



# Internet of Things

## Senior Design Project Course

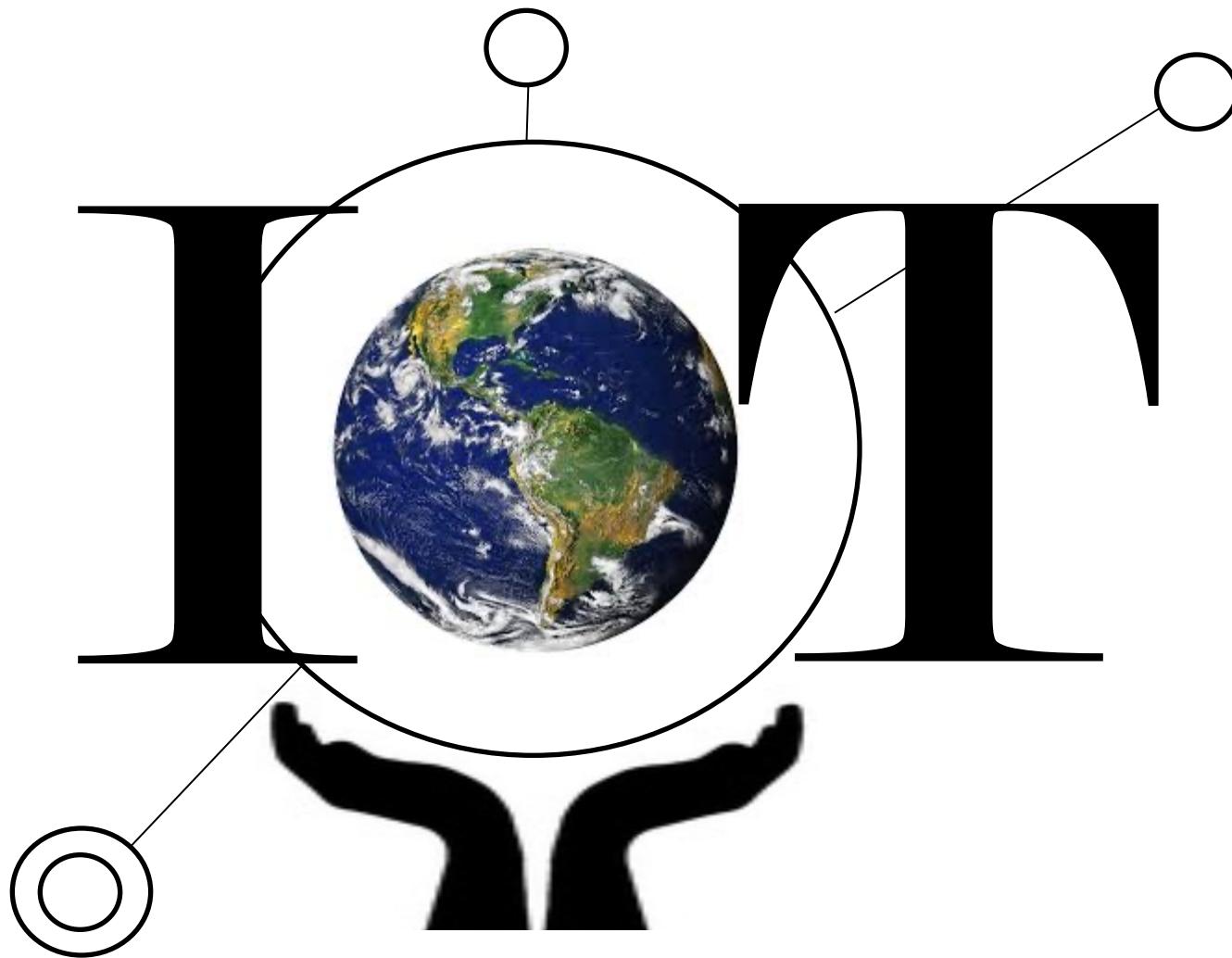
### ***Introduction - Part 2***

**Lecturer: Avesta Sasan**

University of California Davis  
Fall 2023

# Let's Get Started:

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# Required Reading:

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- F. Samie, L. Bauer and J. Henkel, "**IoT technologies for embedded computing: A survey**," *2016 International Conference on Hardware/Software Codesign and System Synthesis (CODES+ISSS)*, Pittsburgh, PA, 2016, pp. 1-10.
  - <http://ieeexplore.ieee.org/document/7750968/>

# Let's Get Started!

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The IoT was probably coined by **Kevin Ashton**, co-founder of Auto-ID Center at the Massachusetts Institute of Technology (MIT), as the title of a presentation in 1999

Internet Of Things

- Name Coined by Kevin Ashton 1999
  - Originally for RFID
  - Lipstick inventory problem
- Apps moving from the smartphone to a world of connected devices
- **Internet of Things aka IoT**



If RFID is an IoT..... Then???

# Related Terms and Technologies:

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Web of Things (WoT)

ambient intelligence (Aml)

ubiquitous computing

Big Data

Internet of Everything (IoE)

pervasive computing

Internet of Me (IoM)

Internet of Things(IoT)

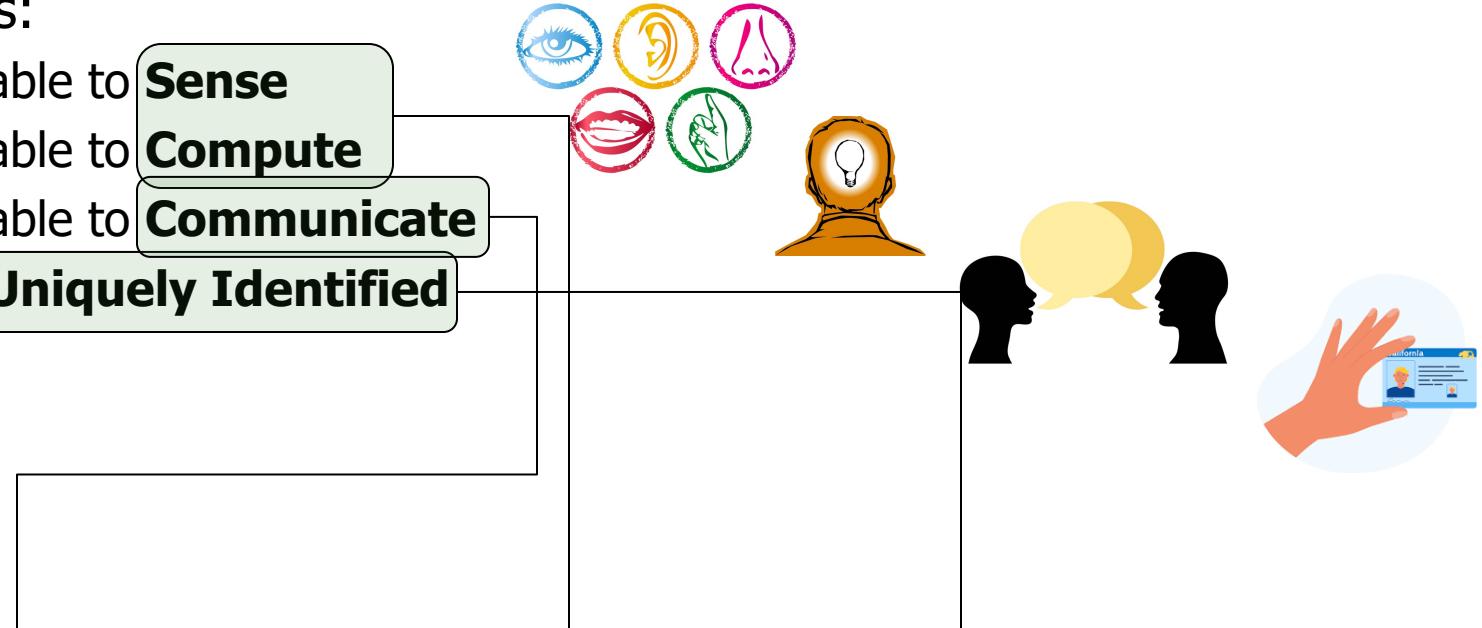
Smarter Planet

Cyber Physical Systems (CPS)

