# Examples


MONITA OR SUSAN
7813880078
CUSP DENTAL
381 PEARL ST.
MALDEN MA 02148
1 LBS
1 OF 1
SHIP TO:
MONITA OR SUSAN
7813880078
CUSP DENTAL
381 PEARL ST.
MALDEN MA 02148-6606
MA 021 2-01
UPS NEXT DAY AIR SAVER
1P
TRACKING #: 1Z E14 A50 13 9739 9947
BILLING: P/P
UIS 13.1.13. WXPIE70 15.0A 04/2011
TM

# Examples

**Delivered**

**Delivered On:**
Tuesday, 04/01/2014 at 1:48 P.M.

**Left At:**
Front Door

Proof of Delivery

Request Status Updates »

Report a Claim »

**Additional Information**

| | |
|---|---|
| **Shipped/Billed On:** | 03/30/2014 |
| **Type:** | Package |
| **Weight:** | 1.70 lbs |

**Shipment Progress** What's This?

| Location | Date | Local Time | Activity |
|---|---|---|---|
| Urbana, IL, United States | 04/01/2014 | 1:48 P.M. | Delivered |
| | 04/01/2014 | 4:27 A.M. | Destination Scan |
| | 04/01/2014 | 3:43 A.M. | Arrival Scan |
| Hodgkins, IL, United States | 04/01/2014 | 12:48 A.M. | Departure Scan |
| Hodgkins, IL, United States | 03/31/2014 | 10:52 A.M. | Origin Scan |
| United States | 03/30/2014 | 2:17 P.M. | Order Processed: Ready for UPS |

# Examples

# Examples

A new kind of buoy in the Indiana waters of Lake Michigan

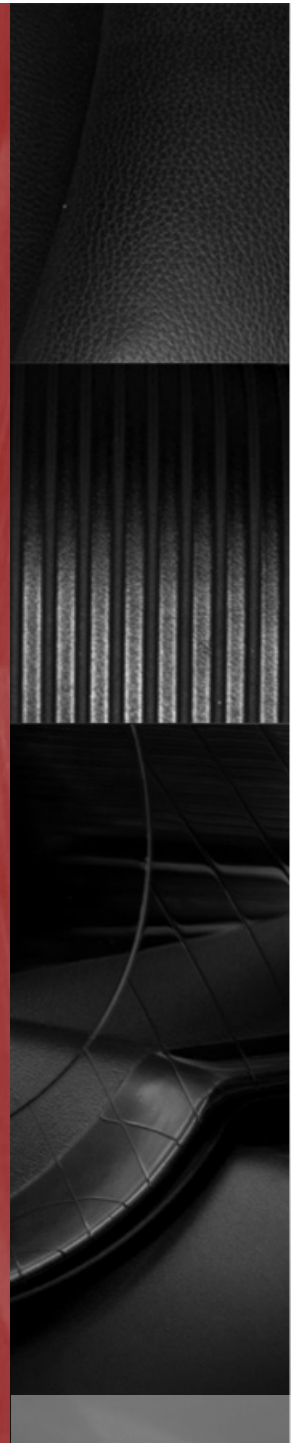
- A new buoy 4 miles off the coast of Michigan City in Lake Michigan. It will provide real-time information on lake conditions for boaters, advance the understanding of near-shore waters, alert the public to hazardous conditions, protect water quality and improve weather forecasts.

# Examples


A mounted wireless sensor node of ***GreenOrbs*** used to collect data in Wuxi City, China.
Image used courtesy of Xiang-Yang Li

- GreenOrbs carries out real-time ecological surveillance in the forest, collecting various sensory data including temperature, humidity, illumination and carbon dioxide titer. All these information can be utilized to support various significant applications, such as forest surveillance, fire risk evaluation and succor in the wild.

# Internet of Things

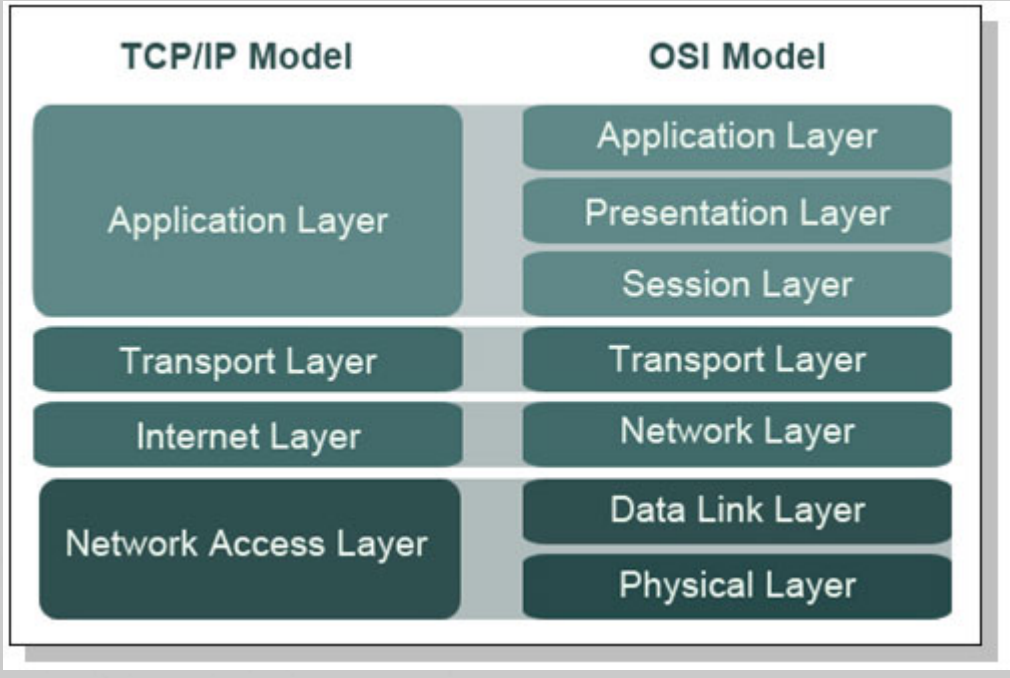


# What is ‘Internet of Things’?

- “Internet of Things” is a concept in which the virtual world of information technology integrates seamlessly with the real world of things.
- The phrase “Internet of Things” is first presented by Prof. Kevin Ashton in a presentation at Procter & Gamble in 1999. He was interested in using RFID to help P&G’s supply chain. This work led him to MIT, where he helped start an RFID research consortium called Auto-ID with the goal of creating a global open standard system to put RFID everywhere.

