



Mastère CréaCity

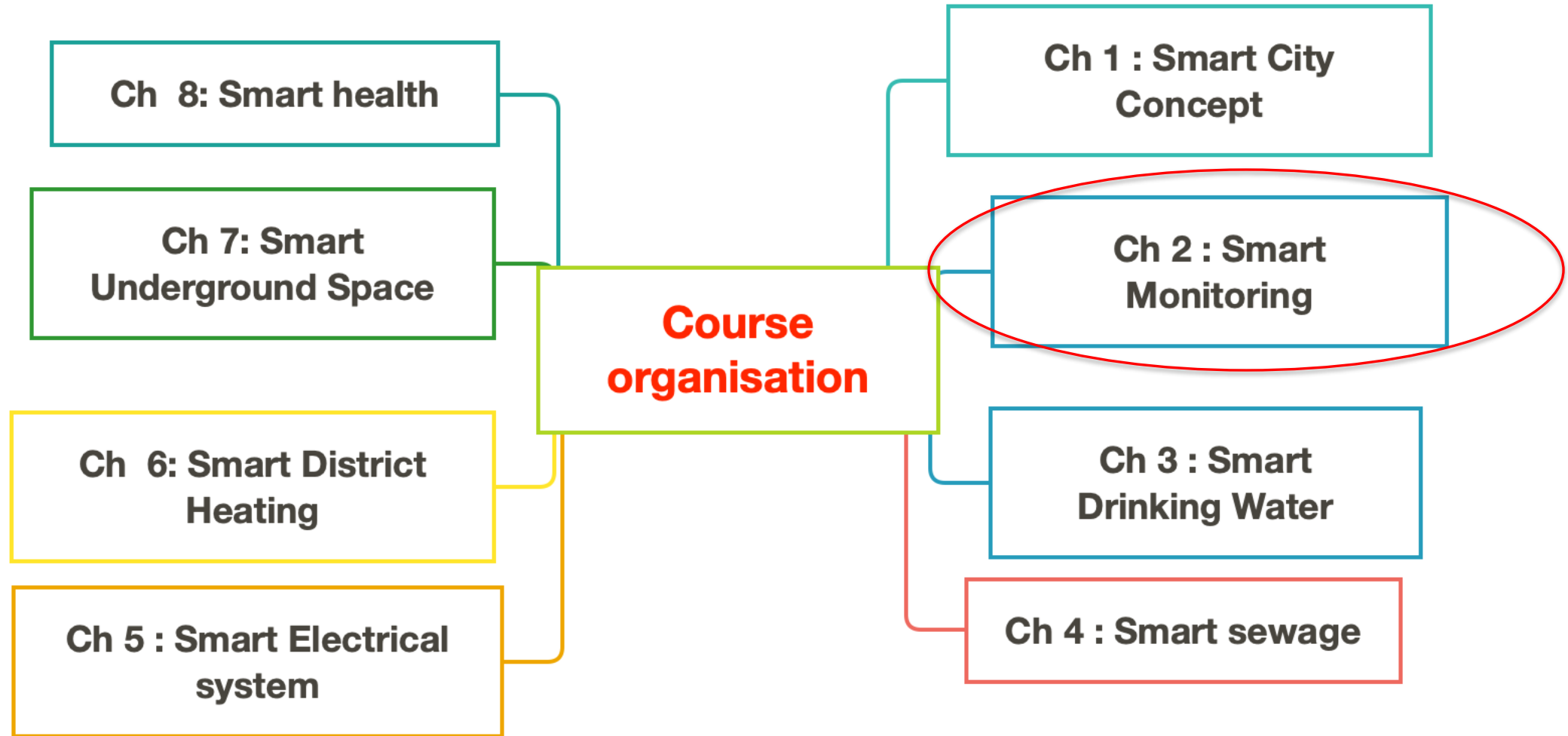


Cours « Smart City »

Ch2: Smart Monitoring

Professeur Isam Shahrour

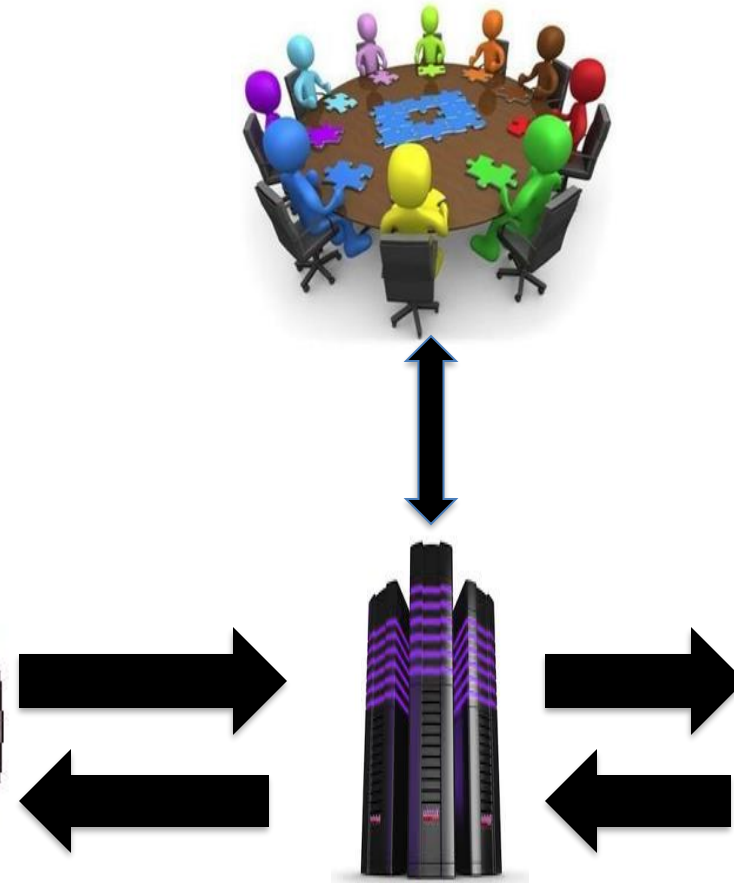
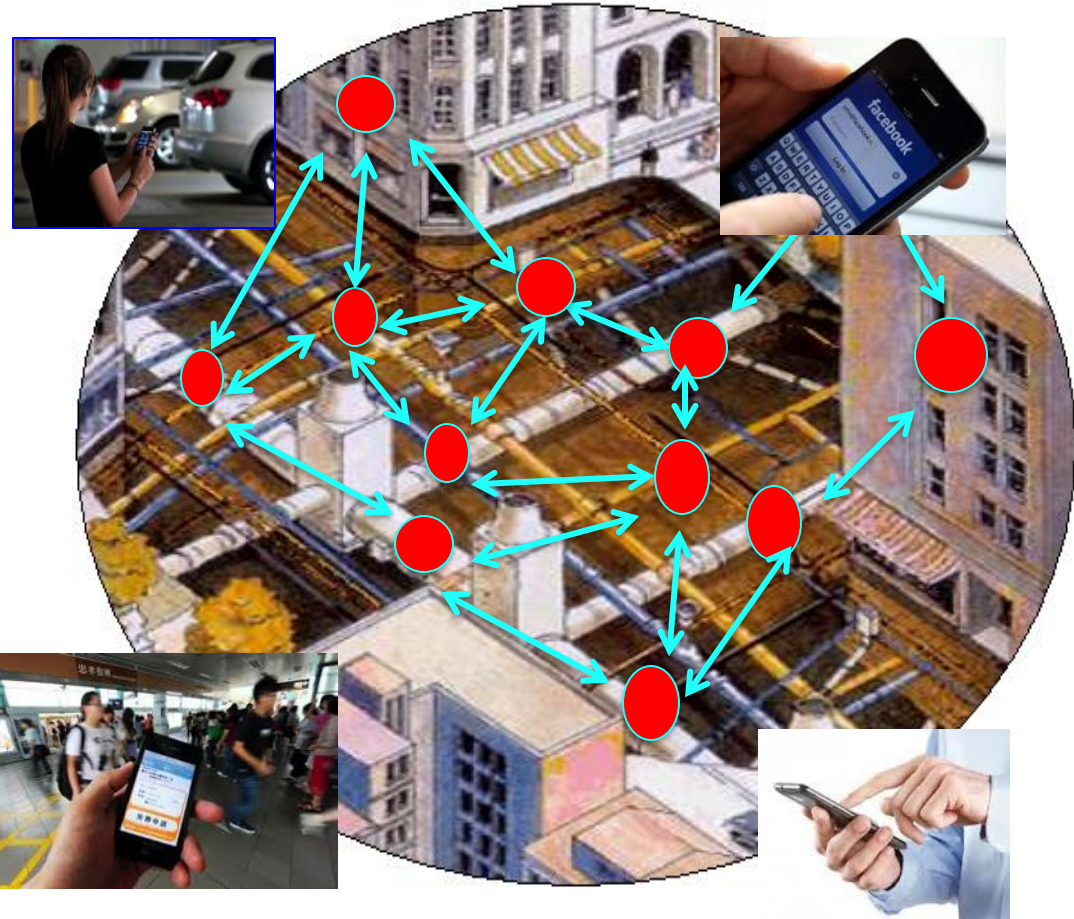
Course organisation