Industrial Internet of Things (IIoT)

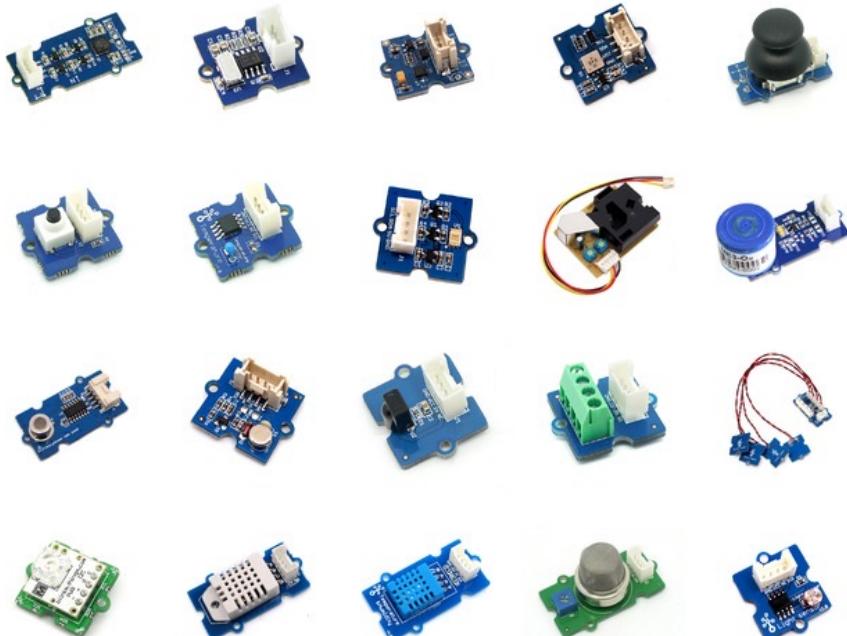
# What is IoT

- An IoT smart object is characterized by having the following 4 properties:
  - To be able to **Sense**
  - To be able to **Compute**
  - To be able to **Communicate**
  - To be **Uniquely Identified**
- IoT is a system of **Smart Objects** with **unique identifiers** and the **ability to transfer** data over a network without requiring human-to-human or human-to-computer interaction.



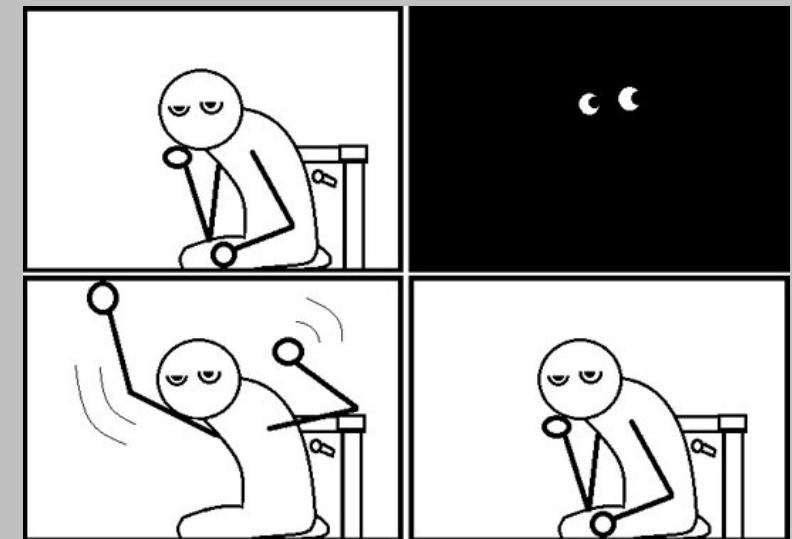
# Sensors

- **Measure values** in digital or analogue form
- With little or no processing they **send the raw data**
- Best if they consume little **power**



## Quiz:

Is a motion sensor an IOT Object?  
What is missing?

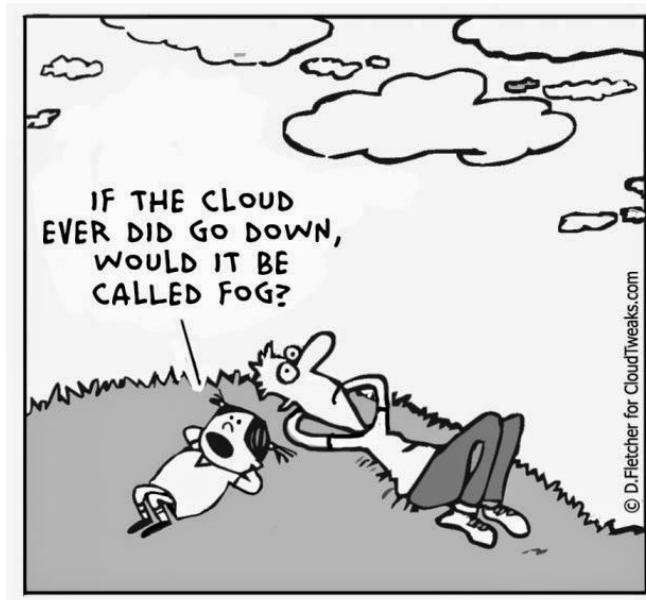


Motion Sensor controlling the light!