# How it works?

- Sensing
- Communication
- Management
- Application

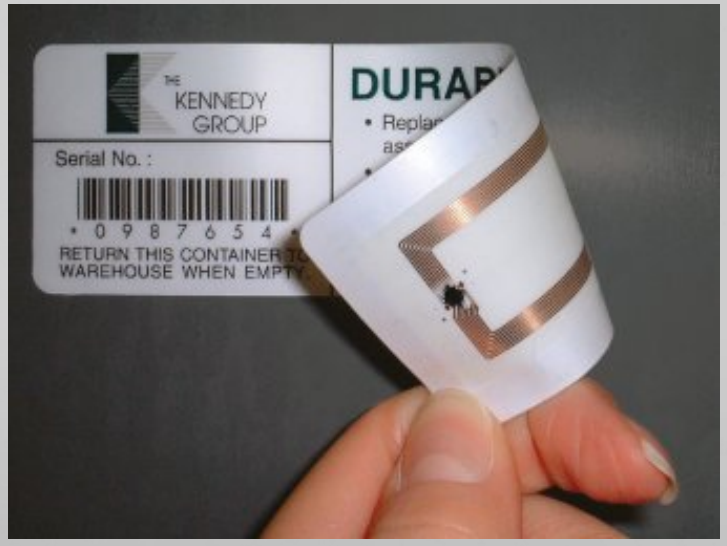


# Sensing

- The sensing layer collects and gathers physical parameters such as the temperature, humidity, and air composition. It comprises: 1) field devices that have sensing, computing, and communication capabilities, like RFID labels and readers, cameras, the GPS, sensors and actuators; 2) field networks that are formed by interconnecting these devices.
- With the maturity of wireless sensor network technologies such as ZigBee in recent years, communication modules become more energy-efficient and cost-effective. Networks using these technologies do not need cables and support multi-hop routing, self-organization, and self-recovery. Moreover, their ease of deployment and maintenance is very suitable for connecting large number of field devices at the sensing layer.


GPS Blazer12
MAGELLAN
ENTER
NAV
GOTO
MARK
MENU
PWR


nest


THE KENNEDY GROUP
Serial No. :
RETURN THIS CONTAINER
WAREHOUSE WHEN EMPTY

# Communication

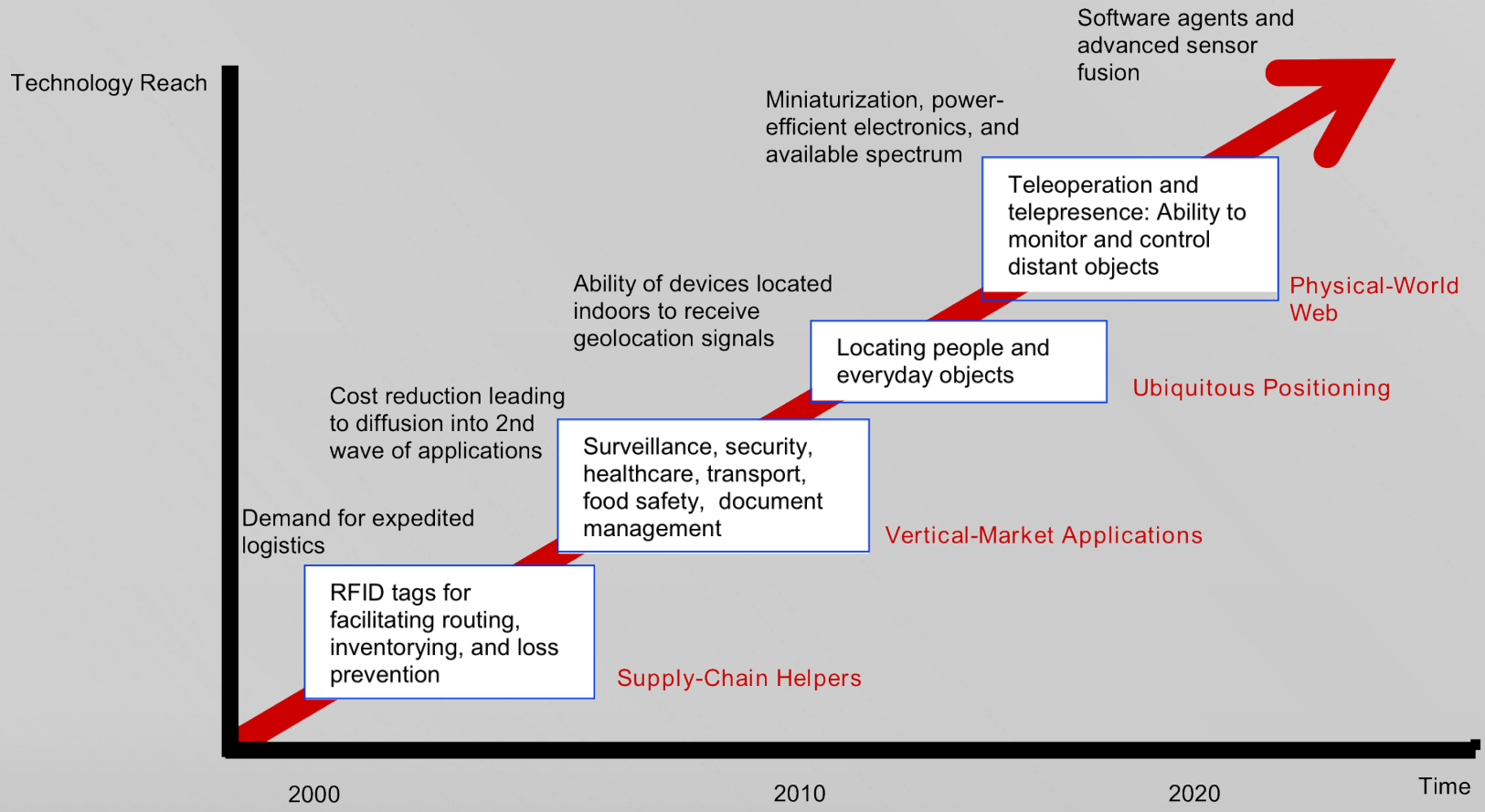
- The communication layer is the information trunk for the Internet of Things. It consists of various IP WANs provided by operators, including wired networks (such as the ATM, xDSL, and fibers) and mobile networks (such as GPRS, 3G, and 3G+). Whilst wired networks use various underlying protocols at the communication layer, all upper-layer protocols are under the TCP/IP stack.
- Compared with wired network technologies, mobile technologies allow M2M applications to be deployed more flexibly. The advent of wireless broadband has accelerated M2M service development and promoted 3G networks as the preferred medium for M2M applications.

