, are inadequate in an increasing number of cases. They are cheap but the stumbling block is their low storage capacity and the fact that they cannot be reprogrammed.

RFID

- A feasible solution was putting the data on silicon chips. The ideal situation is contactless transfer of data between the data carrying device and its reader.
- A feasible solution was putting the data on silicon chips. The ideal situation is contactless transfer of data between the data carrying device and its reader.
- RFID enabled stores will monitor the consumption in real time. Shelf will signal the inventory when it needs more stuff and inventory will pull supplies from the manufacturer based on its level of stock.

RFID

- RFID System can be visualized as the sum of the following three components:

1. RFID tag or transponder
2. RFID reader or transceiver
3. Data processing subsystem

An RFID tag is composed of an antenna, a wireless transducer and an encapsulating material. These tags can be either **active** or **passive.**

Active tags have on-chip power, **passive tags** use the power induced by the magnetic field of the RFID reader.

RFID

- An RFID reader consists of an antenna, transceiver and decoder, which sends periodic signals to inquire about any tag in vicinity. On receiving any signal from a tag it passes on that information to the data processor.
- The data processing subsystem provides the means of processing and storing the data.

RFID systems can also be differentiated based on the frequency range it uses.

common ranges are Low-Frequency (LF: 125 - 134.2 kHz and 140 - 148.5 kHz), High-Frequency (HF: 13.56 MHz) and Ultra-High-Frequency (UHF: 868 MHz - 928 MHz).

Applications:

- Person Identification
- Food Production Control
- Vehicle Parking Monitoring
- Toxic Waste Monitoring
- Valuable Objects Insurance Identification
- Asset Management
- Access Control

Conclusion

- As we have already seen the potential of IoT is still unexplored since it’s still in its emerging phase.
- The beauty of IoT is the fact that it is by birth Pervasive in nature i.e. its easily acceptable.
- Finally, it depends on you all how the story of this area will unfold.

Thank you for your time!
Q&A

What is IoT?

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data.

IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

"**Things**," in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist fire-fighters in search and rescue operations.

These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices.

History of IoT

The concept of the Internet of Things first became popular in 1999, through the Auto-ID Center at MIT and related market-analysis publications. R

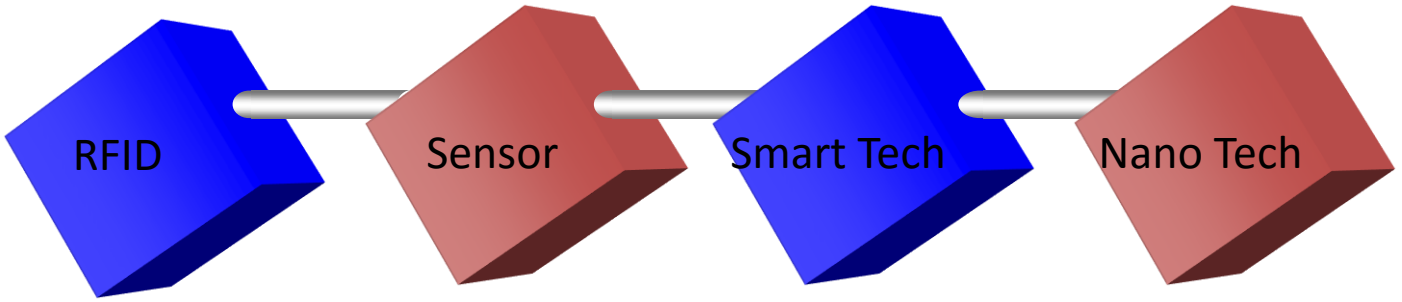
Radio-frequency identification (RFID) was seen as a prerequisite for the IoT at that point. If all objects and people in daily life were equipped with identifiers, computers could manage and inventory them. Besides using RFID, the tagging of things may be achieved through such technologies as near field communication, barcodes, QR codes, bluetooth, and digital watermarking.

How IoT Works?

Internet of Things is not the result of a single novel technology; instead, several complementary technical developments provide capabilities that taken together help to bridge the gap between the virtual and physical world. These capabilities include:

- ***Communication and cooperation***
- ***Addressability***
- ***Identification***
- ***Sensing***
- ***Actuation***
- ***Embedded information processing***
- ***Localization***
- ***User interfaces***

How IoT Works?



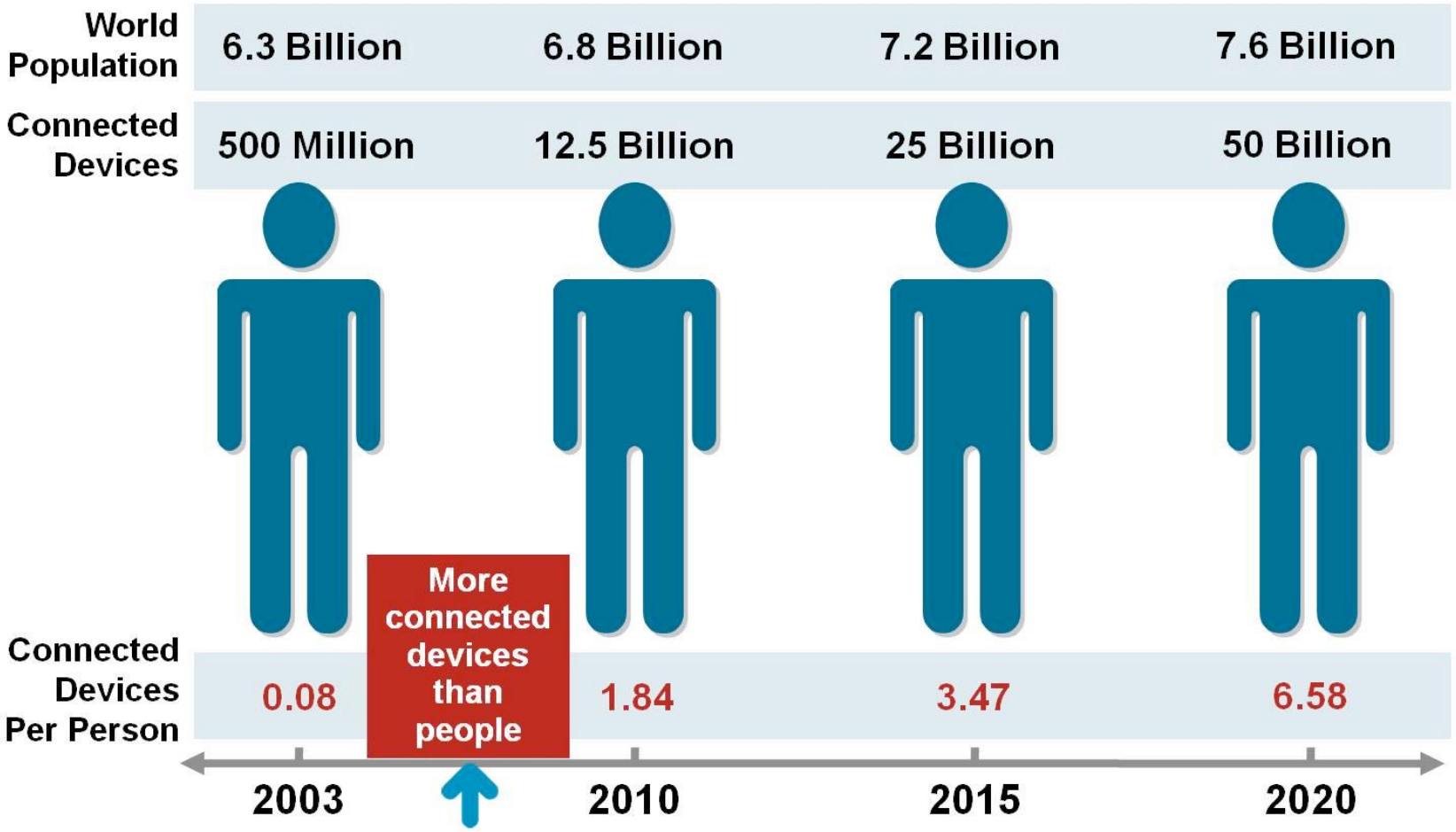
To identify and track the data of things	To collect and process the data to detect the changes in the physical status of things	To enhance the power of the network by devolving processing capabilities to different part of the network.	To make the smaller and smaller things have the ability to connect and interact.

The Structure of IoT

The IoT can be viewed as a gigantic network consisting of networks of devices and computers connected through a series of intermediate technologies where numerous technologies like RFIDs, wireless connections may act as enablers of this connectivity.