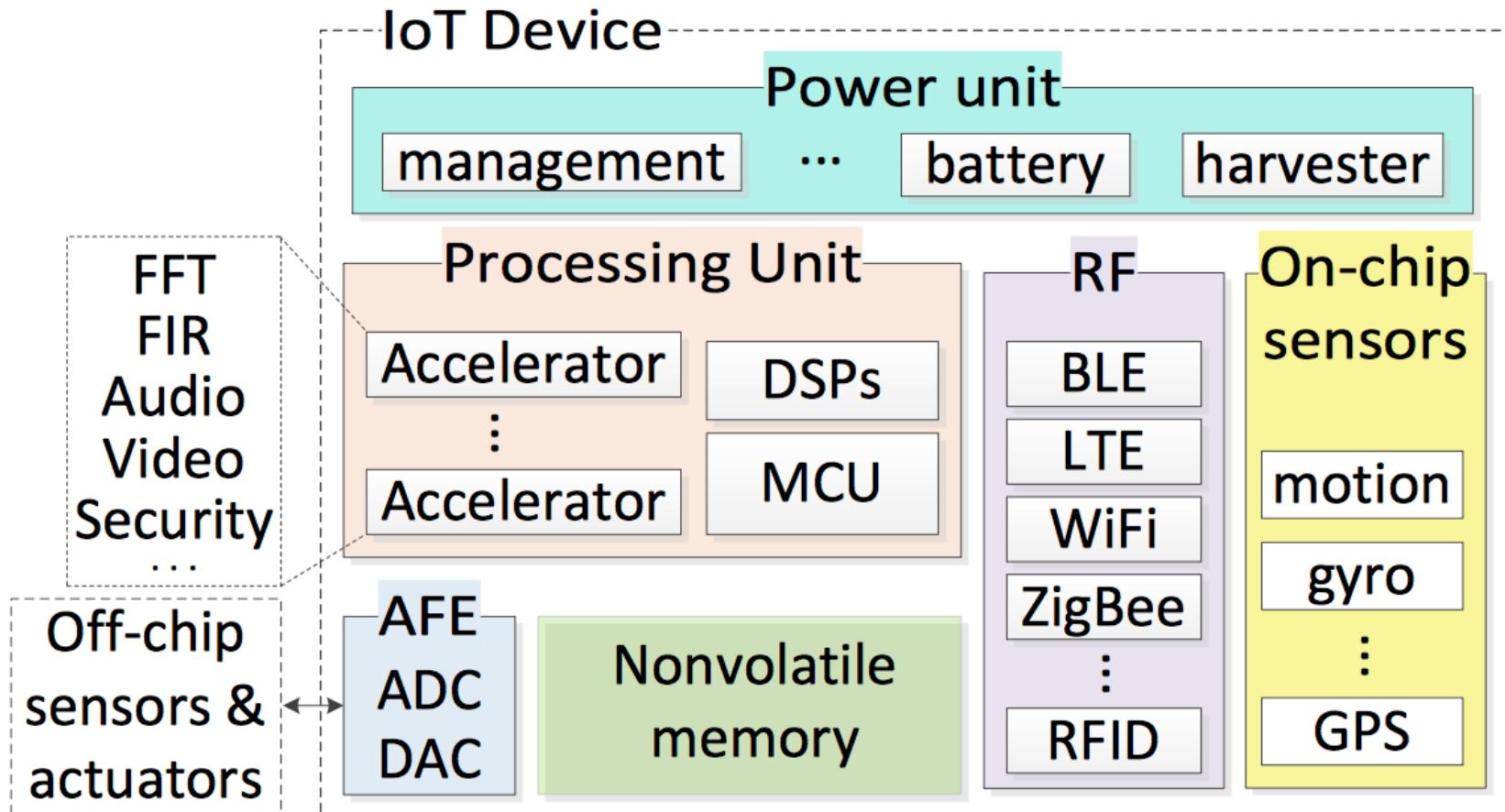
# Local Processing and Local Storage

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- Receive data from sensors
- Process the data (Edge/Fog Computing)
  - Make some decision locally
  - Store some of data locally
- Communicate raw or processed data to the Cloud.



# General architecture of an IoT device



# Flow of Data in Internet of Things

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Image source: <http://www.cchc.cl/informacion-a-la-comunidad/industria-de-la-construccion/personaje/>

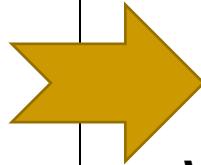
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# IoT makes Autonomous!

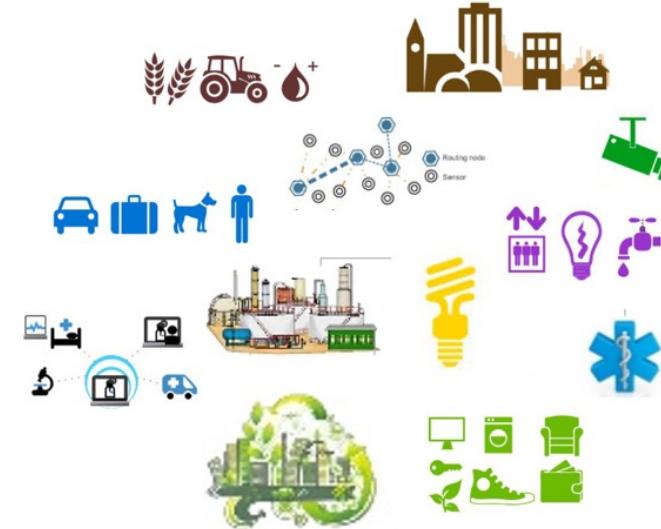
**Passive**



**Active**



## Automation



### Why?

- We like to collect data (information is power)
- We want to control things
- We want to automate processes
- We want to make things faster
- We want to enhance availability of services
- We want to make products cheaper
- etc....