Outline :

- Smart monitoring ?
- Smart Sensors
- Smart Actuators
- Local unit
- Data Communication

Digital technology in the City

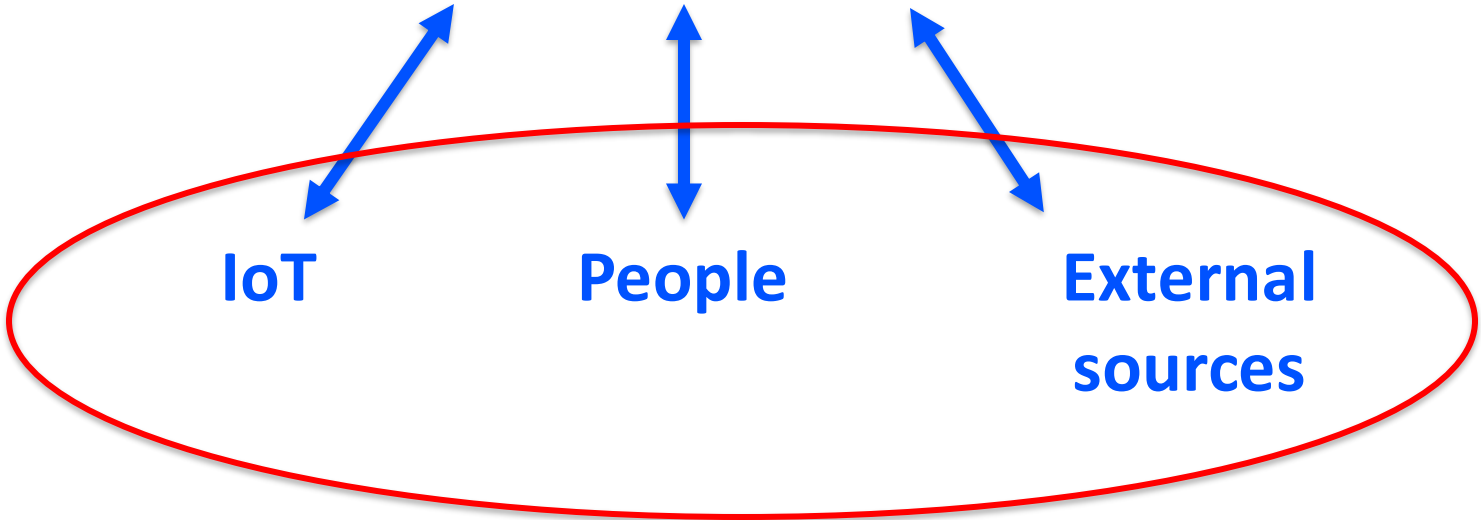


Smart Monitoring : Connect object, people and external data

Information system
Big data: structured and unstructured data

Smart City Platform (Server)

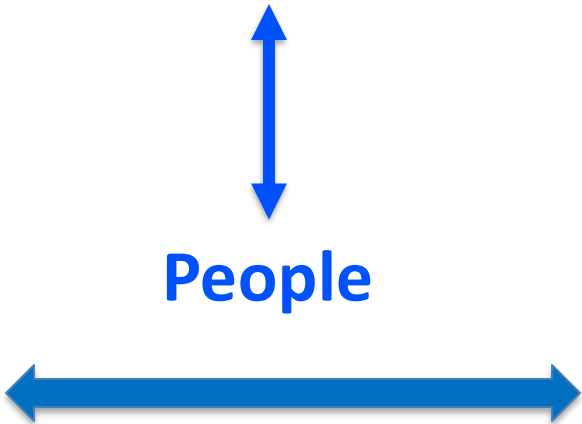
Digital tools
(Analysis, graphic, user's interface)



Smart Monitoring : Connect object, people and external data

Smart City Platform

Connexion software



Software



Smart Monitoring : Connect object, people and external data

Information system
Big data: structured and unstructured data

Smart City Platform

Digital tools
(Analysis, graphic, user's interface)



- Structure of the data
- Access
- Connectors

External sources

Smart Monitoring : Connect object, people and external data

Information system
Big data: structured and unstructured data



Smart City Platform



Digital tools
(Analysis, graphic, user's interface)