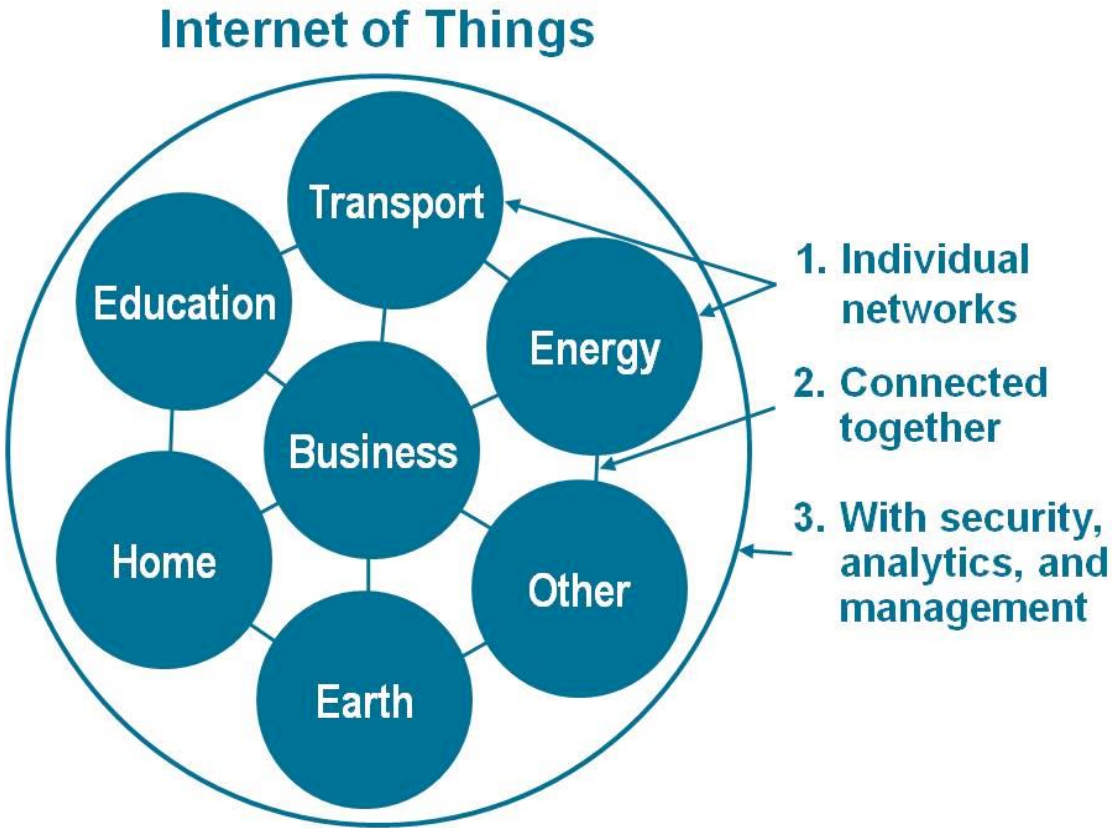
- ***Tagging Things :*** Real-time item traceability and addressability by ***RFID***s.
- ***Feeling Things : Sensors*** act as primary devices to collect data from the environment.
- ***Shrinking Things :*** *M*iniaturization and ***Nanotechnology*** has provoked the ability of smaller things to interact and connect within the “things” or “smart devices.”
- ***Thinking Things : Embedded intelligence*** in devices through sensors has formed the network connection to the Internet. It can make the “things” realizing the intelligent control.

Current Status & Future Prospect of IoT



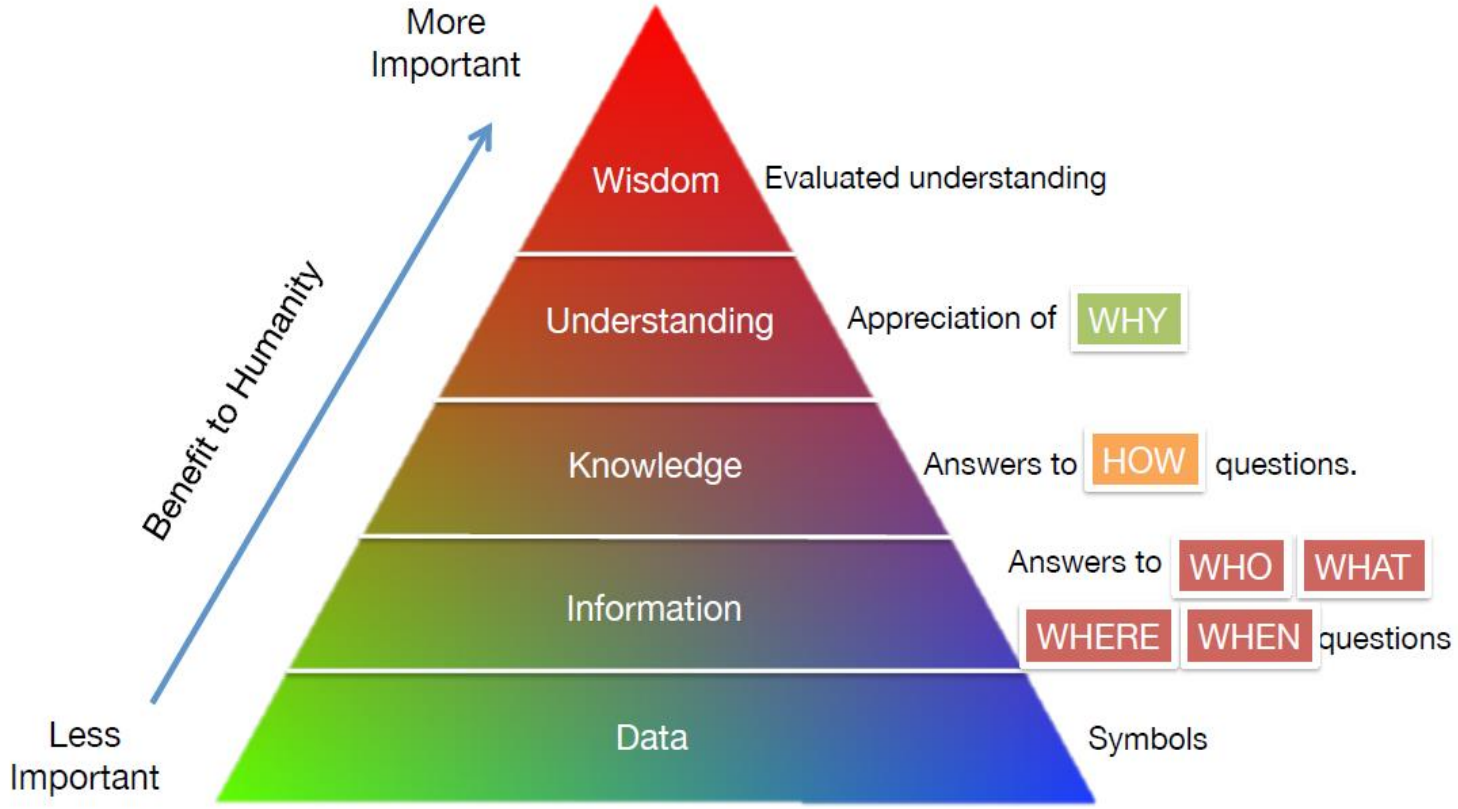
"Change is the only thing permanent in this world"

IoT as a Network of Networks:



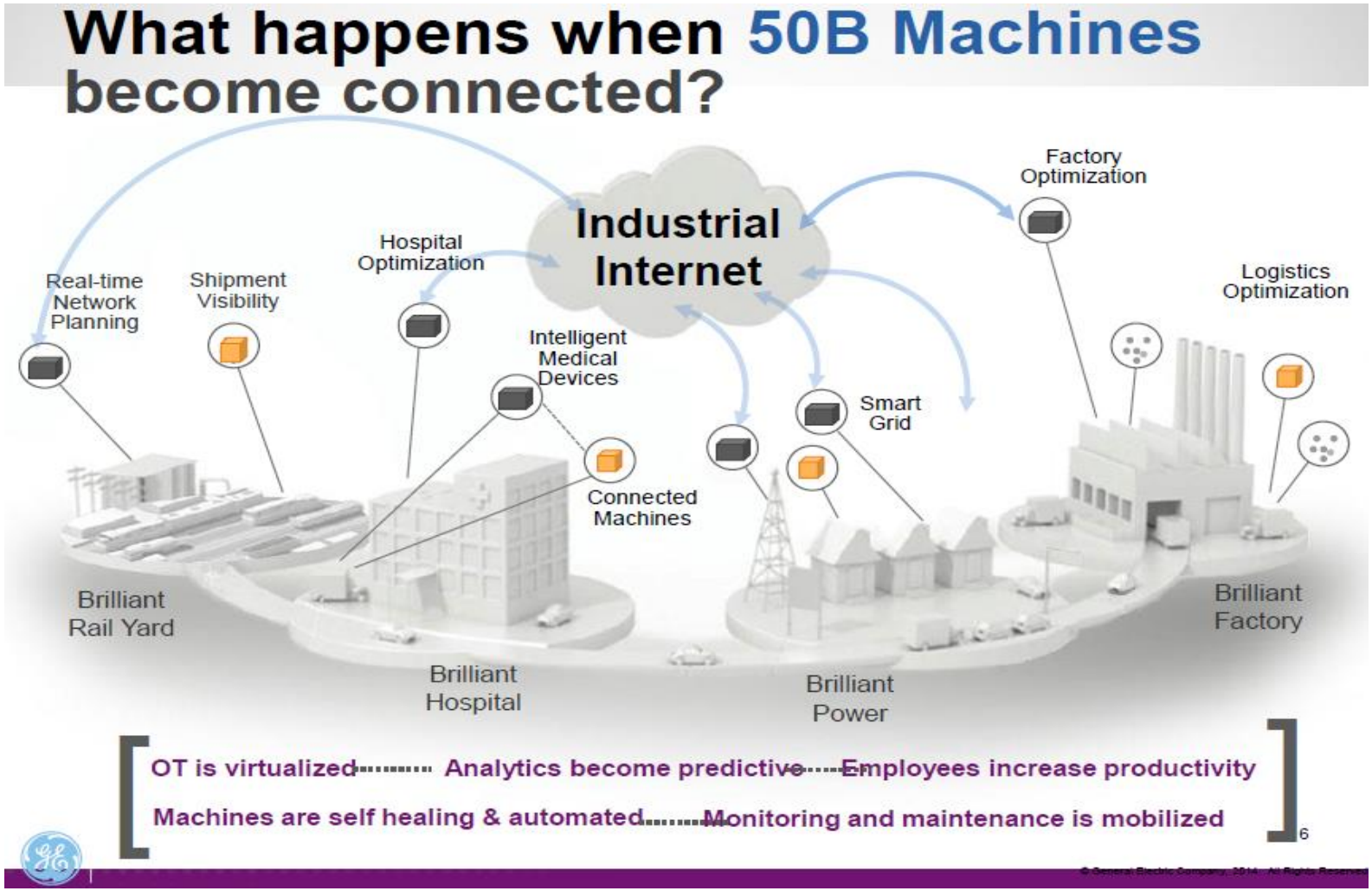
These networks connected with added security, analytics, and management capabilities. This will allow IoT to become even more powerful in what it can help people achieve.