# What is Connected in IoT?

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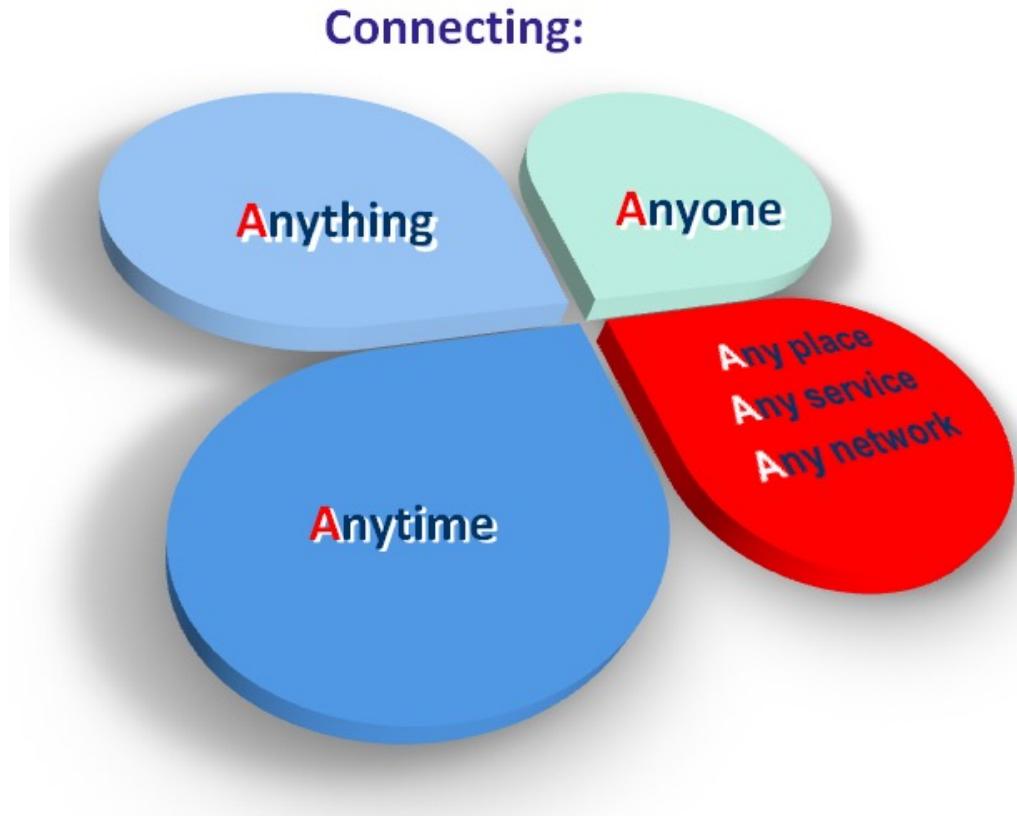
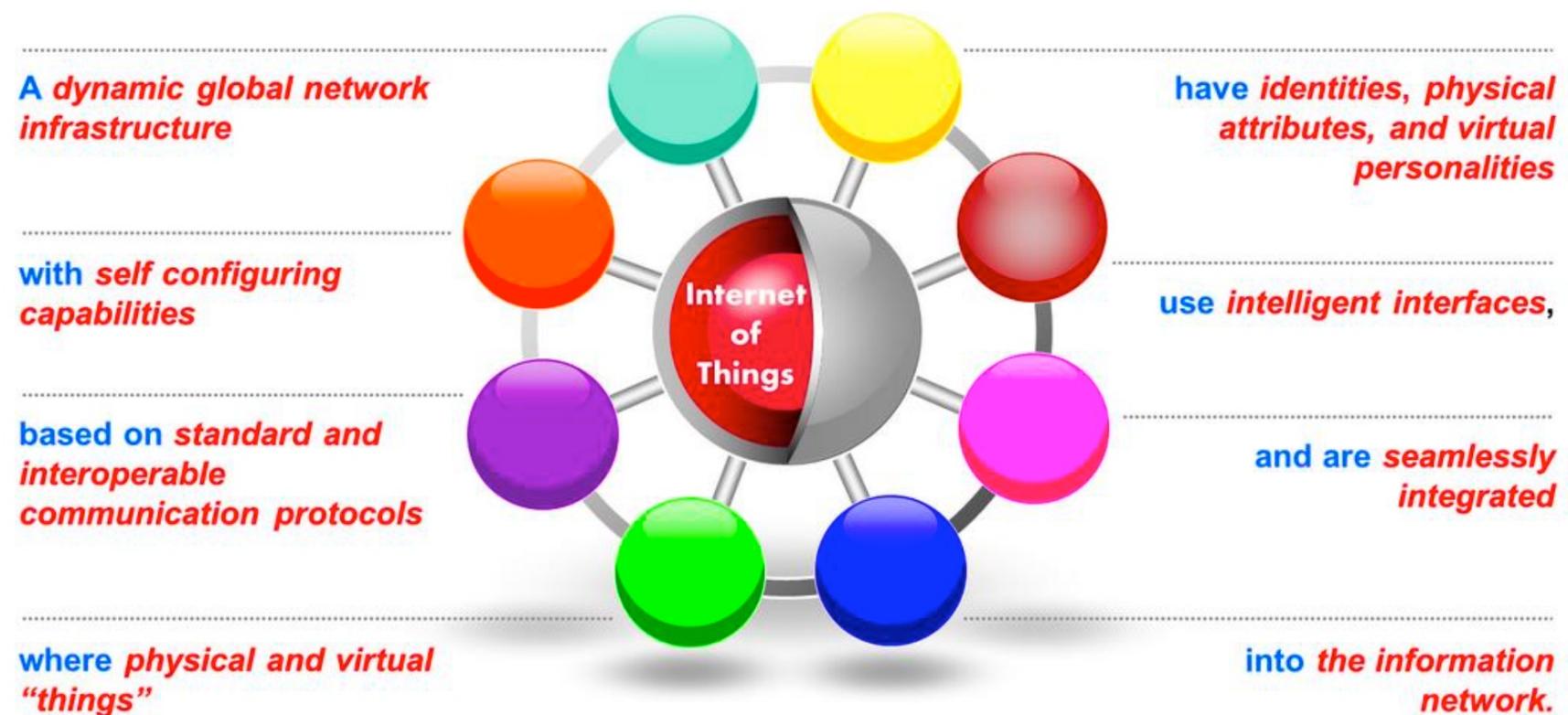


Image source: [http://www.internet-of-things-research.eu/about\\_iot.htm](http://www.internet-of-things-research.eu/about_iot.htm)

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# IERS definition of IoT?

The European Research Cluster on the Internet of Things (IERC) definition of the IoT is:



# How IoT differs from Traditional Internet?

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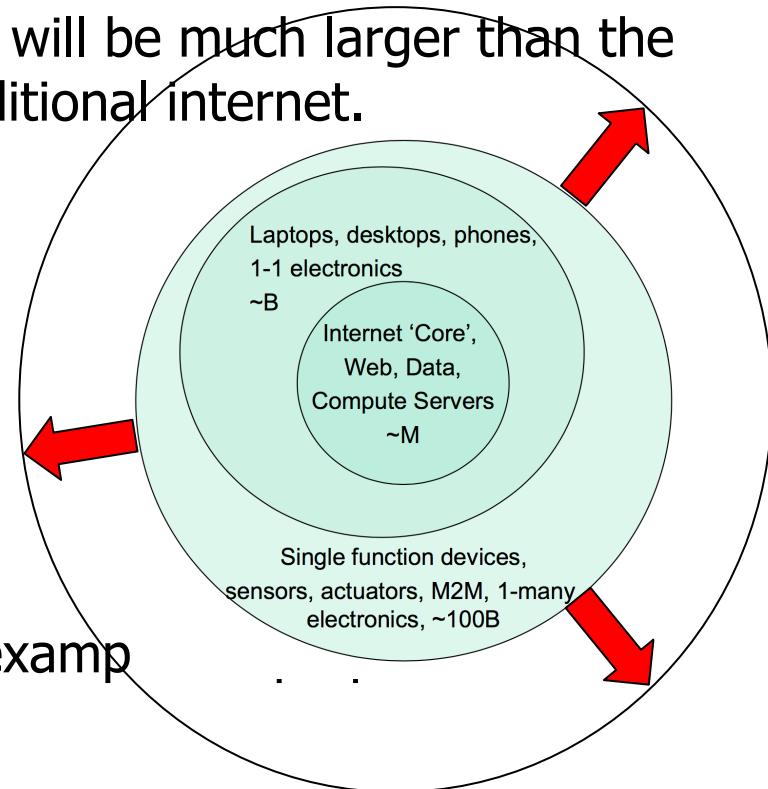
| Topic                        | Traditional Internet  | The Internet of Things (IoT)                  |
|------------------------------|---|---|
| Who creates content?         | Human   | Machine                                       |
| How is the content consumed? | By request  | By pushing information and triggering actions |
| How is the content combined? | Using explicitly defined links  | Through explicitly defined operators          |
| What is the value?           | Answer questions  | Action and timely information                 |
| What was done so far?        | Both content creation (HTML) and content consumption (search engines) | Mainly content creation                       |

Source: <https://www.rtinsights.com/differences-between-the-iot-and-traditional-internet/>