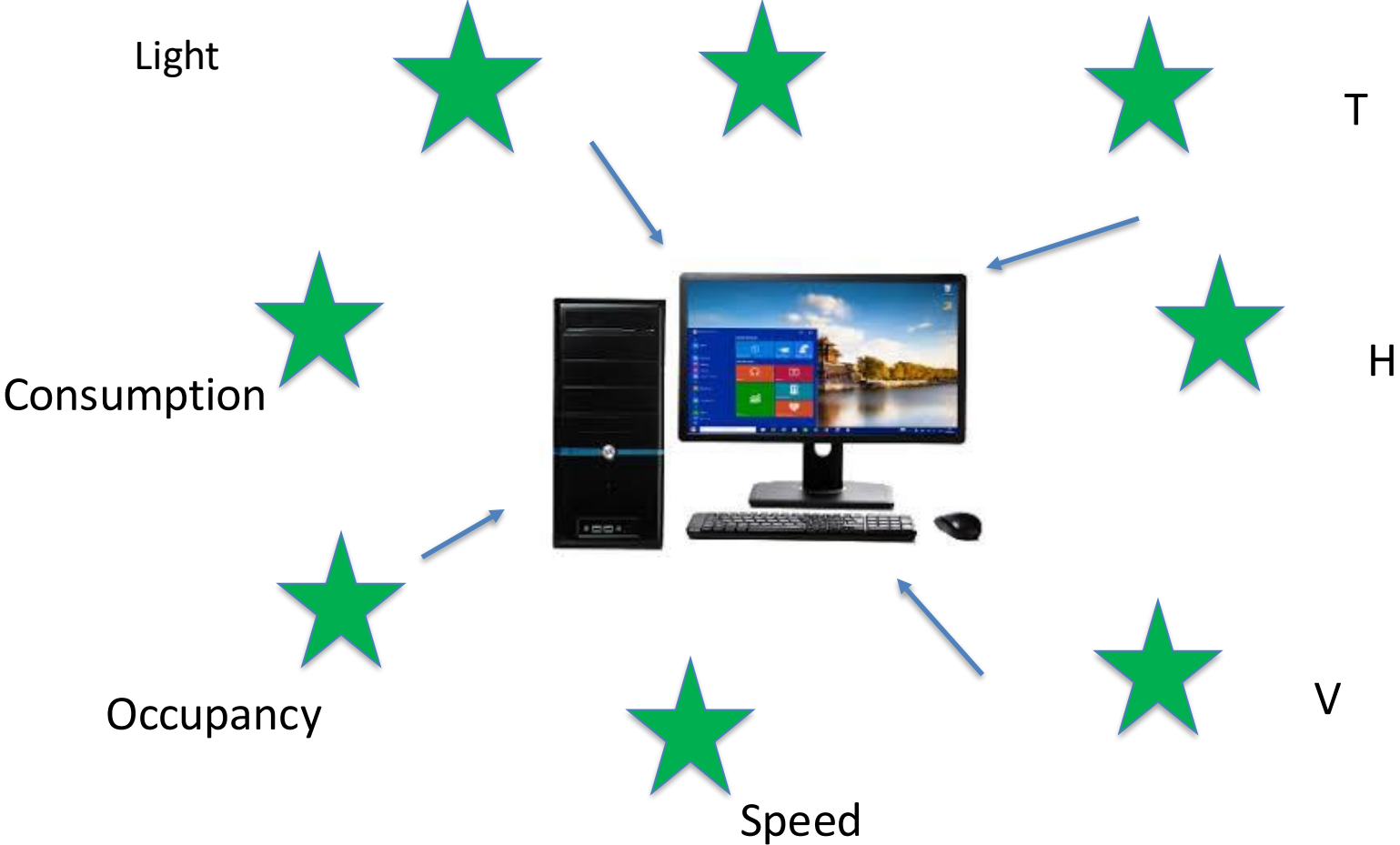
IoT



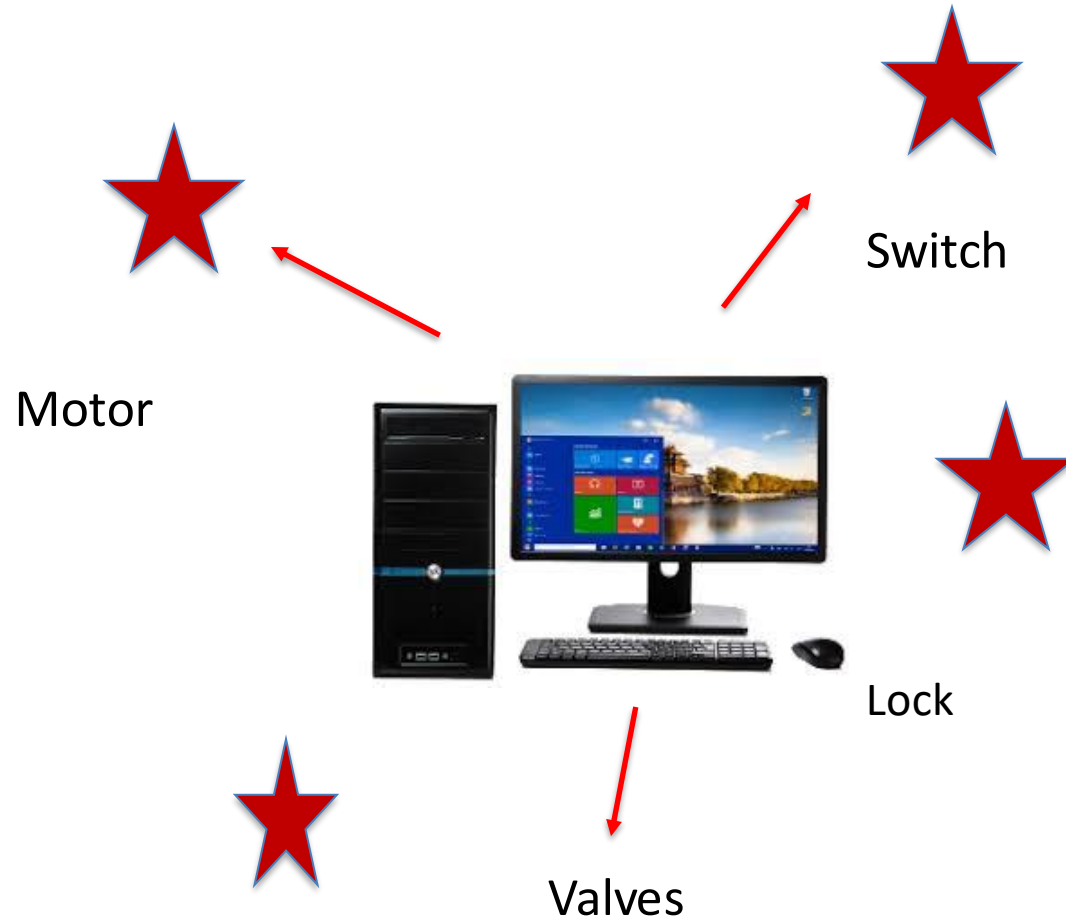
- Wired
- Wireless

- Data collection (sensing)
- Control

Example: Data exchange with sensors



Devices' Control



Collect and control



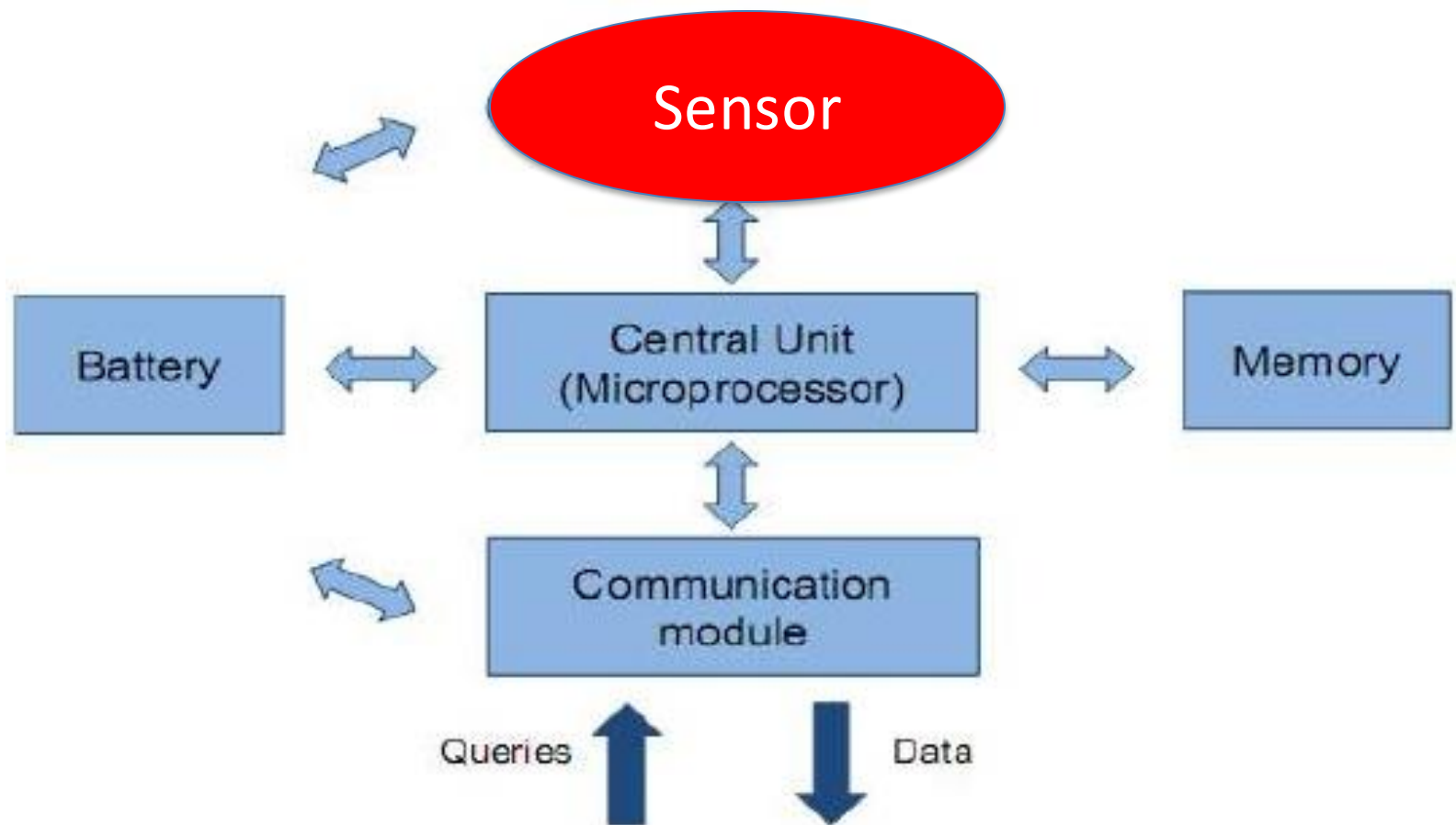
NOUS avons besoin d'un système intelligent:

- Capteurs intelligents
- Actionneurs intelligents
- Communication de données

Outline :

- Smart monitoring ?
- **Smart Sensors**
- Smart Actuators
- Local unit
- Data Communication

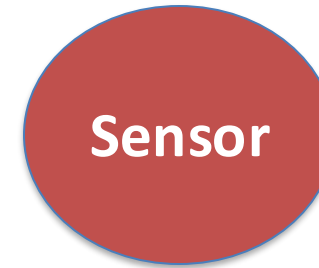
General Architecture of the Smart Sensors



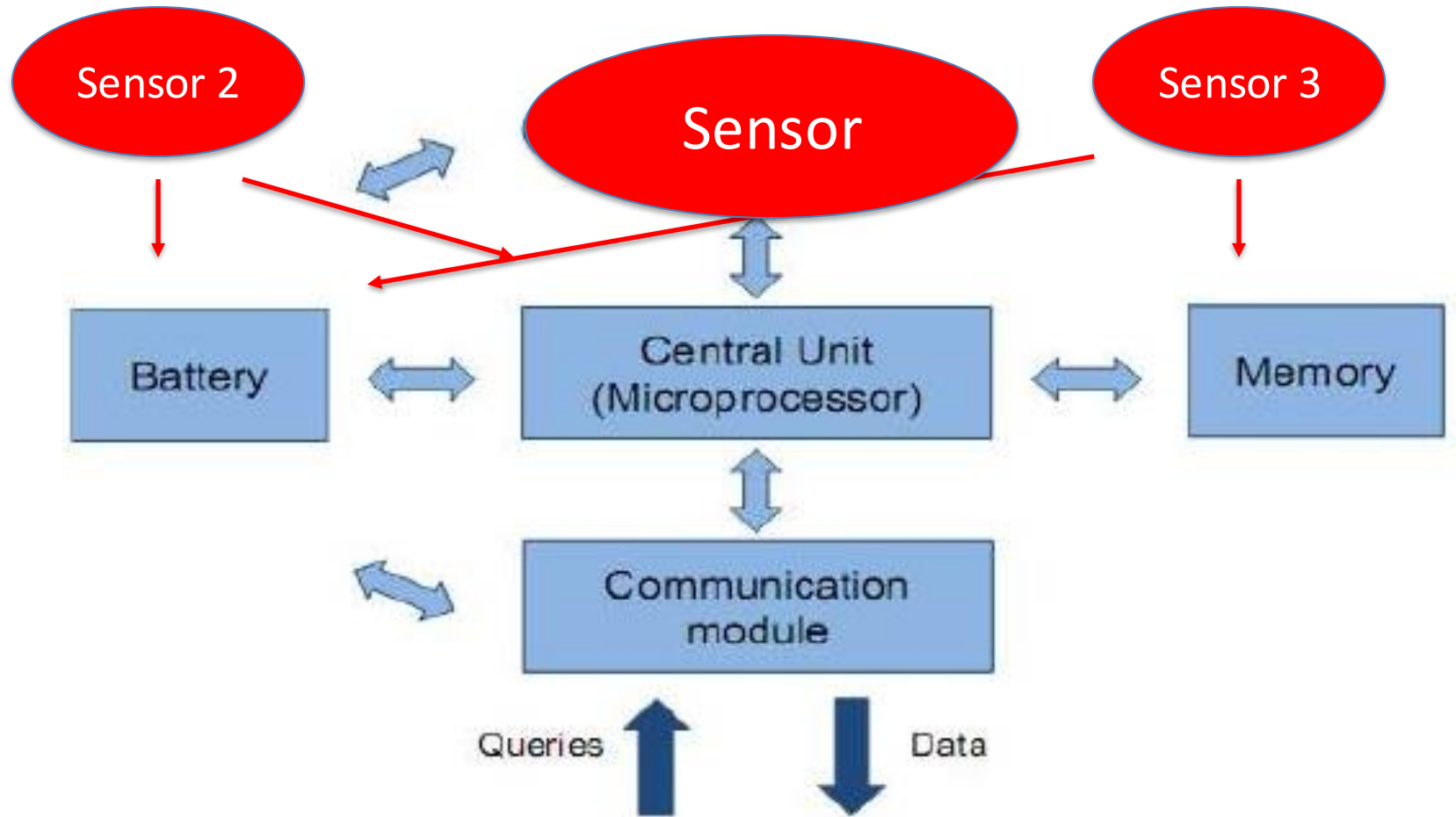
Smart sensor : Internet of Things (IoT)

IoT can :

- Meter
- Store data
- Analyze data (embedded intelligence)
- Communicate with other IoTs
- Operate actions