Knowledge Management – Turning Data into Wisdom



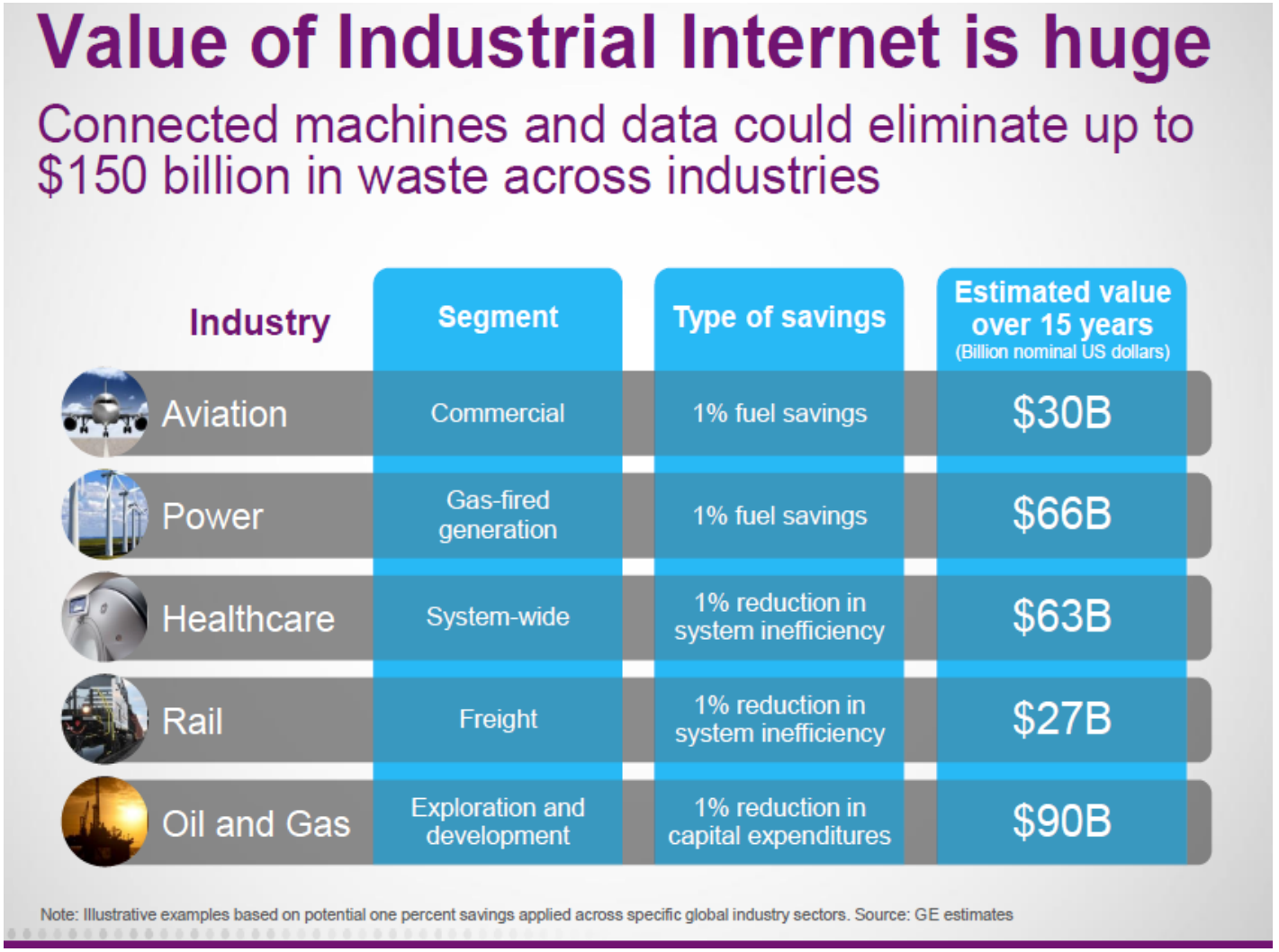
The more data that is created, the better understanding and wisdom people can obtain.

The Future of IoT



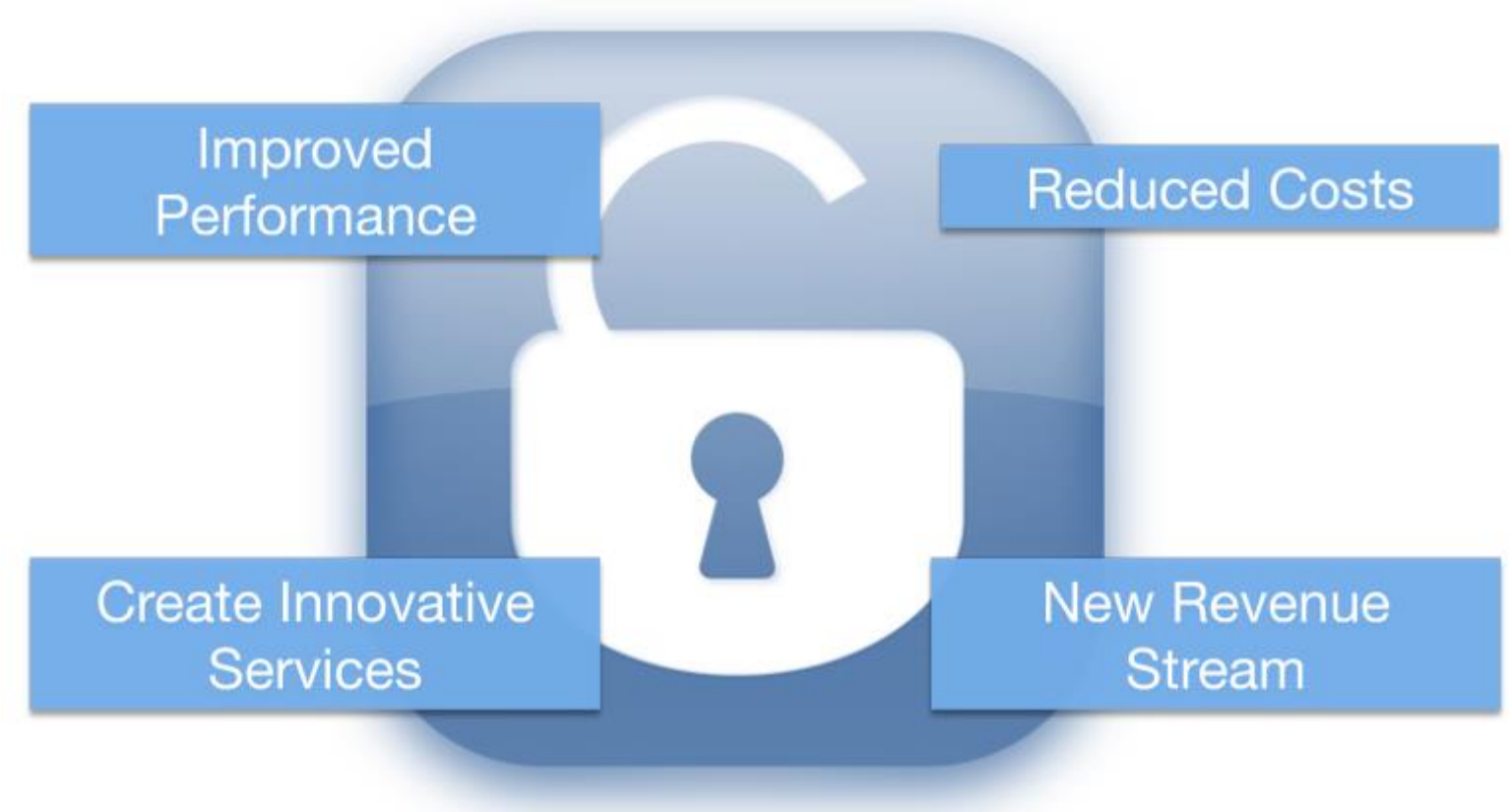
"The Sky's not the limit. It's only the beginning with IoT."