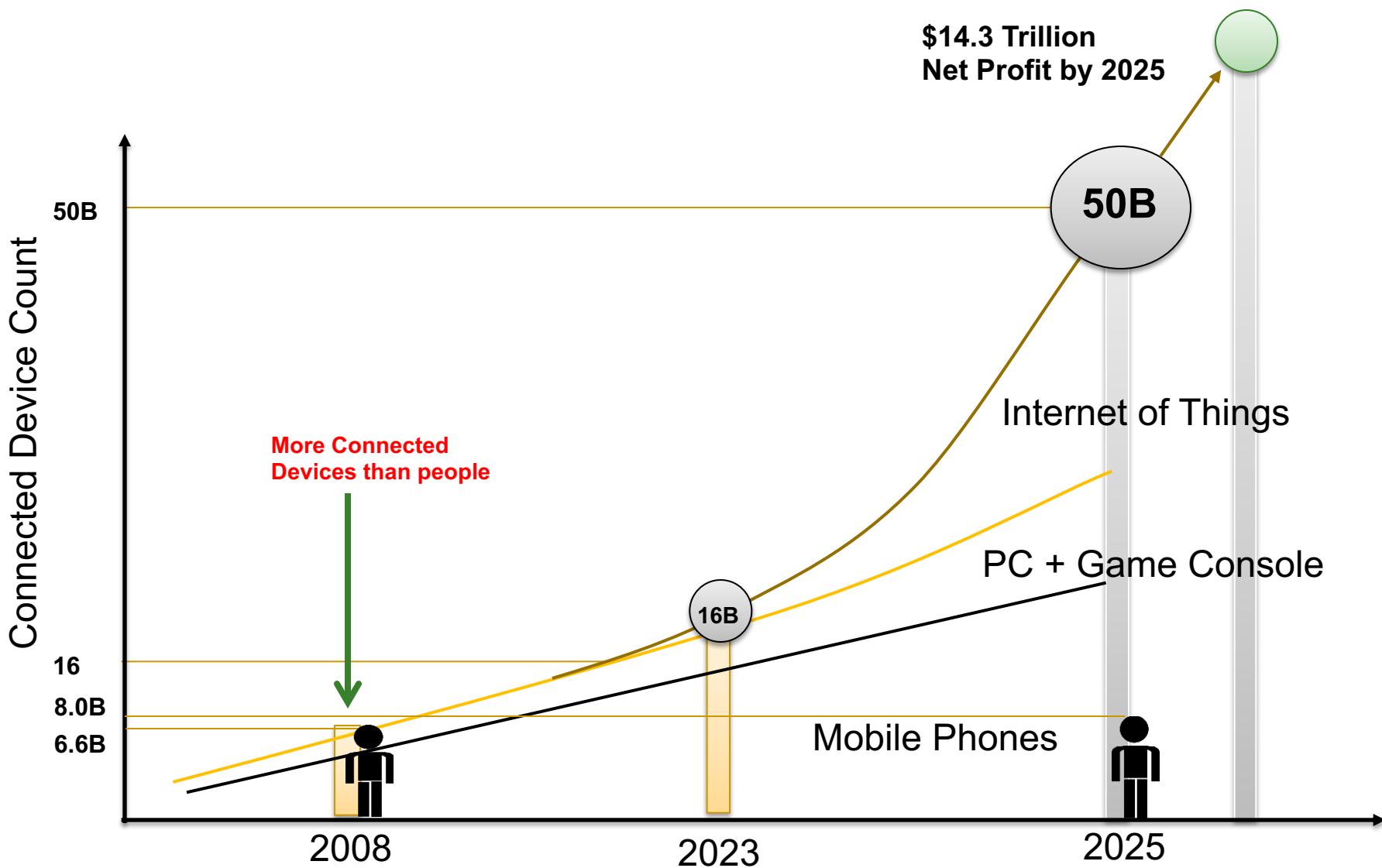
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# IoT Is far larger than Internet

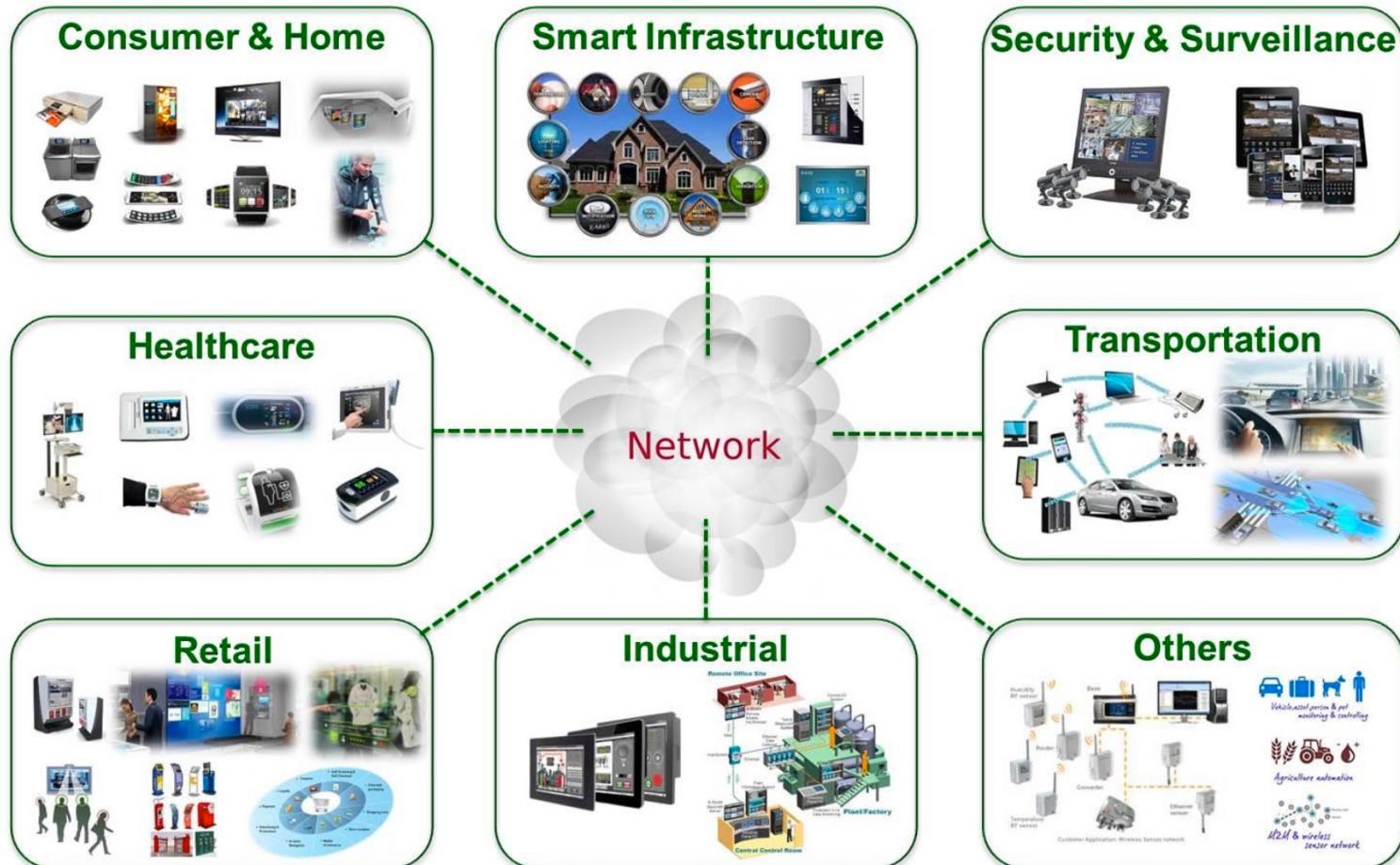
- Number of connected objects in the IoT will be much larger than the number of connected devices in the traditional internet.
- Objects in IoT:
  - Have limited functions
  - Are not useful by themselves
  - Are connected to low capacity networks
  - Gen/Receive Limited data per device
  - Do not have proper UI
  - Are In large numbers >> 1/human
  - Interact with the real world
- Devices connected to the Internet (for example phone)
  - Support wider range of functions
  - Are useful devices for the user
  - Are connected to WWW
  - Could Gen/Receive large amount of data
  - Have a proper UI (ex. OSX in apple phones)
  - Are in proportional number to human users (  $\leq 1/\text{human}$  )
  - Interact with human users