# Management

- The management layer is a solution set for a wide range of intelligent applications. As a management platform, this layer is integral to the Internet of Things architecture and industry chain, integrating management, control, and operations on terminals and assets, including mobile assets.
- The management platform comprises the following software sets: integrated frameworks, Internet of Things middleware, industry suites, and industry application solutions. The middleware abstracts and implements the basic function sets of the management platform, such as network and device management, authentication, authorization, and accounts (AAA) management, data management, and service management.

# Application

## TECHNOLOGY ROADMAP: THE INTERNET OF THINGS



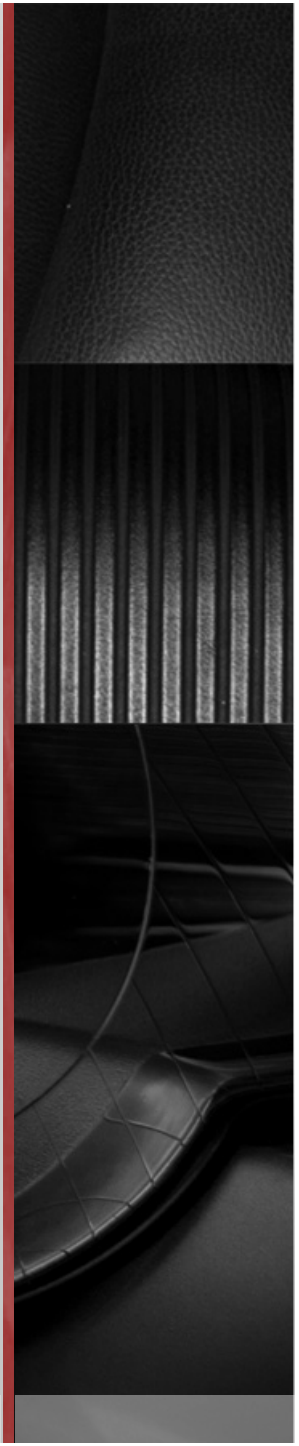

Source: SRI Consulting Business Intelligence

# Sensors

- A **sensor** is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument. For example, a mercury-in-glass thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. A thermocouple converts temperature to an output voltage which can be read by a voltmeter.

# RFID

- **R**adio **F**requency **ID**entification

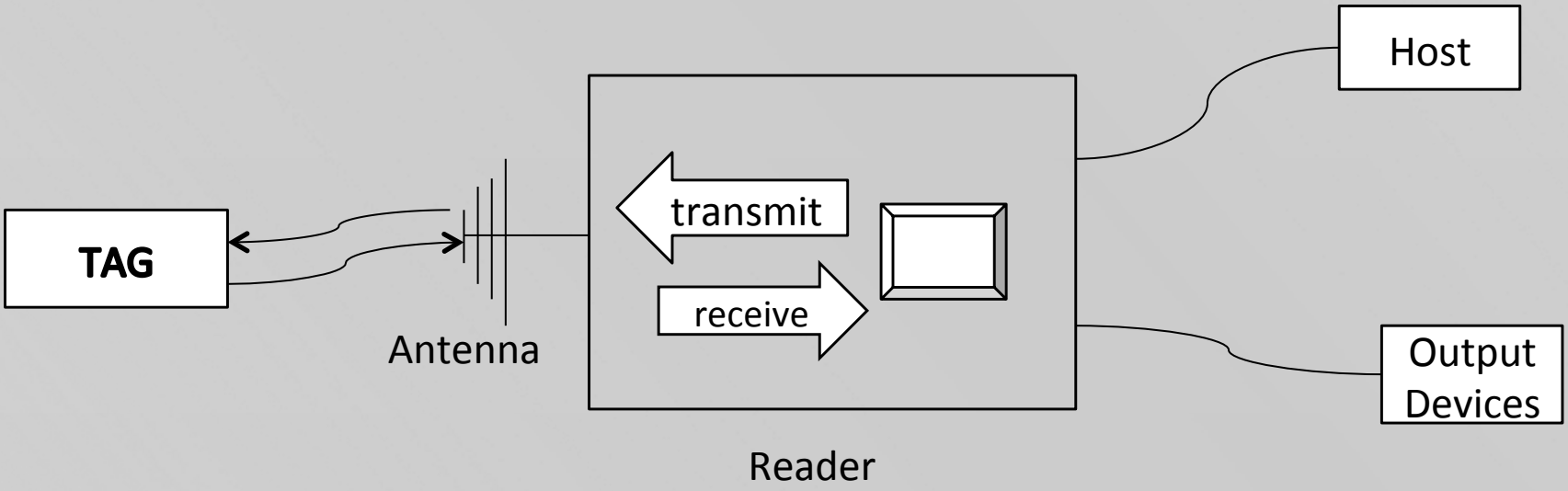


# Concept

- **Radio-frequency identification** (**RFID**) is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by and read at short ranges (a few meters) via magnetic fields (electromagnetic induction). Others use a local power source such as a battery, or else have no battery but collect energy from the interrogating EM field, and then act as a passive transponder to emit microwaves or UHF radio waves (i.e., electromagnetic radiation at high frequencies). Battery powered tags may operate at hundreds of meters. Unlike a bar code, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object.

# Structure

- Transponder (TAG)
- Reader(interrogator)
- Antenna


Host
TAG
transmit
receive
Antenna
Output
Devices
Reader

# Tags

A radio-frequency identification system uses *tags*, or *labels* attached to the objects to be identified. Two-way radio transmitter-receivers called *interrogators* or *readers* send a signal to the tag and read its response.

RFID tags can be either passive, active or battery-assisted passive. An active tag has an on-board battery and periodically transmits its ID signal. A battery-assisted passive (BAP) has a small battery on board and is activated when in the presence of an RFID reader. A passive tag is cheaper and smaller because it has no battery. However, to start operation of passive tags, they must be illuminated with a power level roughly three magnitudes stronger than for signal transmission. That makes a difference in interference and in exposure to radiation.

Tags may either be read-only, having a factory-assigned serial number that is used as a key into a database, or may be read/write, where object-specific data can be written into the tag by the system user. Field programmable tags may be write-once, read-multiple; "blank" tags may be written with an electronic product code by the user. A tag with no inherent identity is always threatened to get manipulated.