General Architecture of the Smart Sensor



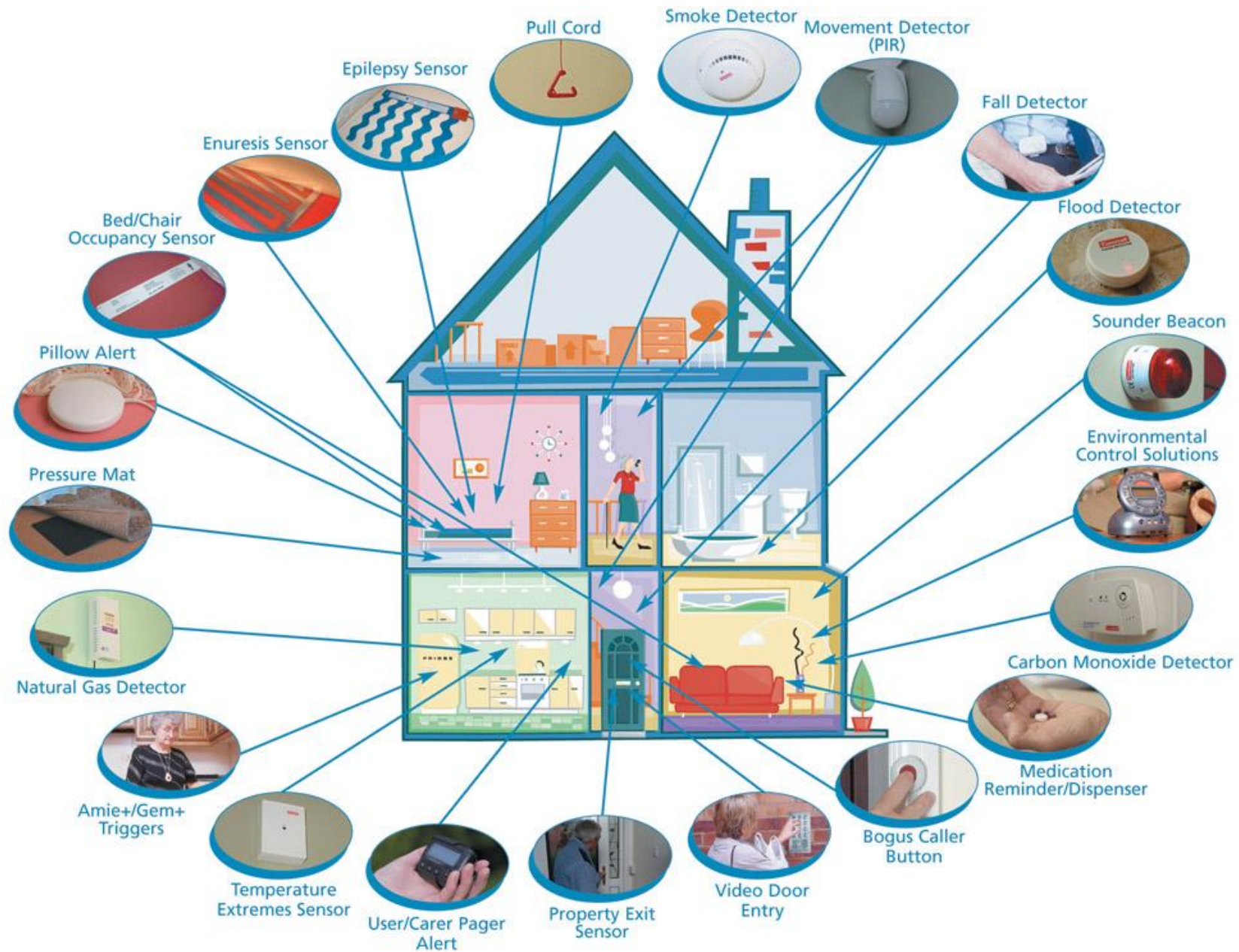
Internet of Things (IoT) What is IoT How it works

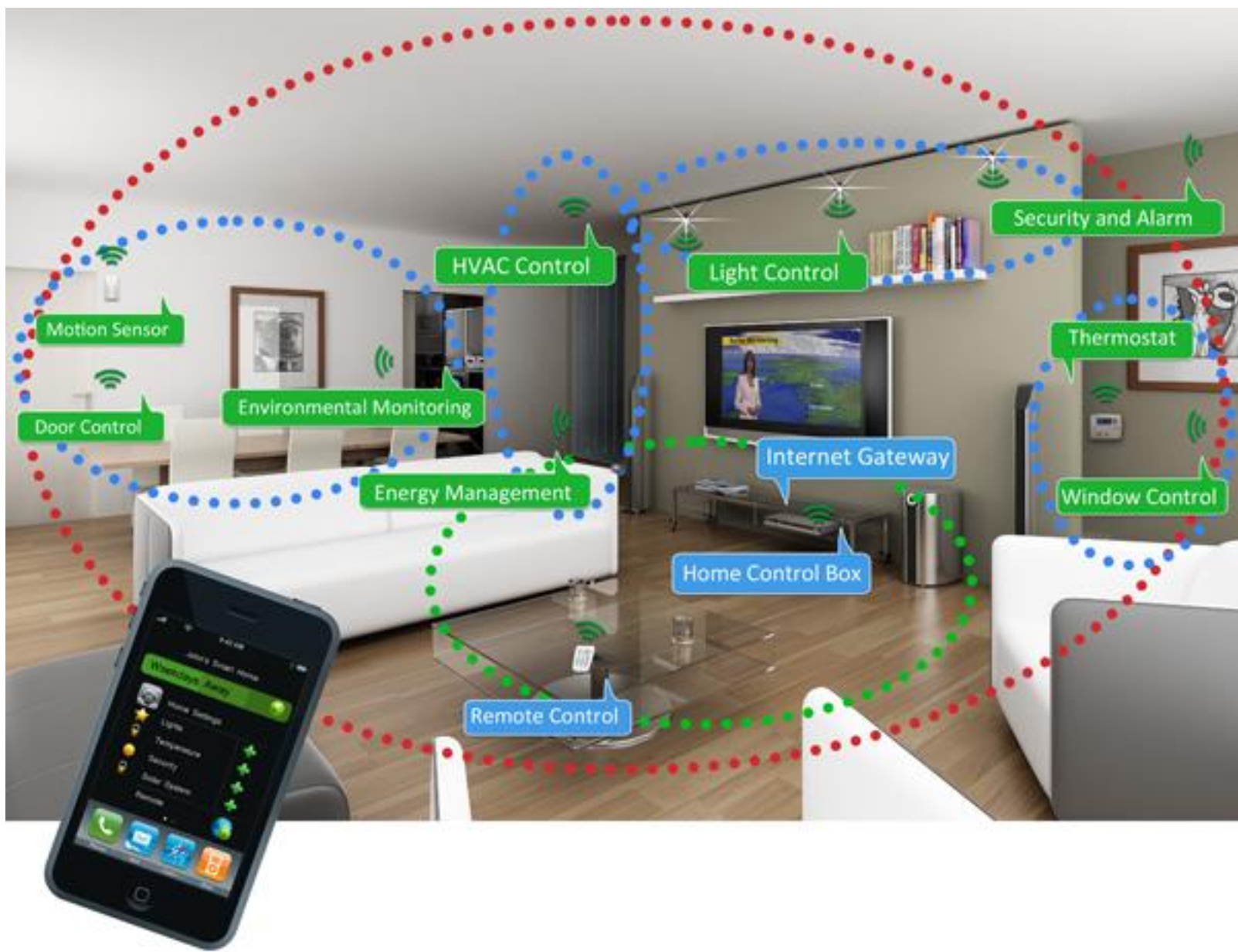
edureka!