The Potential of IoT

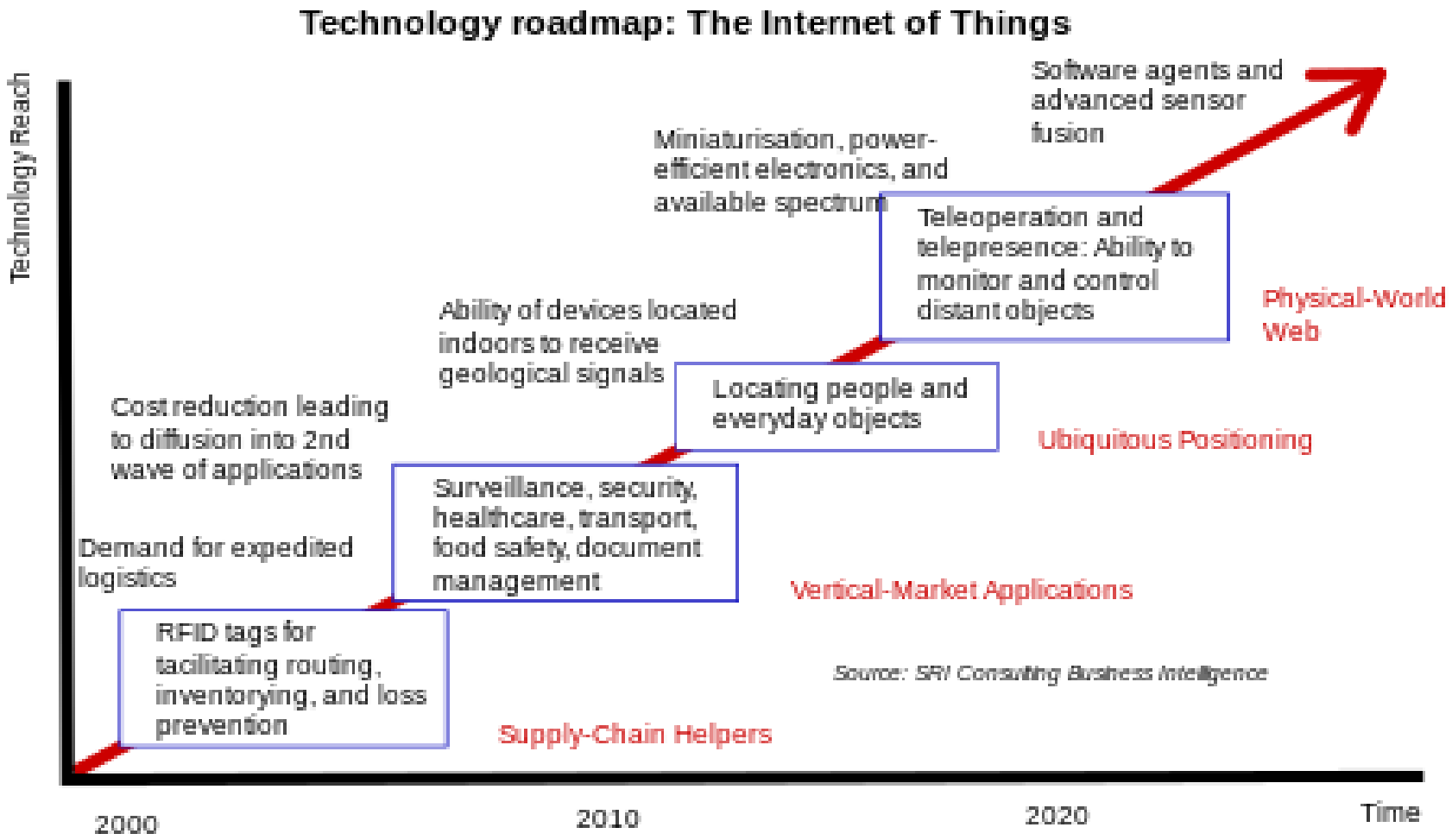


GE's estimates on potential of just ONE percent savings applied using IoT across global industry sectors.