# Tags

RFID tags contain at least two parts: an integrated circuit for storing and processing information, modulating and demodulating a ratio-frequency (RF) signal, collecting DC power from the incident reader signal, and other specialized functions; and an antenna for receiving and transmitting the signal. The tag information is stored in a non-volatile memory. The RFID tag includes either a chip-wired logic or a programmed or programmable data processor for processing the transmission and sensor data, respectively.

An RFID reader transmits an encoded radio signal to interrogate the tag. The RFID tag receives the message and then responds with its identification and other information. This may be only a unique tag serial number, or may be product-related information such as a stock number, lot or batch number, production date, or other specific information.


## Some examples for RFID tags

# Readers

RFID systems can be classified by the type of tag and reader. A **Passive Reader Active Tag** (**PRAT**) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only). The reception range of a PRAT system reader can be adjusted from 1–2,000 feet (0.30–609.60 m), allowing flexibility in applications such as asset protection and supervision.

An **Active Reader Passive Tag** (**ARPT**) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags.

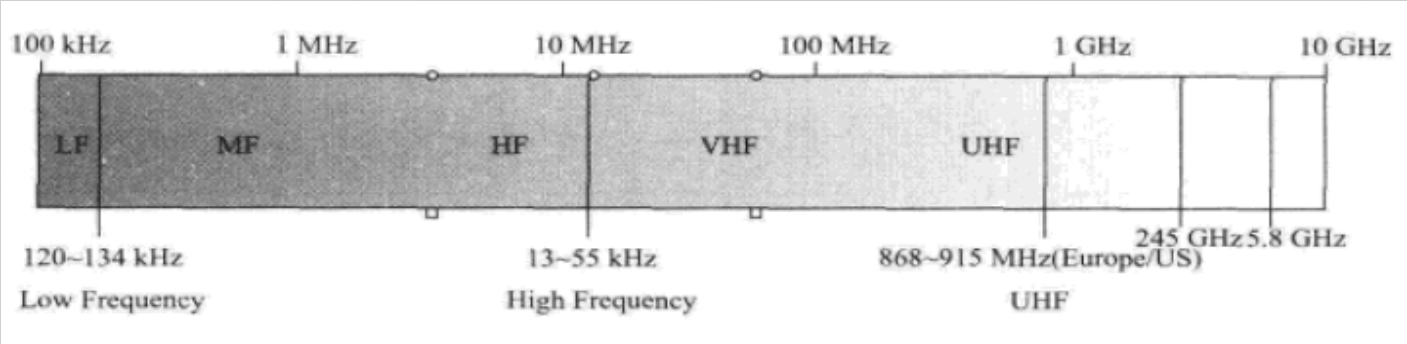
An **Active Reader Active Tag** (**ARAT**) system uses active tags awoken with an interrogator signal from the active reader. A variation of this system could also use a Battery-Assisted Passive (BAP) tag which acts like a passive tag but has a small battery to power the tag's return reporting signal.

Fixed readers are set up to create a specific interrogation zone which can be tightly controlled. This allows a highly defined reading area for when tags go in and out of the interrogation zone. Mobile readers may be hand-held or mounted on carts or vehicles.

# Some examples for readers


# Frequencies

- RFID frequency bands




| Band | Regulations | Range | Data speed | Remarks |
|---|---|---|---|---|
| 120–150 kHz (LF) | Unregulated | 10 cm | Low | Animal identification, factory data collection |
| 13.56 MHz (HF) | ISM band worldwide | 10 cm - 1 m | Low to moderate | Smart cards (MIFARE, ISO/IEC 14443) |
| 433 MHz (UHF) | Short Range Devices | 1–100 m | Moderate | Defence applications, with active tags |
| 865-868 MHz (Europe)<br>902-928 MHz (North America) UHF | ISM band | 1–12 m | Moderate to high | EAN, various standards |
| 2450-5800 MHz (microwave) | ISM band | 1–2 m | High | 802.11 WLAN, Bluetooth standards |
| 3.1–10 GHz (microwave) | Ultra wide band | to 200 m | High | requires semi-active or active tags |

# The unique features of RFID

1.Possibility of having a unique ID (unique in the world)

No duplication, no copy

2. On the fly reading

No line of sight

3. High speed data capture

Time to read the ID: about 10 ms

4. Simultaneous multi-tag reading

Ability to read about 10 to 50 tags per second

5. Writing capability

Ability to store information into the tag memory, with read/write password protection modes