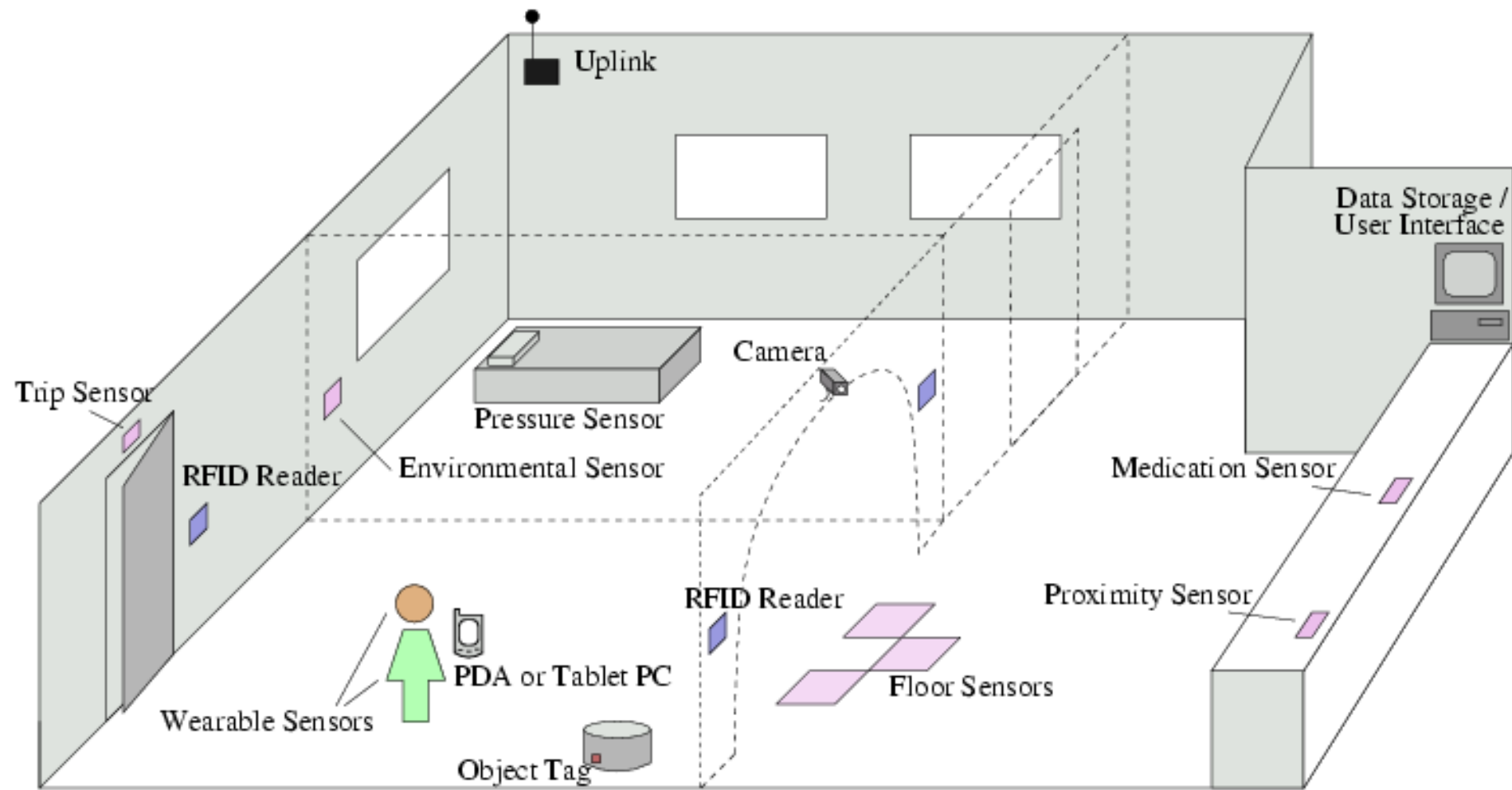
Sensors Categories

Buildings:

- Temperature
 - Humidity
 - Air Quality
 - Lightening
 - Noise
- Presence
 - Contact (windows, doors,..)
 - Water and Energy consumptions
-
- Health
 - Traffic
 - Environment
 - Industrial process
 - Social activity
 - Commerce



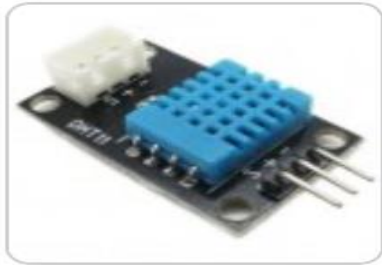




Examples of smart commercialized sensors



Temperature & Humidity Sensor



Electronic Brick
DHT11 Humidity /
Temperature Sen-
sor

USD \$3.15



 In stock

[Home](#) » [Light Sensor Module](#)

Light Sensor Module



Brand: ITEAD Studio
Product Code: BR010028
Availability: In Stock

Price: \$2.50

Qty: [Add to Cart](#) - OR - [Add to Wish List](#)
[Add to Compare](#)

 [0 reviews](#) | [Write a review](#)

[+ Share](#)    

Air Quality Sensor

Grove - Air Quality Sensor

This sensor is designed for comprehensive monitor over indoor air condition responsive to a wide scope of harmful gases, as carbon monoxide, alcohol, acetone, thinner, formaldehyde and so on. Due to the measuring mechanism this sensor can not output specific data to describe target gases' concentration quantitatively. But it's still competent enough to be used in applications that require only qualitative results, like auto refresher sprayers and auto air cycl systems.

Get One Now 

Contents

- 1 Features
- 2 Cautions
- 3 Getting Started
 - 3.1 With Arduino
 - 3.2 With Raspberry Pi
- 4 Resources
- 5 Related Projects
 - 5.1 Air Quality Box 1
 - 5.2 Air Quality Box 2
- 6 Help us to make it better



```
/*
AirQuality Demo V1.0.
connect to A1 to start testing. it will needs about 20s to start
* By: http://www.seeedstudio.com
*/
#include "AirQuality.h"
#include "Arduino.h"
AirQuality airqualitysensor;
int current_quality =-1;
void setup()
{
  Serial.begin(9600);
  airqualitysensor.init(14);
}
void loop()
{
  current_quality=airqualitysensor.slope();
  if (current_quality &gt;= 0)// if a valid data returned.
  {
    if (current_quality==0)
      Serial.println("High pollution! Force signal active");
    else if (current_quality==1)
      Serial.println("High pollution!");
    else if (current_quality==2)
      Serial.println("Low pollution!");
    else if (current_quality ==3)
      Serial.println("Fresh air");
  }
}
ISR(TIMER2_OVF_vect)
{
  if(airqualitysensor.counter==122)//set 2 seconds as a detected duty
  {
    airqualitysensor.last_vol=airqualitysensor.first_vol;
    airqualitysensor.first_vol=analogRead(A0);
    airqualitysensor.counter=0;
    airqualitysensor.timer_index=1;
    PORTB=PORTB^0x20;
  }
}
```

seeedstudio.com/wiki/Grove_-_Air_Quality_Sensor

Contact Sensor

Wired Magnet Door Magnetic Contact Sensor with NC or NO Optional

Model Number: MC-35-1-1-1-1-1-1-1-1-1-1-1

Brand Name: Bestgo

Min. Order: 1000 Sets

FOB Price: US\$ 0.5 - US\$ 0.8

FOB Port: Shenzhen

Lead Time: 1 - 5 days

Payment Terms: L/C, T/T, Western Union or PayPal

[Inquire on This Product](#)

Occupancy Sensor



The screenshot shows the Leviton website's product page for occupancy sensors. At the top, the Leviton logo is on the left, a 'Live Chat' button is in the center, and a search bar with the text 'Search by Keyword, Product# or Manufacturer Cross Reference' is on the right. Below the logo is a navigation menu with links for 'Products', 'Solutions', 'News', 'Support', 'Professionals', 'Where to Buy', and 'About'. A 'PRINT' icon is visible in the top right corner. The main heading is 'Occupancy Sensors Information Request'. Below this is a large image of three different occupancy sensor models: a rectangular wall-mounted sensor, a circular ceiling-mounted sensor, and a rectangular wall-mounted sensor with a display. To the left of the image, the text reads 'Occupancy Sensors' in large blue font, followed by 'Sensing controls deliver one of the simplest and most effective methods of reducing energy usage.' At the bottom, a paragraph states: 'Leviton offers a wide selection of sensors for virtually any commercial and residential application to enhance convenience, security, and provide smart energy saving solutions for both indoor and outdoor use. As an additional advantage, Leviton also offers no costs sensor layout requests and no cost Dollars & Sensors® online energy audit tool.'