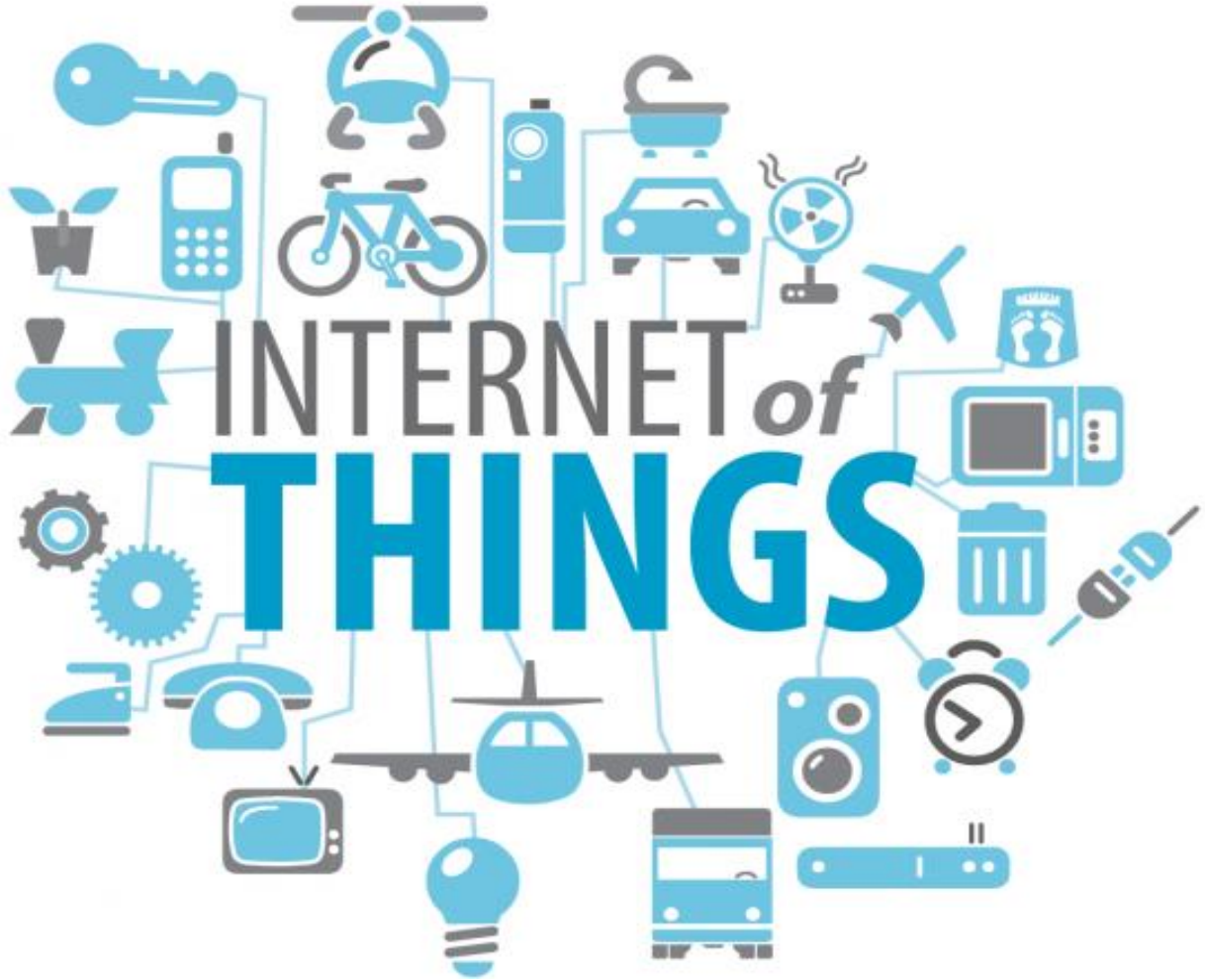
Unlock the Massive potential of IoT



Technology roadmap of IoT



Applications of IoT



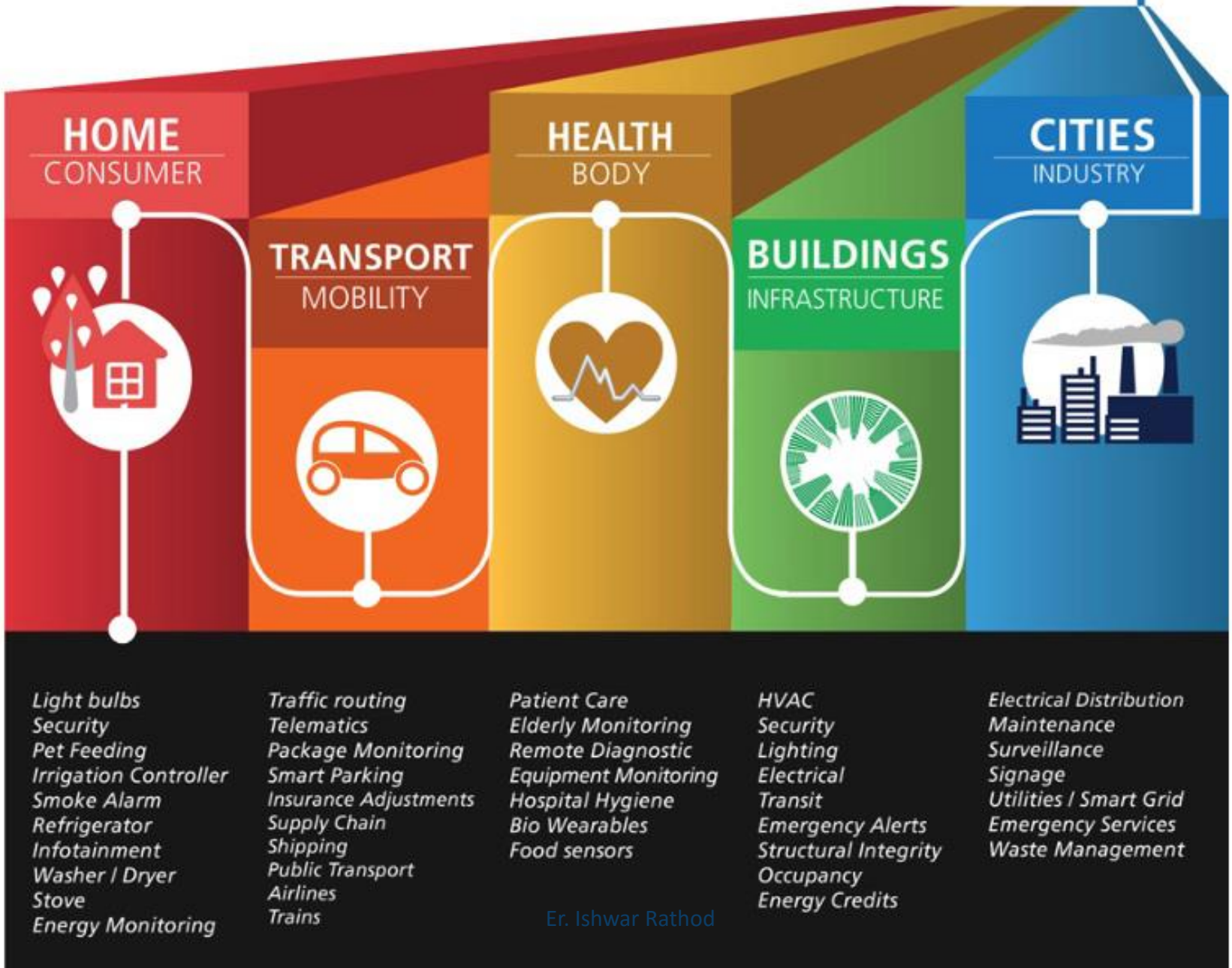
"The Ultimate Goal of IOT is to Automate Human Life."

Few Applications of IoT

- ✓ Building and Home automation
- ✓ Manufacturing
- ✓ Medical and Healthcare systems
- ✓ Media
- ✓ Environmental monitoring
- ✓ Infrastructure management
- ✓ Energy management
- ✓ Transportation
- ✓ Better quality of life for elderly
- ✓ … … …

You name it, and you will have it in IoT!

TO ➡ DIVERSE APPLICATIONS



Sensors in even the holy cow!

In the world of IoT, even the cows will be connected and monitored. Sensors are implanted in the ears of cattle. This allows farmers to monitor cows' health and track their movements, ensuring a healthier, more plentiful supply of milk and meat for people to consume. On average, each cow generates about 200 MB of information per year.

Of course, we know nothing remains static, especially when it comes to the Internet. Initiatives and advances, such as Cisco‘s Planetary Skin, GE’s Industrial Internet, HP‘s central nervous system for the earth (CeNSE), and smart dust, have the potential to add millions—even billions—of sensors to the Internet.

As cows, water pipes, people, and even shoes, trees, and animals become connected to IoT, the world has the potential to become a better place.

“With a trillion sensors embedded in the environment—all connected by computing systems, software, and services—it will be possible to hear the heartbeat of the Earth, impacting human interaction with the globe as profoundly as the Internet has revolutionized communication.” - Peter Hartwell, Senior Researcher, HP Labs.

“How much more IoT can do is only left to your imagination”

Internet of Things is the next stage of the information revolution and referenced the inter-connectivity of everything from urban transport to medical devices to household appliances.

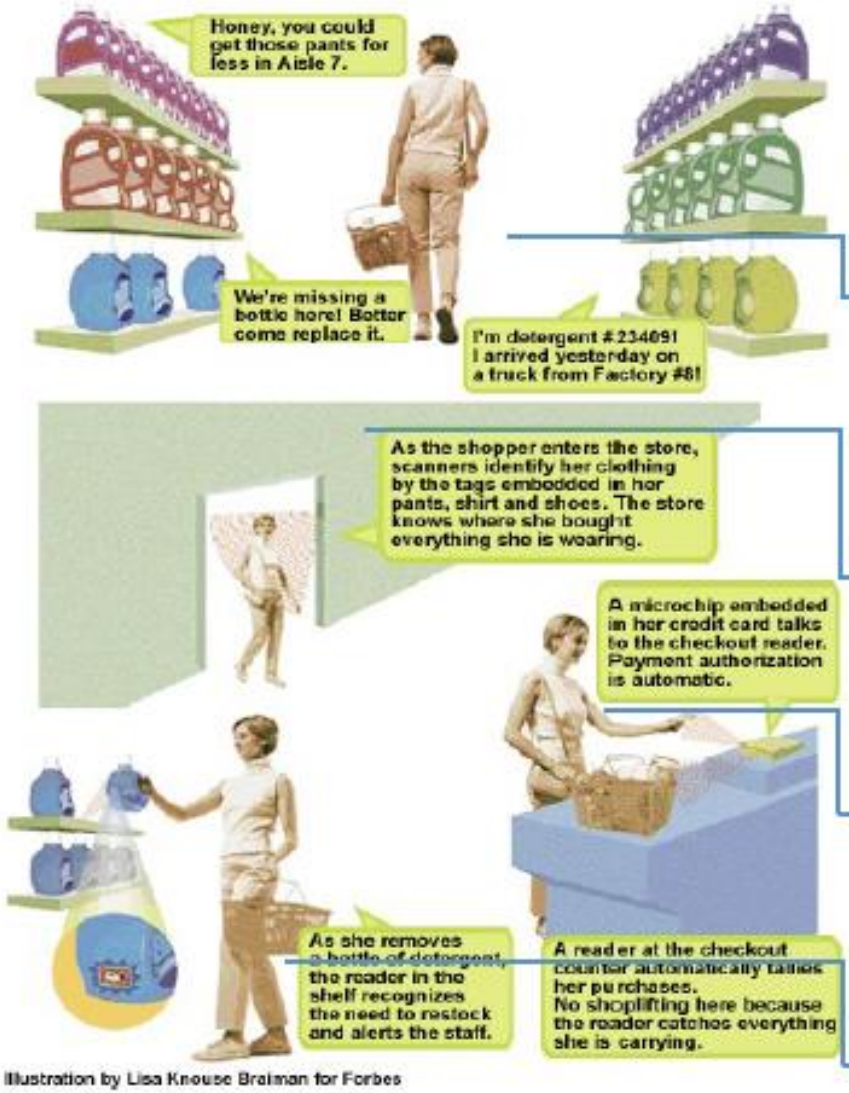
Integration with the Internet implies that devices will use an IP address as a unique identifier. However, due to the limited address space of IPv4 (which allows for 4.3 billion unique addresses), objects in the IoT will have to use IPv6 to accommodate the extremely large address space required.

Objects in the IoT will not only be devices with sensory capabilities, but also provide actuation capabilities (e.g., bulbs or locks controlled over the Internet).

On the other hand, IoT systems could also be responsible for performing actions, not just sensing things. Intelligent shopping systems, for example, could monitor specific users' purchasing habits in a store by tracking their specific mobile phones. These users could then be provided with special offers on their favourite products, or even location of items that they need, which their fridge has automatically conveyed to the phone.

Additional examples of sensing and actuating are reflected in applications that deal with heat, electricity and energy management, as well as cruise-assisting transportation systems. Other applications that the Internet of Things can provide is enabling extended home security features and home automation.

IOT Application Scenario - Shopping



(2) When shopping in the market, the goods will introduce themselves.

(1) When entering the doors, scanners will identify the tags on her clothing.

(4) When paying for the goods, the microchip of the credit card will communicate with checkout reader.

(3) When moving the goods, the reader will tell the staff to put a new one.

How Well Do I Sleep?