6. Durability of the ID

The lifetime of the tag depends only on the packaging quality

The packaging be very light: disposable tag, or highly rugged

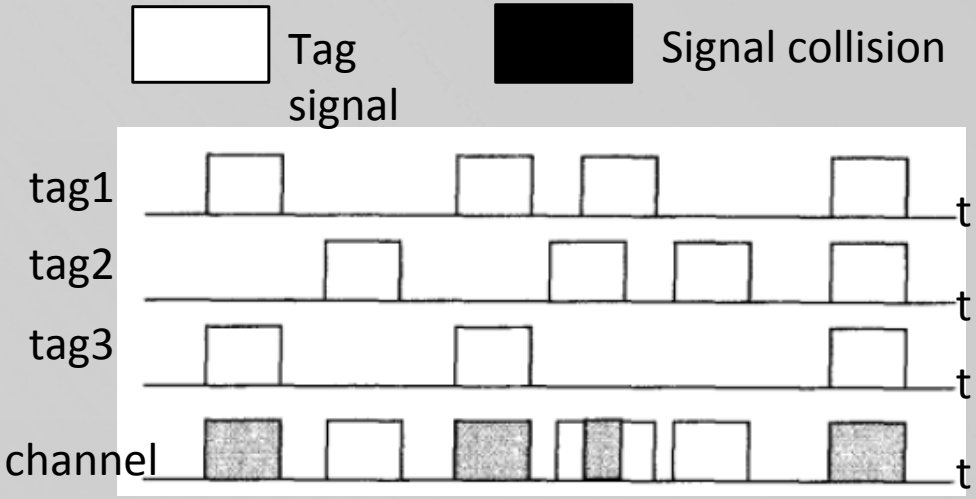
# Uses

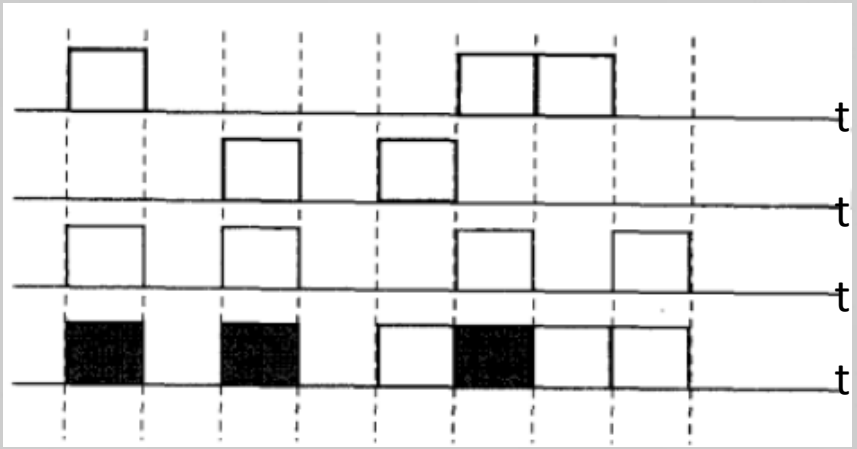
- RFID can be used in a variety of applications, such as:
- Access management
- Tracking of goods
- Tracking of persons and animals
- Toll collection and contactless payment
- Machine readable travel documents
- Smartdust(for massively distributed sensor networks)
- Tracking sports memorabilia to verify authenticity
- Airport baggage tracking logistics

# RFID tags collision

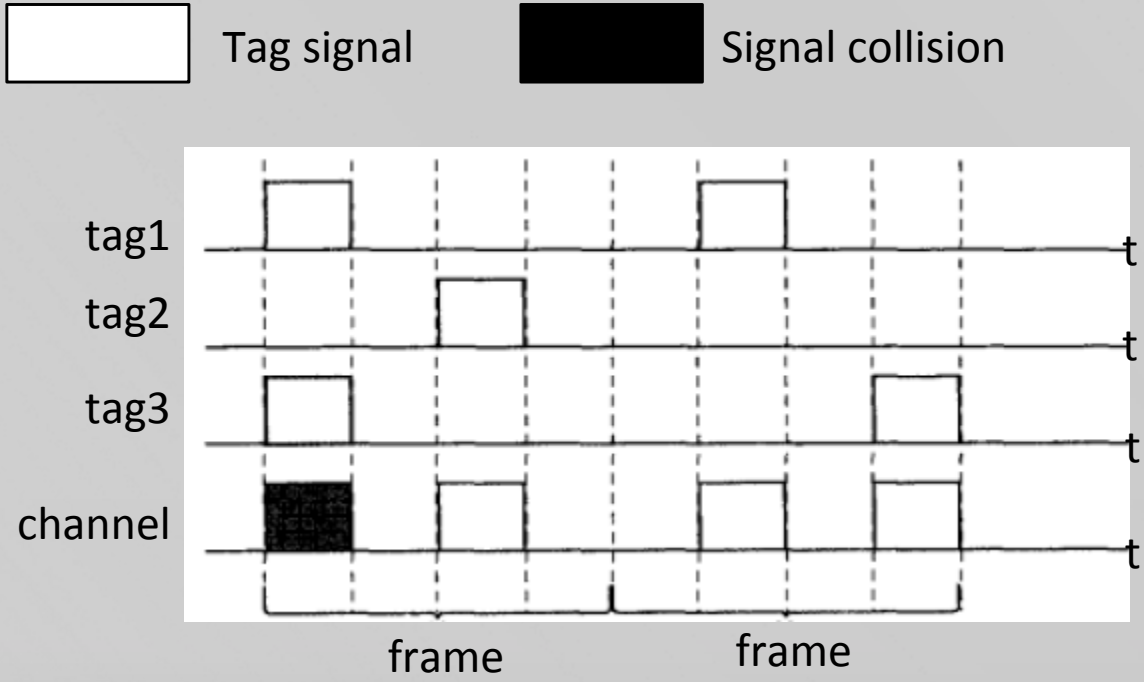
- RFID anti-collision algorithm:
  - TDMA anti-collision algorithm
    - ALOHA-based anti-collision algorithm
    - Stack-based ID-binary tree anti-collision algorithm