# Growth of Connected Devices



# Many Application Domains

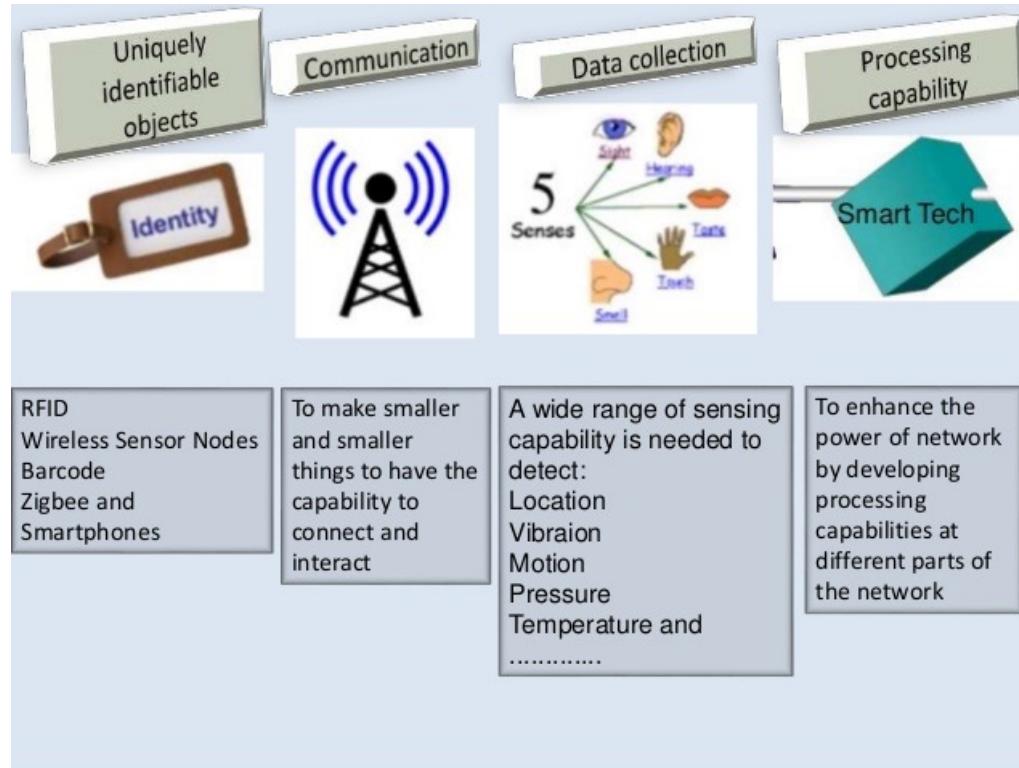


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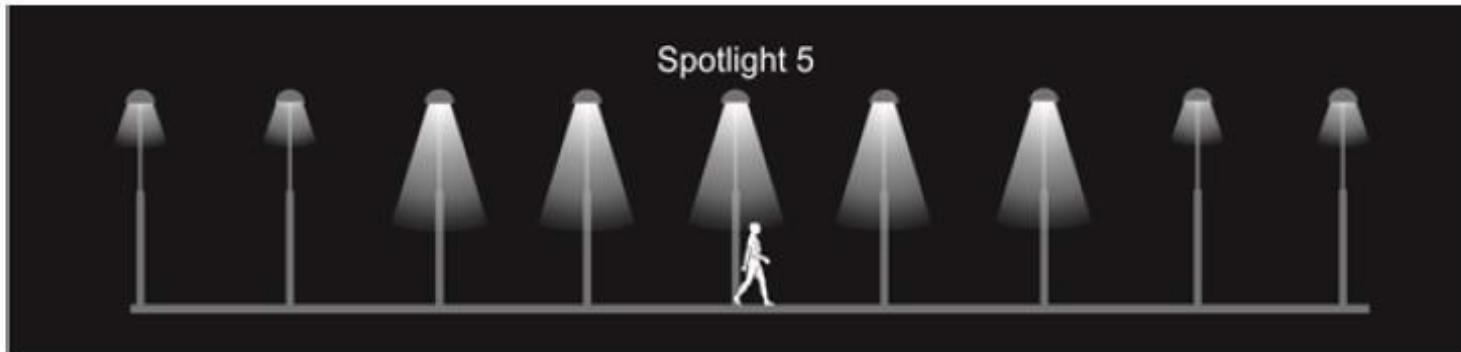
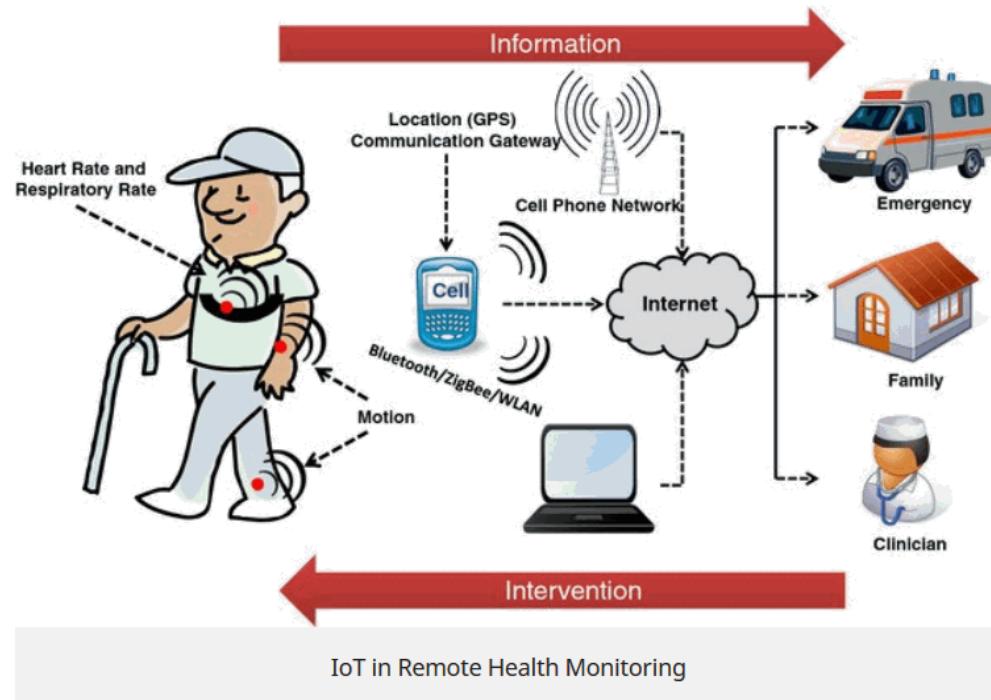
# Things

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- Goods
- Objects
- Machines
- Appliances
- Buildings
- Vehicles
- Animals
- **People**
- Plans
- Soil
- Etc....