Sleep

zzzZ

YOUR SLEEP EFFICIENCY
92%

Your sleep pattern asleep awake

11pm 12am 1am 2am 3am 4am 5am

You went to bed at	Time to fall asleep	Times awakened	You were in bed for	Actual sleep time
11:00PM	0min	20	6hrs 40min	6hrs 6min

8 h 50 mins asleep

1d 1w 1m 3m 1y

- Awake for 212 mins (81x)
- Restless for 278 mins (91x)

10:00 AM 3:00 AM

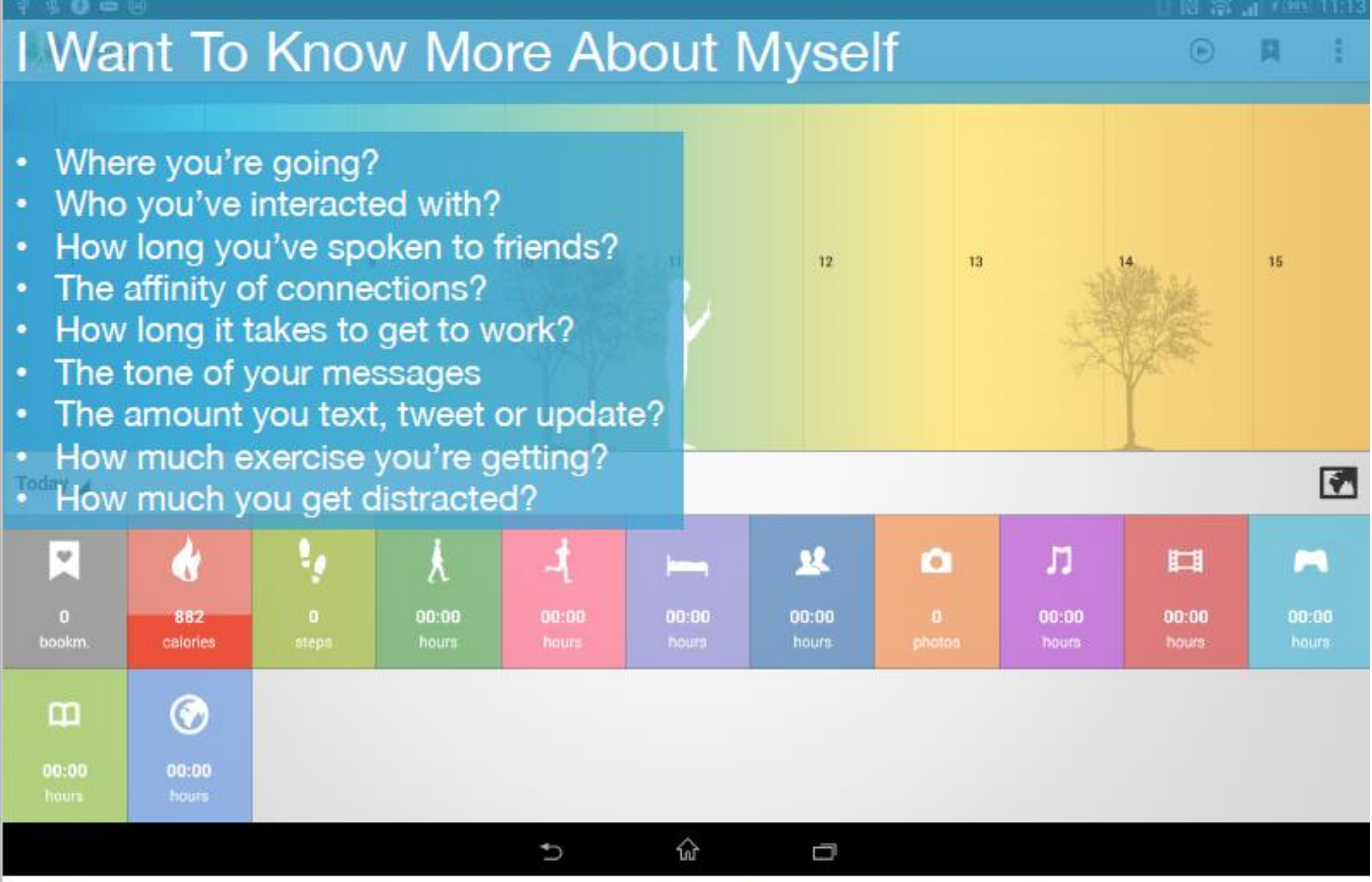
Thursday, February 27

Sleep Stats

Time asleep over the past 30 days in hours

Times awoken over the past 30 days

fitbit flex
Wireless Activity + Sleep Wristband



Can Internet of Things (IOT) Help Us To Know More About Ourselves?

IoT helps you in LIFE LOGGING

Thought Controlled Computing

The flagship product, MindWave, is a headset that can log into your computer using just your thoughts. Researchers recently used the EEG headset to develop a toy car that can be driven forward with thought.

NeuroSky's smart sensors can also track your heart rate and other bodily metrics and can be embedded in the next generation of wearable devices.

"We make it possible for millions of consumers to capture and quantify critical health and wellness data," Yang (CEO of Softbank) said. Softbank is the funder.

[Source: http://venturebeat.com/2013/11/04/next-step-for-wearables-neurosky-brings-its-smart-sensors-to-health-fitness/]

TECHNOLOGICAL CHALLENGES OF IoT

At present IoT is faced with many challenges, such as:

- Scalability
- Technological Standardization
- Inter operability
- Discovery
- Software complexity
- Data volumes and interpretation
- Power Supply
- Interaction and short range communication
- Wireless communication
- Fault tolerance


"Big Data is not magic. It doesn't matter how much data you have if you can't make sense of it."
BIG DATA

Criticisms and Controversies of IoT

Scholars and social observers and pessimists have doubts about the promises of the ubiquitous computing revolution, in the areas as:

- Privacy
- Security
- Autonomy and Control
- Social control
- Political manipulation
- Design
- Environmental impact
- Influences human moral decision making

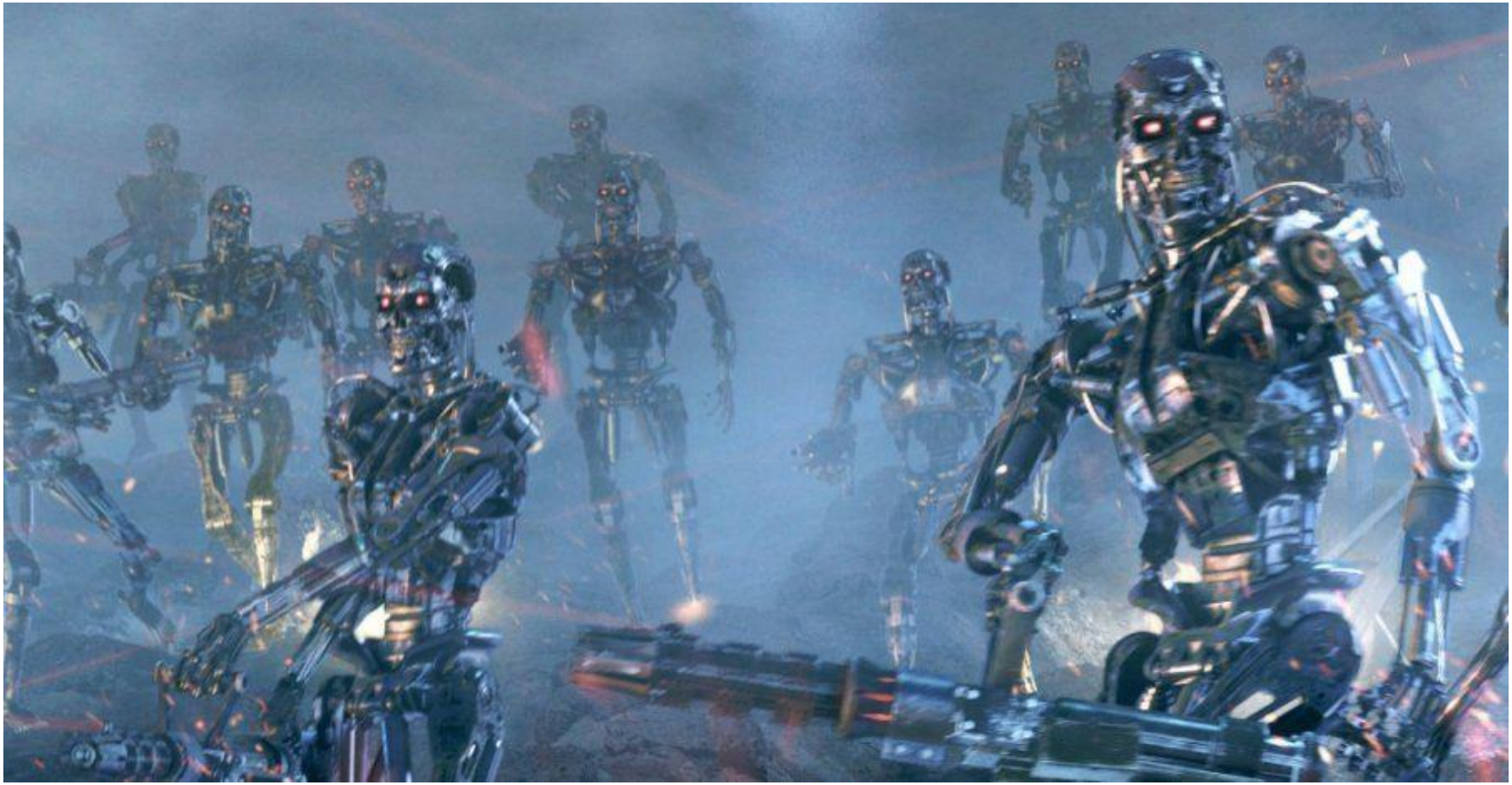
What is the Internet of Things?