# ALOHA algorithm & S-ALOHA algorithm



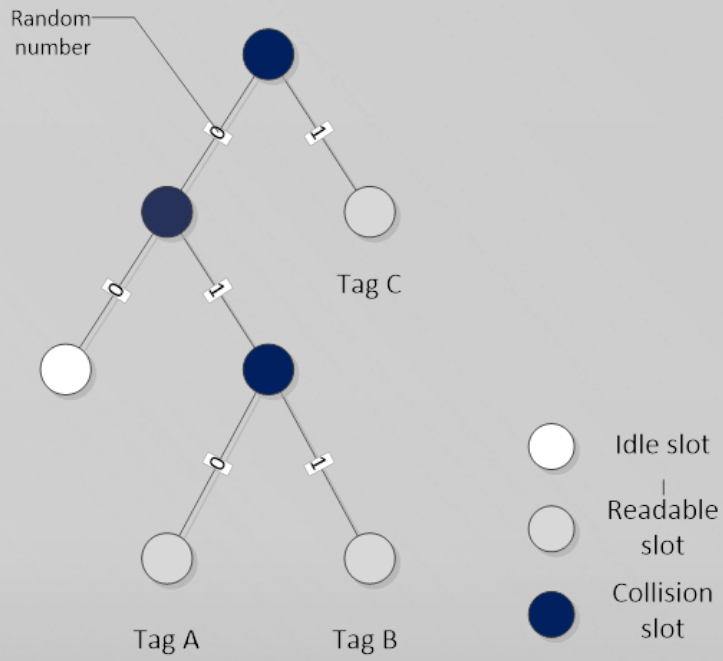



# FSA algorithm

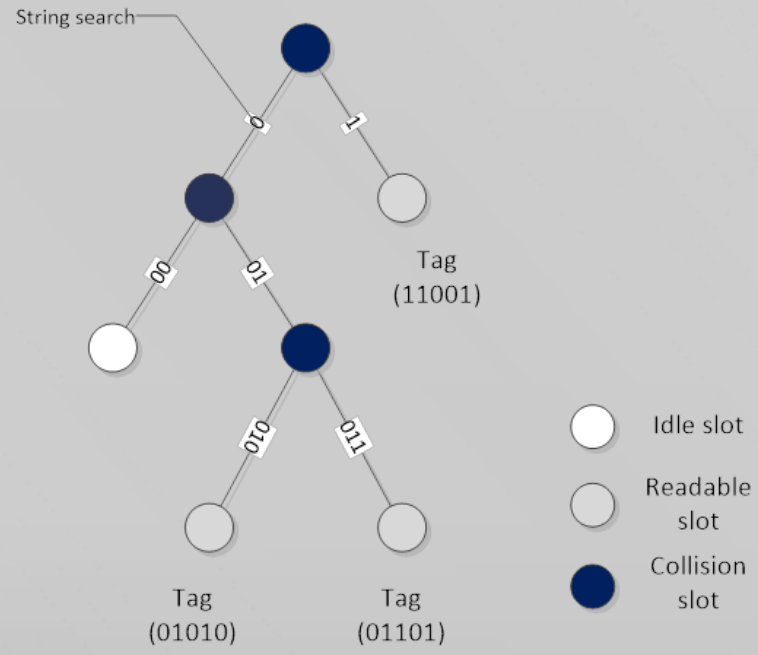


# Stack-based ID-binary tree anti-collision algorithm

## Random Binary Tree Algorithm




## Query Binary Tree Algorithm



# Applications of IoT

- Past

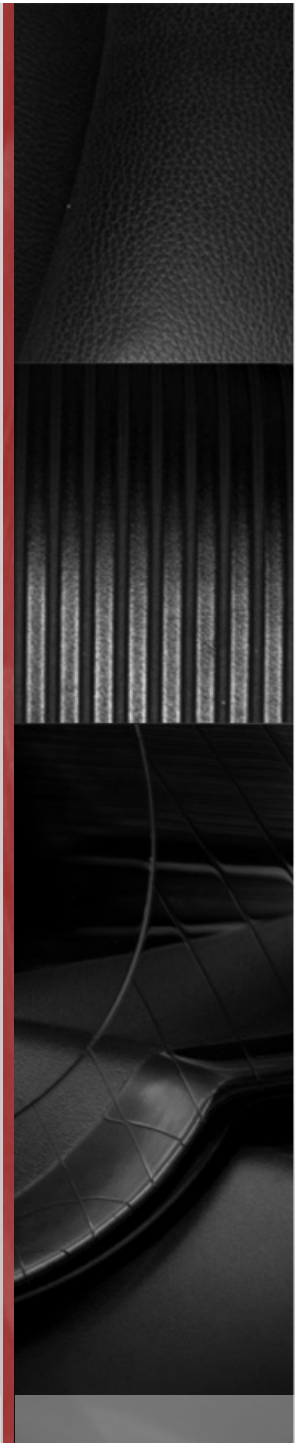
  IoT in use everyday

- Now

  IoT techniques in progress

- Future

  Future IoT concepts



# IoT in use everyday

- Few examples


Fire security system

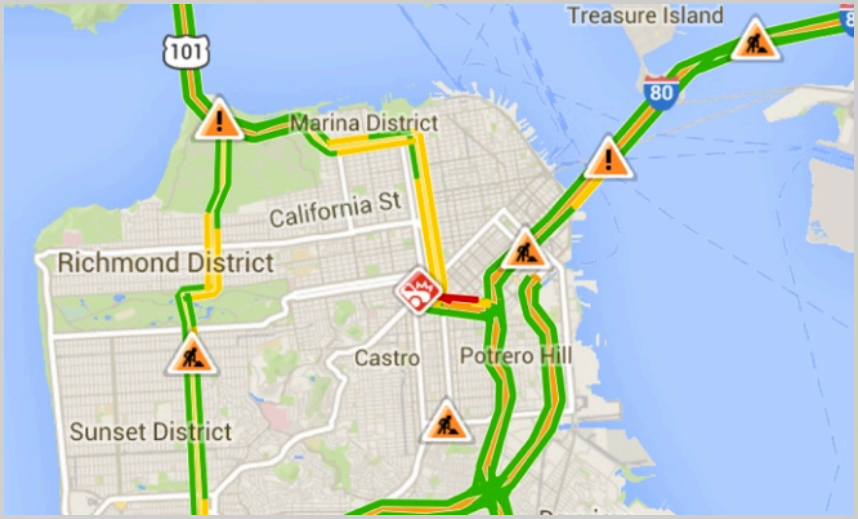
Card access system


- Google traffic

  A practical traffic solution for everyday life

# Google Traffic

- User Interface




Normal Google map interface

when driving

- Information

Aside from the roads information, we could get two kinds of information at real time:

1. Live traffic condition

red: very heavy

yellow: a bit heavy

green: ok

2. Real-time incident report

car accidents, constructions, road closure (3rd party traffic data providers like Waze)

# Live traffic condition

- How could it be possible

  Sensors? No!

  No sensors on roads

  No camera data collected

- Truth

  IoT system of GPS information collection

  (From Google official blog )

# IoT architecture of live traffic condition

Realization

Network

Data management

Applications

GPS data from cellphones running Google maps app

Wireless internet connection (2g 3g 4g)

Google data center(collect and analyze)

Post on Google map service

# Why GPS?

- How GPS works

  We need:

  The location of at least three satellites above you(signals sent from satellites)

  The distance between you and each of those satellites(travelling time of signals)

  Then:

  Use the distance data to calculate current location

  Use location change and time to calculate speed

- Features

1. Reliable(Just depend on satellites and GPS device)
2. Fast and accurate(Calculate depending on light speed. Satellite position is accurate)
3. No internet data needed(calculations are done only on device)
4. Free and easy to get for Google

# Data collection and analytics

- Use Google maps App to upload

Once a phone is using Google maps with location service on, GPS data will be uploaded automatically through any possible internet connections(2g 3g 4g)

- Analytics

1. Data threshold: determine whether the data is sufficient
2. Level judgment: determine which level the traffic is

(Cannot get exact data and specified algorithm)

# Challenging of this system

- Scale

  You can't get useful traffic results until you have a LOT of devices reporting their speeds.

  Solve: Google maps is easy to install and use. It is free and support most portable devices. As a result, it attract a large number of users.

- Privacy

  The privacy of each user should be protected which means no particular phone movement could be tracked.