# Us as Objects or Hosting Objects!



# Smart Devices on Our Bodies!

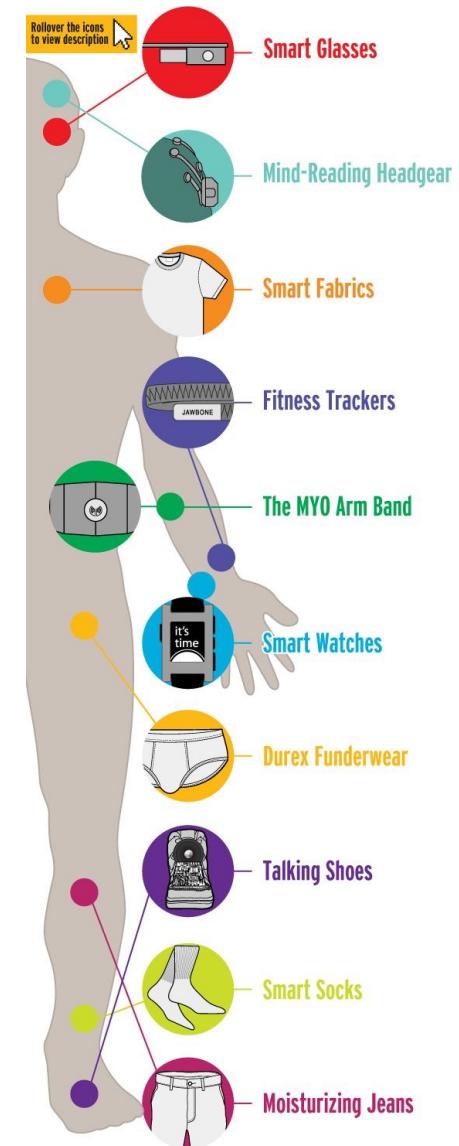
- Technology on our bodies, for
  - Convenience
  - Health
  - ...



- Open and read the following links:

<https://googleblog.blogspot.com/2014/01/introducing-our-smart-contact-lens.html>

<https://www.getqardio.com/qardiocore-wearable-ecg-ekg-monitor-iphone/>



# Smart Devices in Our Bodies

- Health, Monitoring, Management ....

## WIRELESS IMPLANTABLE MEDICAL DEVICES

Deep Brain  
Neurostimulators



Cochlear Implants



A **cochlear implant** is an electronic medical device that replaces the function of the damaged inner ear.

Gastric  
Stimulators



This helps decrease nausea and vomiting in some patients with gastroparesis.

Foot Drop  
Implants



Foot drop implants helps stroke victims suffering from **foot** paralysis

Cardiac Defibrillators/  
Pacemakers

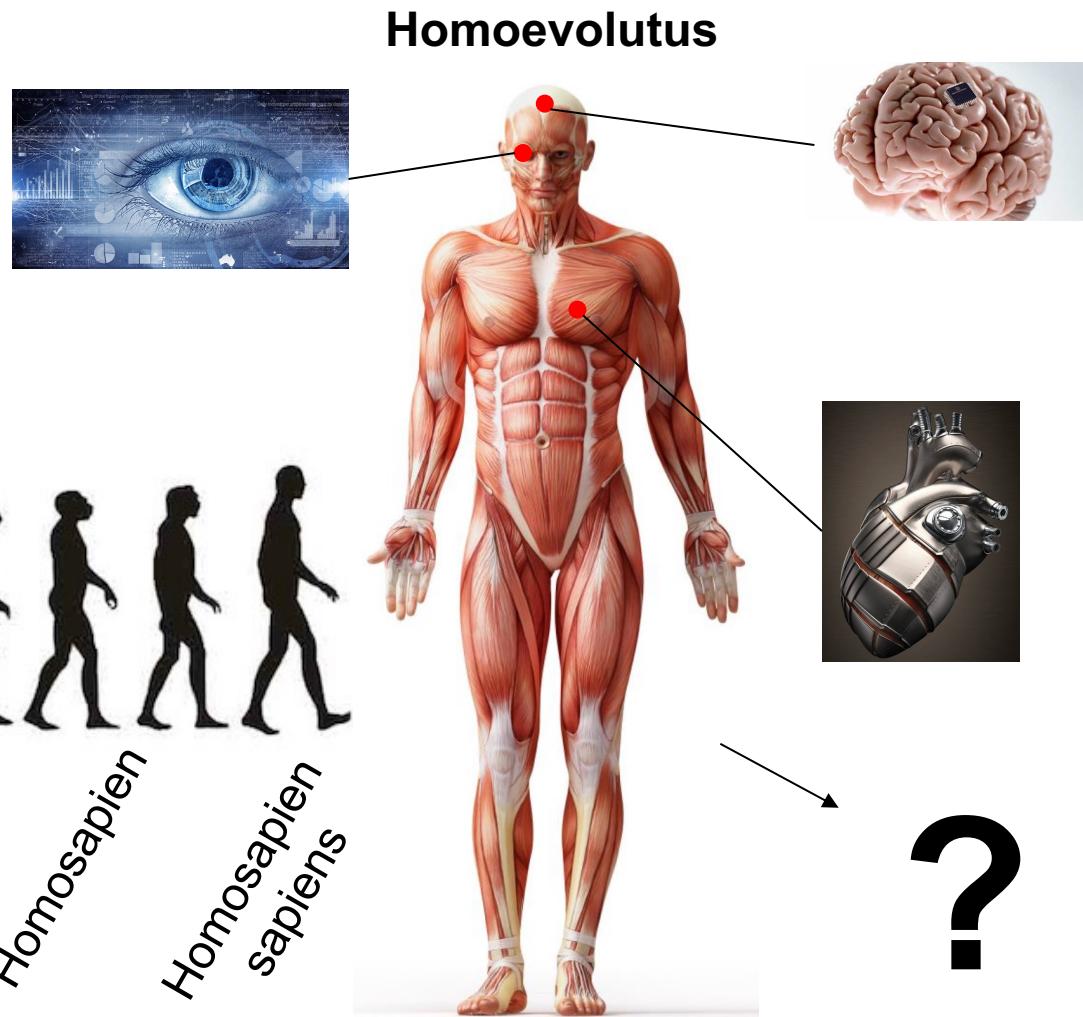
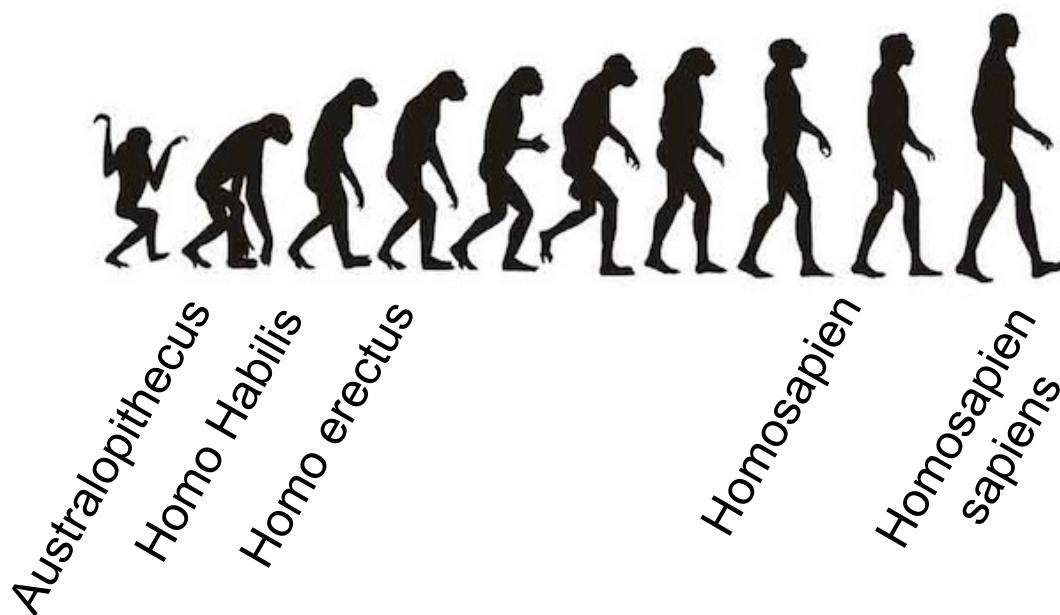