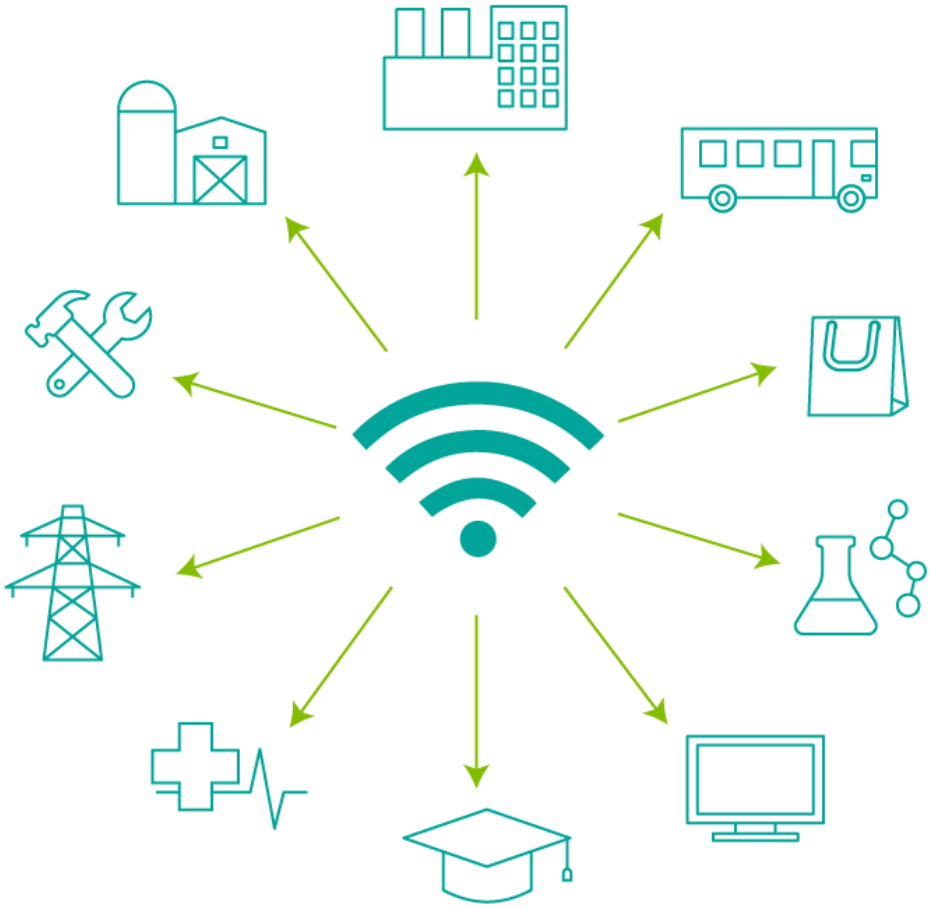
The Internet of Things (IoT) is a network of ‘smart’ devices that connect and communicate via the Internet.

How does the IoT work?

Smart devices collect and exchange information machine to machine (M2M) and with us.

- Remote control and monitoring
- Operate automatically through software, cameras
  and sensors





What sectors use the IoT?

1. Manufacturing
2. Transportation
3. Retail
4. Science and Technology
5. IT and Communications
6. Education
7. Healthcare
8. Energy
9. Construction
10. Agriculture

Retail

Automated checkout
Inventory and warehouse management

Manufacturing

Operations efficiencies
Asset management and maintenance

Consumers

Entertainment
Health and fitness

Offices and Government

Productivity and energy saving
Security and surveillance

Transportation

Automation and traffic control
Fleet management

Healthcare

Monitoring
Automated administration of treatment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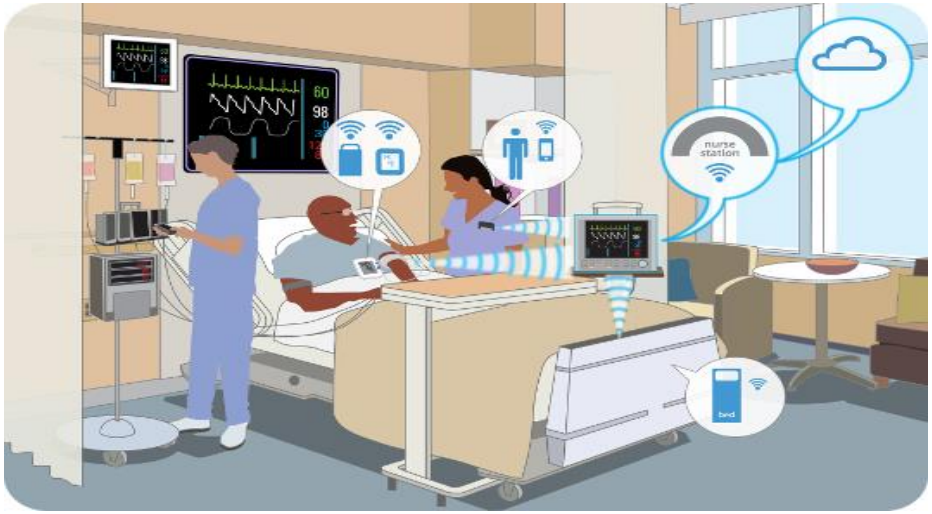
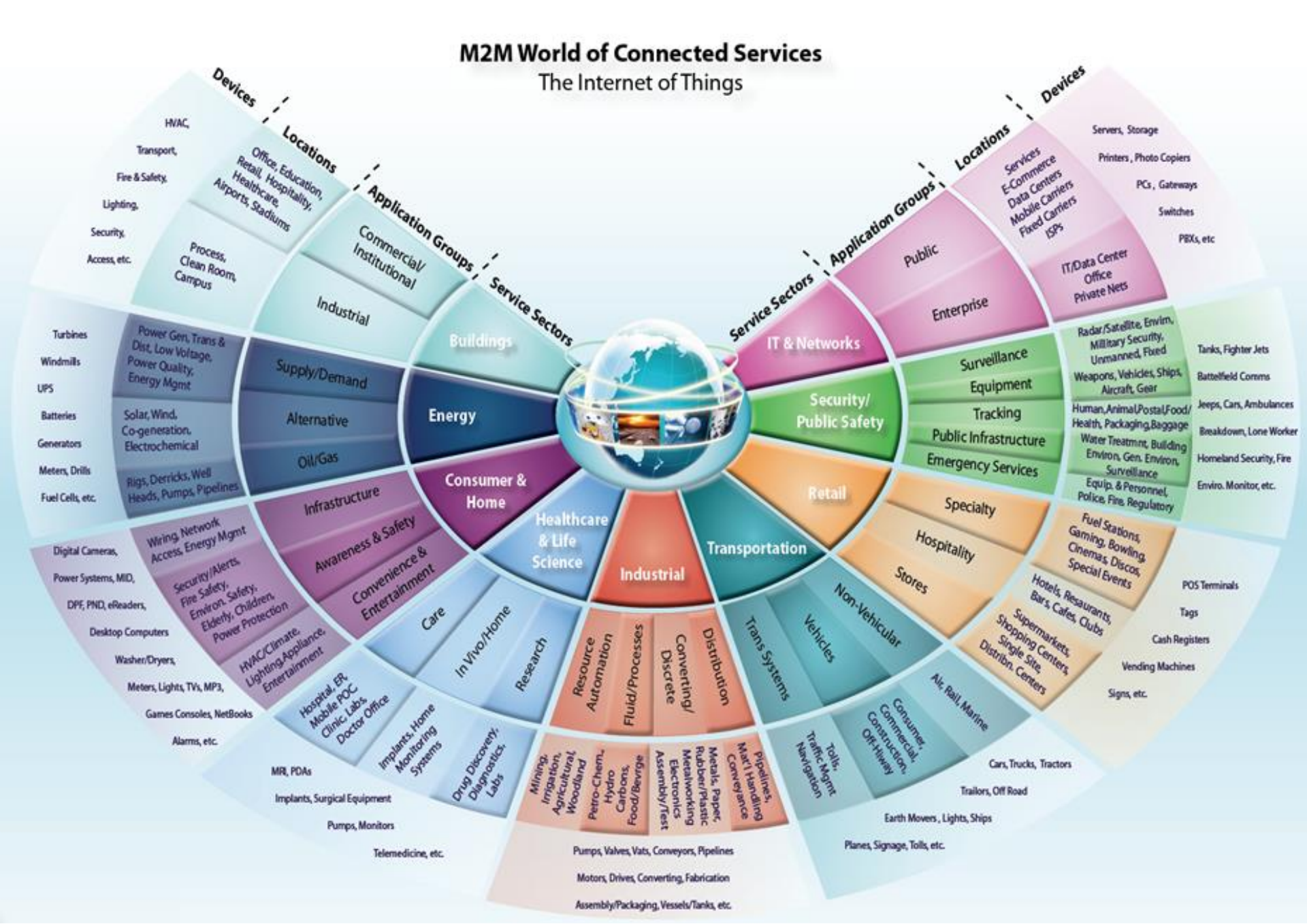