  Solve: Constantly delete the start and end point of any movement, combine data all together once collected (Well, these are all posted by Google, if they don’ t delete we have no way to know…)

# Applications of IoT

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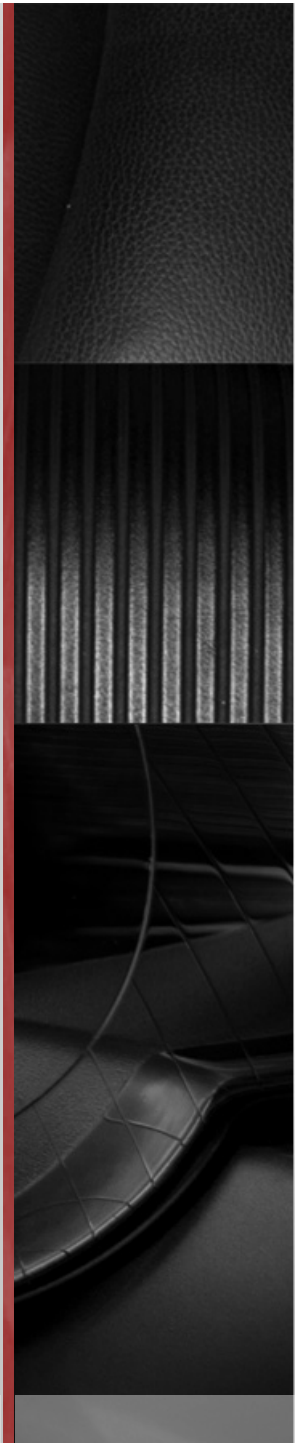
  IoT techniques in progress

- Future

  Future IoT concepts



# IoT techniques in progress

- Some pioneer products on IoT

  What we think may happen in the future has already been reality:

mimo:
Real-time
monitor of baby


BiKN:
Wireless tag
product

Ninja blocks:
A home IoT platform

- Problems: High cost, not practical

# Ninja blocks

Remote control socket set

Temperature and humidity


Door contact sensor

Motion sensor


Ninja Cloud

# Ninja blocks

- Functions

  Connect with sensors and controllers through local network in a house(camera, temperature, door sensor, electric switches)

  Connect with user' s mobile phone through internet on the web platform of Ninja blocks(monitor the sensors and remote control the house)

  Program it locally to achieve basic functions(ex. turn on light when open the door)

  Complex task on web application(security alert, schedule electric outlet)

- Features

  Very flexible and wide range of use

  Too complex for people without enough knowledge (lot coding job)

  Not practical for its high price (Interesting but not for everyday use)

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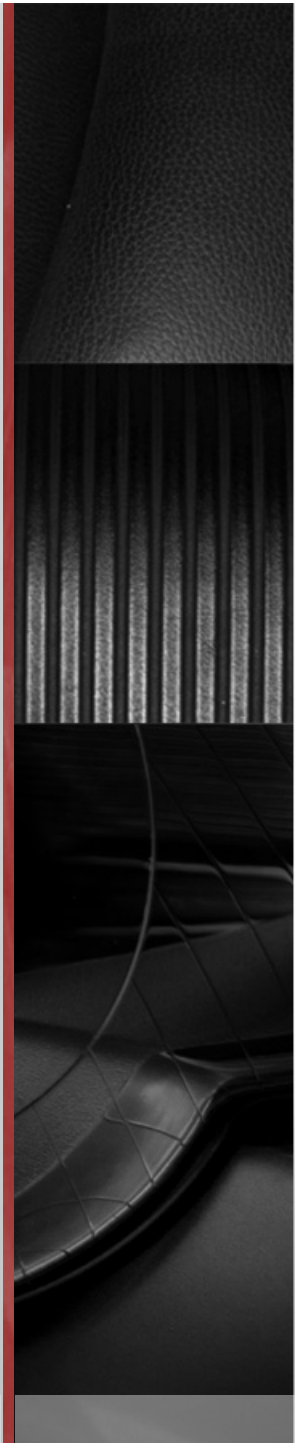
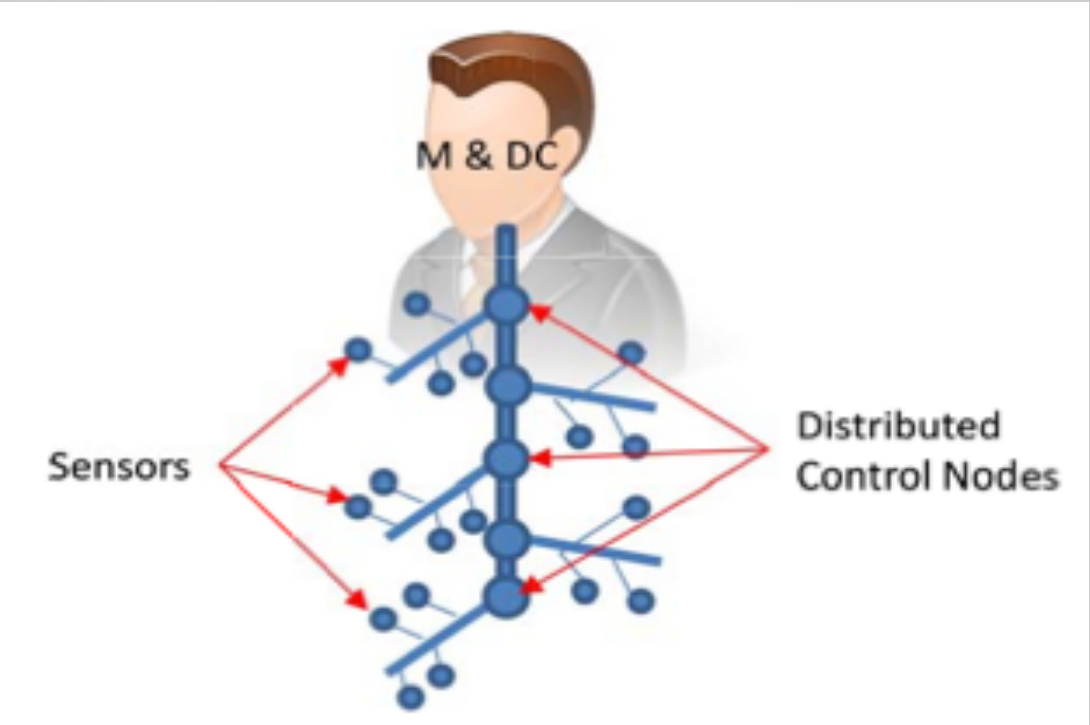


# Future IoT concepts

- Smart City
  - Structural health of buildings
  - Waste Management
  - Air quality
  - Smart parking
  - Smart lighting

- Future IoT Architecture
  - Like Mankind Neural System
  - Social Organization Framework