Fluid and Energy Consumption



Water Consumption

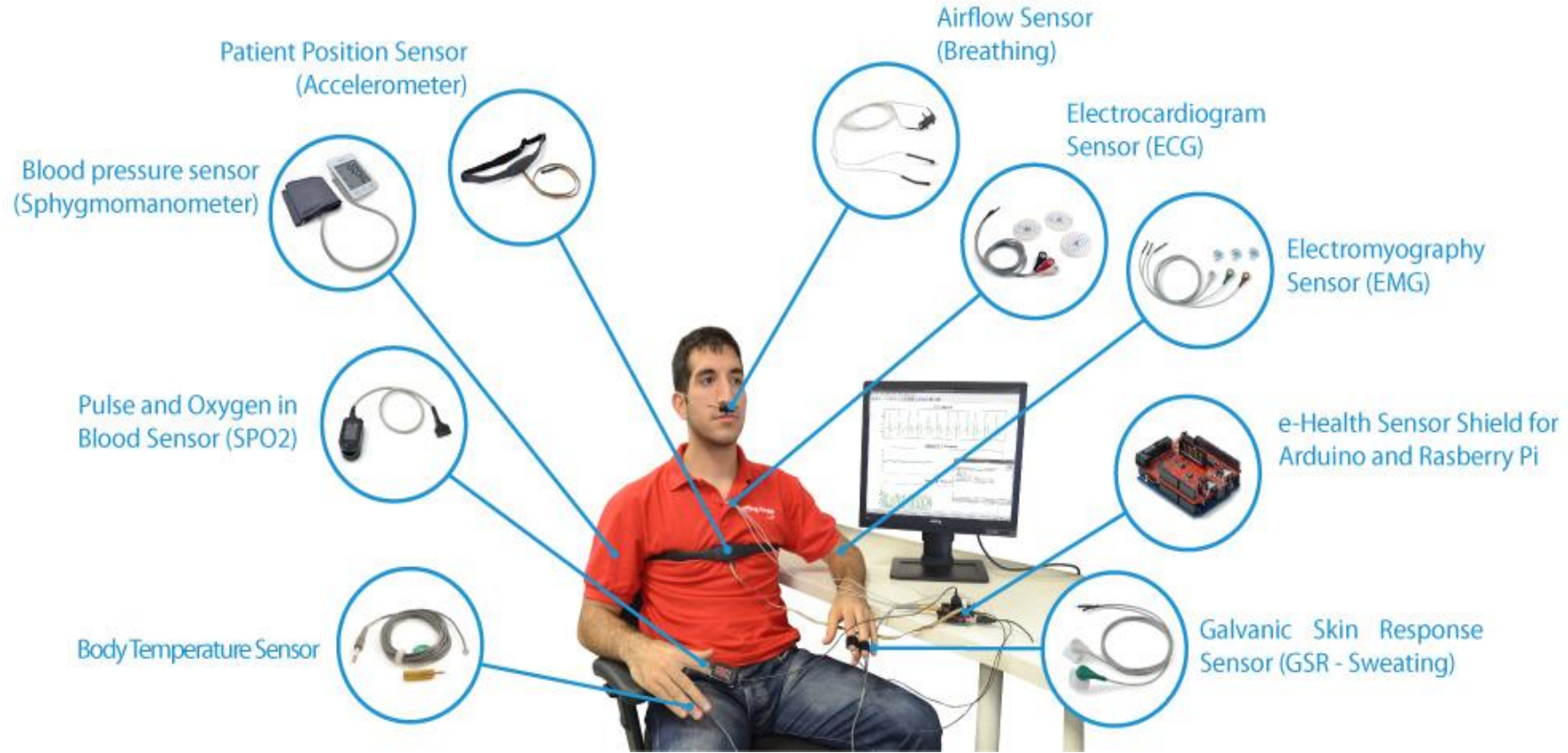


Gas Consumption

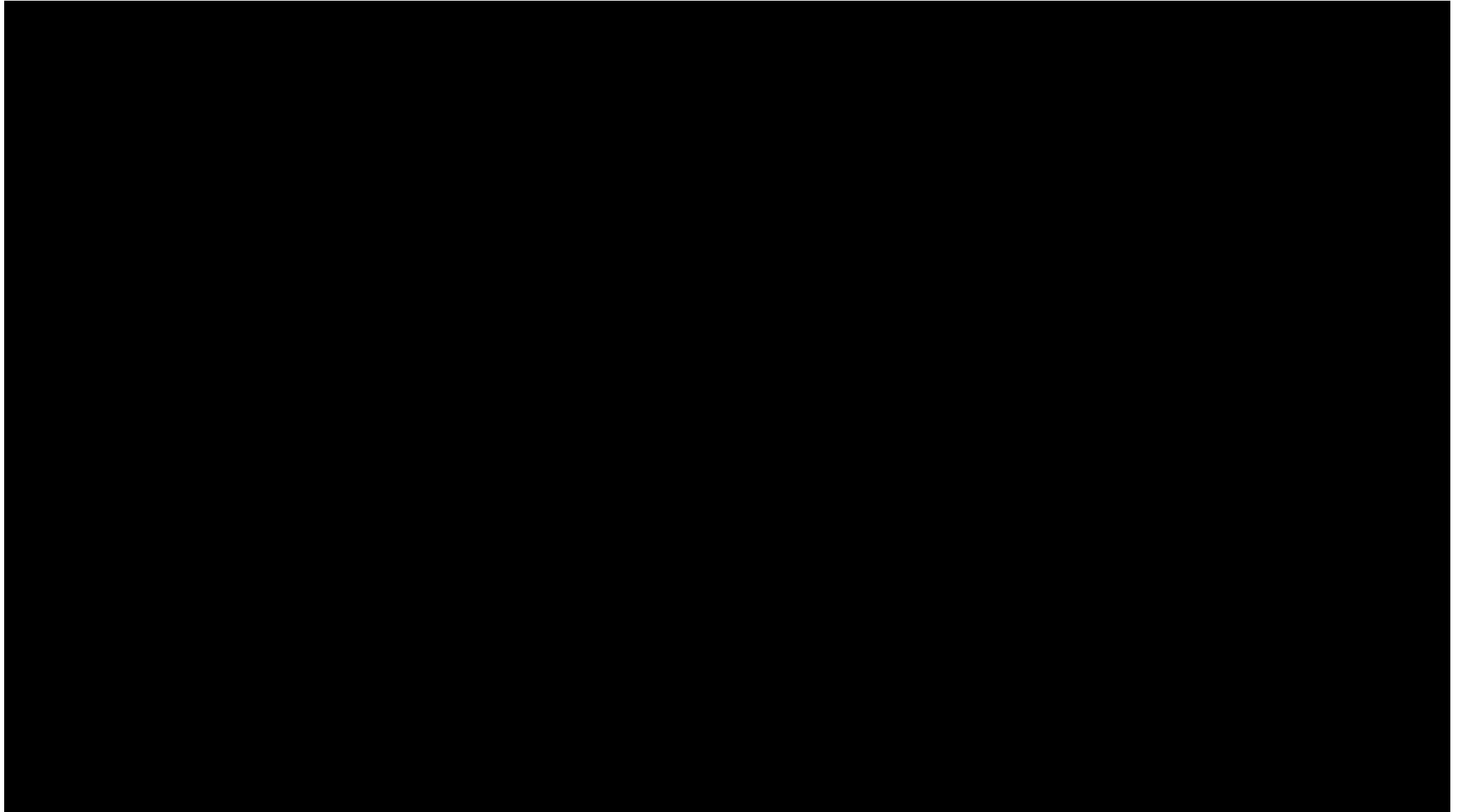


Health Control

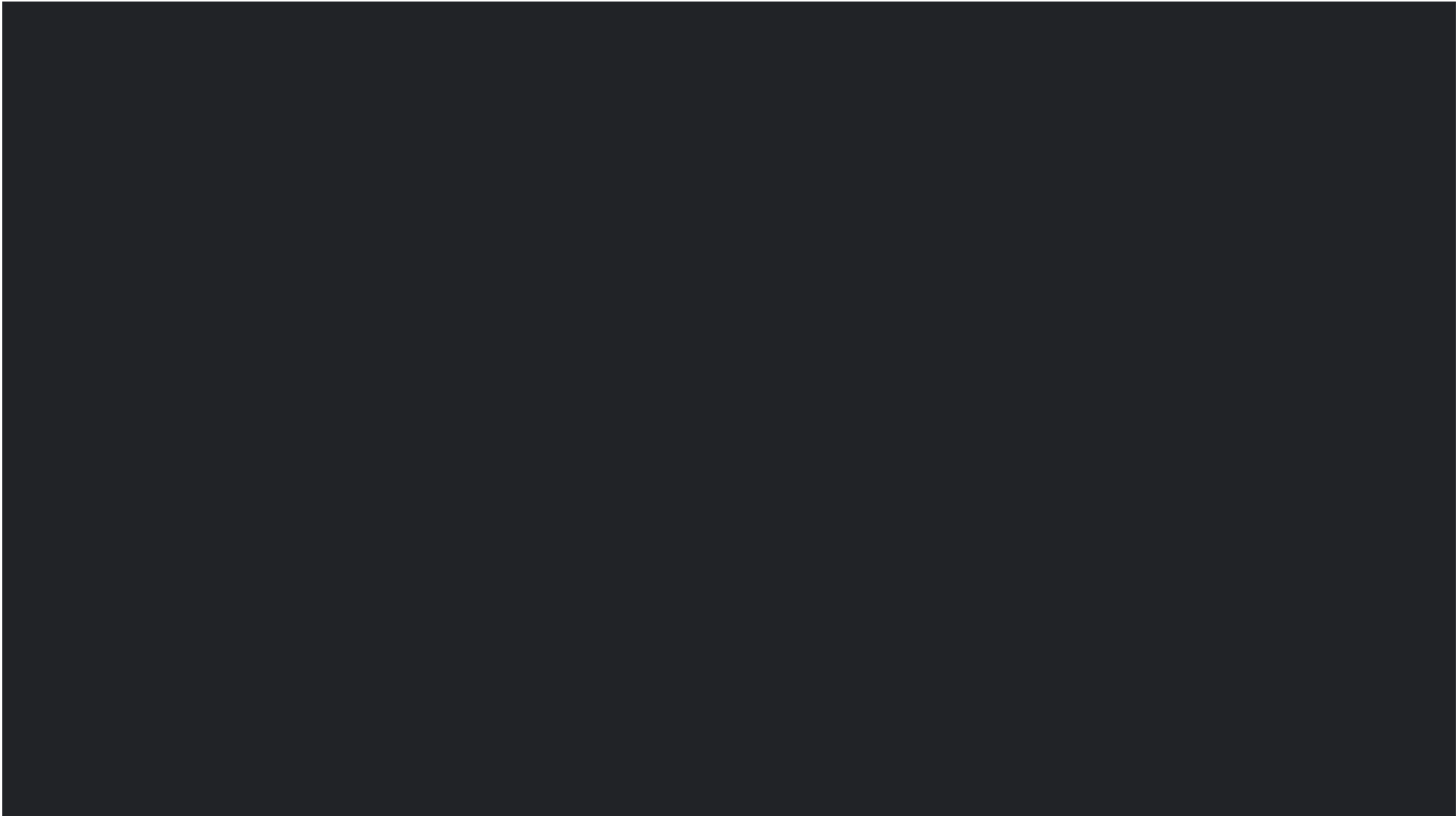
<http://www.libelium.com/e-health-low-cost-sensors-for-early-detection-of-childhood-disease-inspire-project-hope/>



Smart Sensor Explained Different Types and Applications



What is a Sensor Different Types of Sensors, Applications



RFID – Technology

(Radio-frequency identification)



RFID – Technology

(Radio-frequency identification)

Reader

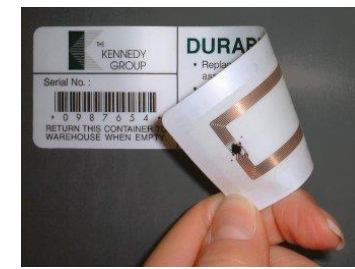
Tag



The tag contains stored information.

Use of electromagnetic fields to track tags attached to objects.

RFID Tag



Tags :

- Passive: collect energy from a nearby RFID reader's
- Active: have a local power source such as a battery

The distance : up to 100 m

RFID frequency bands^{[11][12]}

Band	Regulations	Range	Data speed	ISO/IEC 18000 Section	Remarks	Approximate tag cost in volume (2006) US \$
120–150 kHz (LF)	Unregulated	10 cm	Low	Part 2	Animal identification, factory data collection	\$1
13.56 MHz (HF)	ISM band worldwide	10 cm–1 m	Low to moderate	Part 3	Smart cards (ISO/IEC 15693 , ISO/IEC 14443 A,B). Non fully ISO compatible memory cards (Mifare Classic , iCLASS , Legic , Felica ...). Micro processor ISO compatible cards (Desfire EV1 , Seos)	\$0.50 to \$5