Insulin Pumps



# Smart Devices to Upgrade Our Bodies

- Improve
- Upgrade
- ....

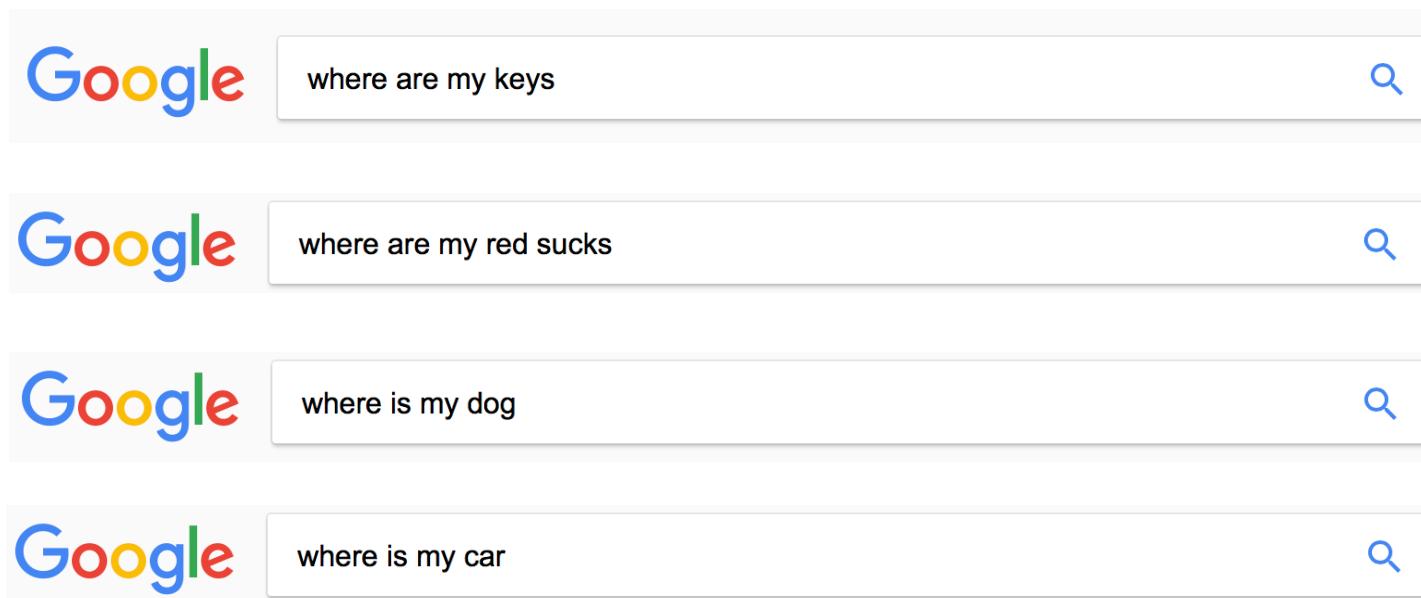


Interesting video: <https://www.youtube.com/watch?v=01hbkh4hXEk>

# Reality Search Engines

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- Things are searchable, reachable and identifiable, therefore search engines could be extended into searching physical world for things!

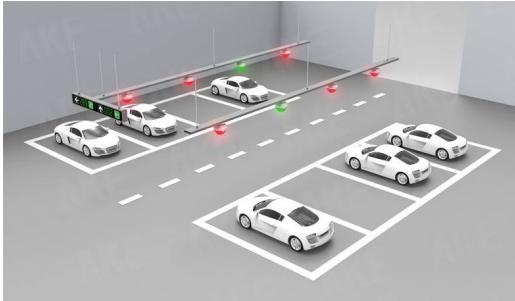


# Managing Things, Building Services

Not Smart!



Some Smart!

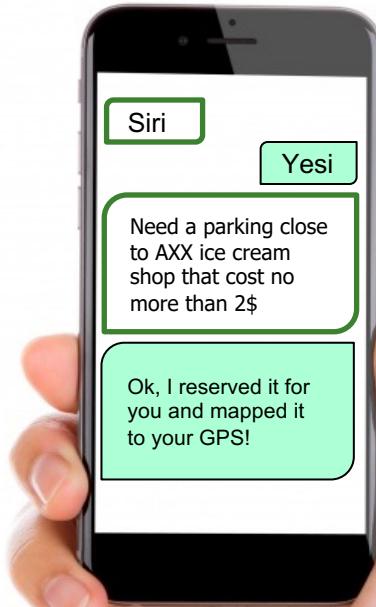


Siri

Yes!

Need a parking close  
to AXX ice cream  
shop that cost no  
more than 2\$

Ok, I reserved it for  
you and mapped it  
to your GPS!



Smart!



# Control Things

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- Control **yourself**
  - e.g. control the lighting of your house as you desire using a voice command!
- Or Give the control to **grid**
  - e.g. charge my electric car when cost of electricity is the lowest!



# Privacy is a Concern!!!