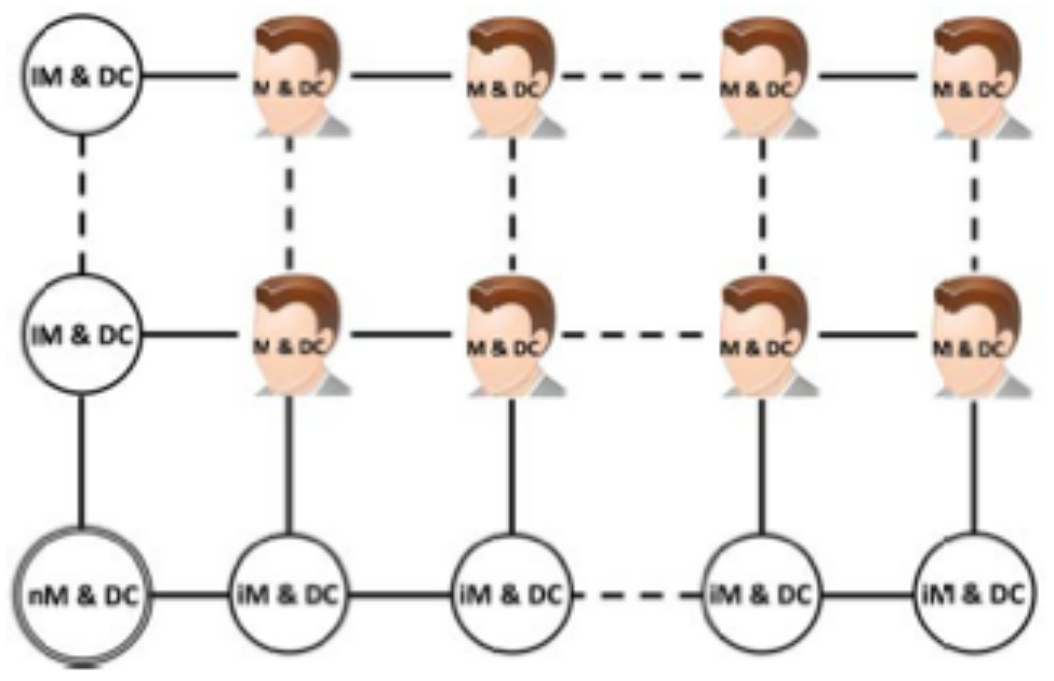
# Future IoT Architecture




Like Mankind Neural System

1) Brain - it responds for objects management and centralized data center, which is called M&DC(Management and data center)
2) Spinal cord - there are distributed control nodes for controlling lowest level sensors
3) A network of nerves - deploy IoT network and end-side sensors

# Future IoT Architecture




Social Organization Framework

1) nM&DC: national management and data center
2) iM&DC: industry management and data center
3) All “brains” are connected together as a social network to share sensors, data and reports

# Barriers ahead

- Technical

More reliable and faster wireless network for sensor connections.

All components of IoT must be lighter and smaller.

Faster calculation speed for more advanced applications.

- Financial

Make services cheaper or even free to make them more practical.

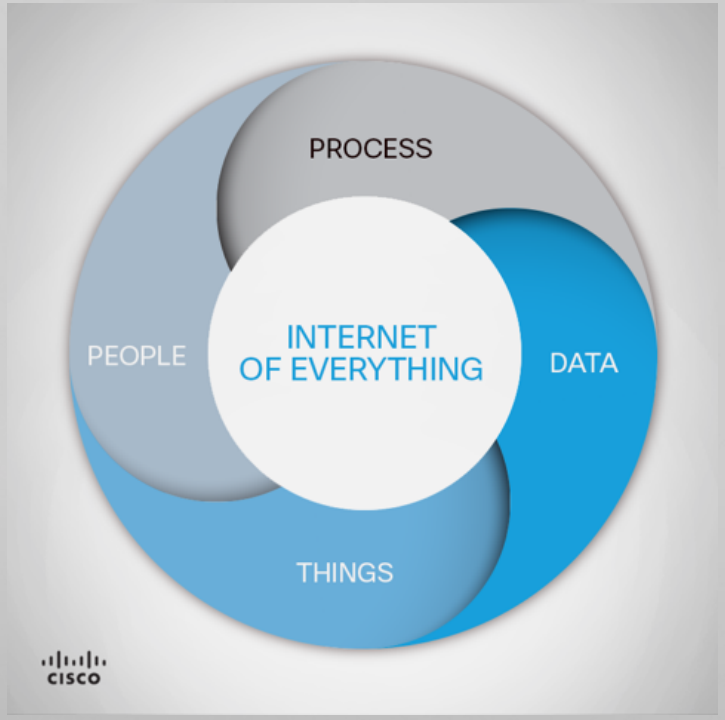
- Political

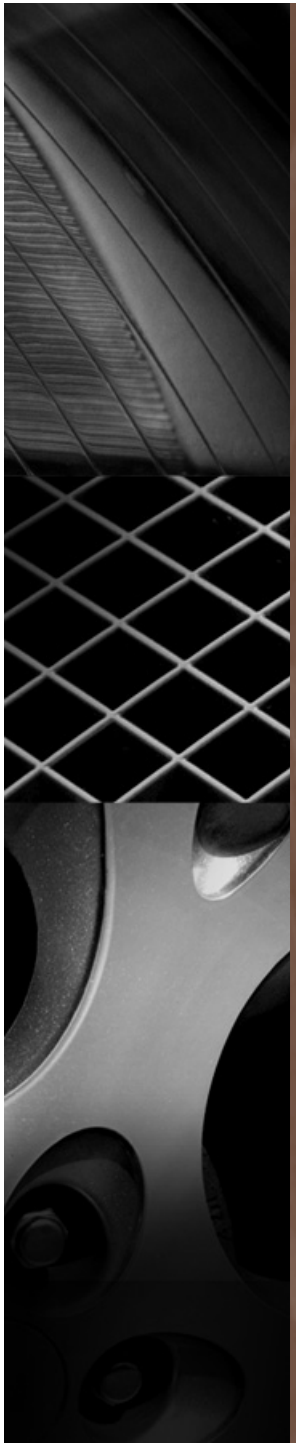
Sensors should be placed everywhere legally

# Next?

- Internet of Everything(IoE).

Connect people, things, data, process and everything you can imagine together.



Speechmaker:

Jiajun Shen

Ruoyan Li

Qiao Gao

# Thank you