60
98
nurse station


M2M World of Connected Services
The Internet of Things
Devices
Locations
Application Groups
Service Sectors
HVAC,
Transport,
Fire & Safety,
Lighting,
Security,
Access, etc.
Office, Education, Retail, Hospitality, Healthcare, Airports, Stadiums
Process, Clean Room, Campus
Commercial/ Institutional
Industrial
Buildings
Energy
Supply/Demand
Alternative
Oil/Gas
Power Gen, Trans & Dist, Low Voltage, Power Quality, Energy Mgmt
Solar, Wind, Co-generation, Electrochemical
Rigs, Derricks, Well Heads, Pumps, Pipelines
Turbines
Windmills
UPS
Batteries
Generators
Meters, Drills
Fuel Cells, etc.
Consumer & Home
Infrastructure
Awareness & Safety
Convenience & Entertainment
Wiring, Network Access, Energy Mgmt
Security/Alerts, Fire Safety, Environ. Safety, Elderly, Children, Power Protection
HVAC/Climate, Lighting,Appliance, Entertainment
Digital Cameras,
Power Systems, MID,
DPF, PND, eReaders,
Desktop Computers
Washer/Dryers,
Meters, Lights, TVs, MP3,
Games Consoles, NetBooks
Alarms, etc.
Healthcare & Life Science
Care
In Vivo/Home
Research
Hospital, ER, Mobile POC, Clinic, Labs, Doctor Office
Implants, Home Monitoring Systems
Drug Discovery, Diagnostics, Labs
MR, PDAs
Implants, Surgical Equipment
Pumps, Monitors
Telemedicine, etc.
Industrial
Resource Automation
Fluid/Processes
Converting/ Discrete
Distribution
Mining, Irrigation, Agricultural, Woodland
Petro-Chem, Hydro Carbons, Food/Bevrge
Electronics Assembly/Test
Metals, Paper, Rubber/Plastic Metalworking
Pipelines, Mat'l Handling Conveyance
Pumps, Valves, Vats, Conveyors, Pipelines
Motors, Drives, Converting, Fabrication
Assembly/Packaging, Vessels/Tanks, etc.
Transportation
Trans Systems
Vehicles
Non-Vehicular
Tolls, Traffic Mgmt, Navigation
Consumer, Commercial, Construction, Off-Hiway
Air, Rail, Marine
Cars, Trucks, Tractors
Trailors, Off Road
Earth Movers , Lights, Ships
Planes, Signage, Tolls, etc.
Retail
Specialty
Hospitality
Stores
Fuel Stations, Gaming, Bowling, Cinemas, Discos, Special Events
Hotels, Resaurants, Bars, Cafes, Clubs
Supermarkets, Shopping Centers, Single Site, Distribn. Centers
POS Terminals
Tags
Cash Registers
Vending Machines
Signs, etc.
Security/ Public Safety
Surveillance
Equipment
Tracking
Public Infrastructure
Emergency Services
Radar/Satellite, Envirn, Military Security, Unmanned, Fixed
Weapons, Vehicles, Ships, Aircraft, Gear
Human, Animal/Postal/Food/ Health, Packaging,Baggage
Water Treatmnt, Building Environ, Gen. Environ, Surveillance
Equip. & Personnel, Police, Fire, Regulatory
Tanks, Fighter Jets
Battelfield Comms
Jeeps, Cars, Ambulances
Breakdown, Lone Worker
Homeland Security, Fire
Enviro. Monitor, etc.
IT & Networks
Public
Enterprise
Services
E-Commerce
Data Centers
Mobile Carriers
Fixed Carriers
ISPs
IT/Data Center
Office
Private Nets
Servers, Storage
Printers , Photo Copiers
PCs , Gateways
Switches
PBXs, etc

The Smart *Internet of Things* School

Personalized learning with adaptive eTextbooks

Digital classroom white boards and display

iBeacons

Complete coverage with high performance Wi-Fi

Wearables for athletics and attendance tracking

Video recorders for lecture capture

International Collaboration and social exchange

Online testing

Sensors on trash receptacles

Supplies and inventory tracking by sensor with auto-reorder

Student devices & eTextbooks

- Notebooks
- Tablets
- Smartphones

Robot cleaning

Augmented and virtual reality

Makerspaces with 3D printers and laser trimmers

Robotics for STEM and remote presence

Internet of Things-based HVAC

Monitor and display of air quality throughout school

File and program storage, local or cloud-based

- Demographics, academics, behavior, interests
- LMS, CMS, SIS
- Educational programs and applications
- Video files: lectures and recorded lab experiments

Surveillance security cameras

Wi-Fi sensors and locks

- Entrances and exits
- Classroom doors

Sensors track buses and verify student passengers

Network application analytics to monitor devices and network behavior

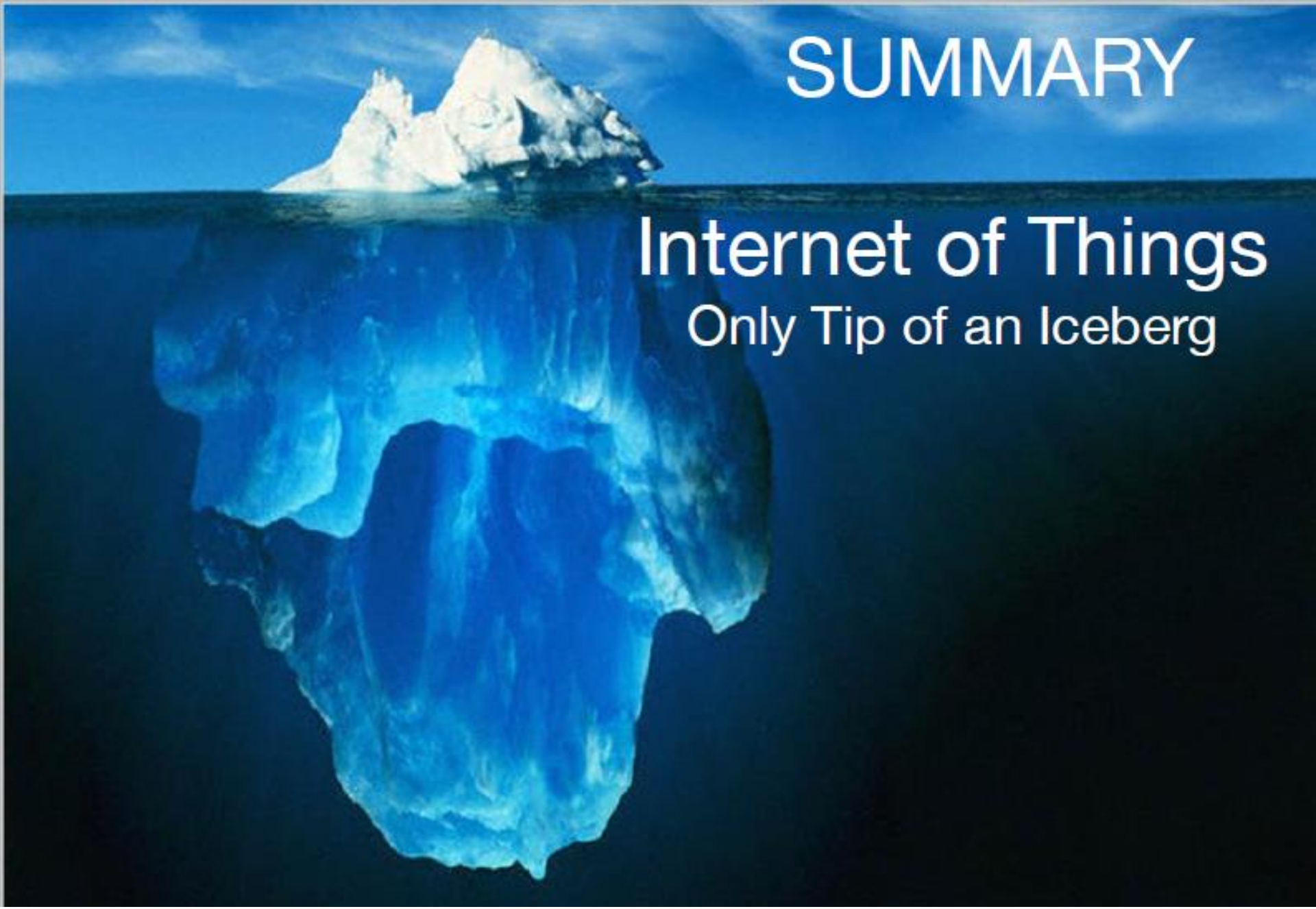
Sensors in parking lot and driveways

The IoT Market

As of 2013, 9.1 billion IoT units

Expected to grow to 28.1 billion IoT devices by 2020

Revenue growth from $1.9 trillion in 2013 to $7.1 trillion in 2020


SUMMARY
Internet of Things
Only Tip of an Iceberg