433 MHz (UHF)	Short Range Devices	1–100 m	Moderate	Part 7	Defense applications, with active tags	\$5
865-868 MHz (Europe) 902-928 MHz (North America) UHF	ISM band	1–12 m	Moderate to high	Part 6	EAN, various standards	\$0.15 (passive tags)
2450-5800 MHz (microwave)	ISM band	1–2 m	High	Part 4	802.11 WLAN, Bluetooth standards	\$25 (active tags)

What is RFID and how does it work



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Smart Switch

https://www.alibaba.com/product-detail/Enocean-Smart-Home-Wireless-Remote-Control_60304177153.html

Enocean Smart Home / Wireless Remote Control Switch / Remote Control Switch Quality Choice

Inquiries: 100+

FOB Price: **US \$25.89 - 155.66 / Piece** | [Get Latest Price](#)

Min.Order Quantity: 50 Piece/Pieces

Supply Ability: 1000000 Set/Sets per Month

Port: Shenzhen / HongKong

Payment Terms: L/C,T/T,PayPal

 [Contact Supplier](#)

 [Leave Messages](#)



Smart Valves

<http://www.aquamat2000.com/en/products/Floriculture/Watering+Pot+plants/Watring+pot+plants/Smart+Valve®+watering+system>



Brand
Smart Tech Ltd.


Smart Valve® watering system

Smart Valve® watering system


Smart Valve® is a patented sensor-transducer valve based on a unique polymer material developed after many years of scientific research.

The **Smart Valve®** is unique product. Completely different from all other plant watering devices available in the market today, it delivers water to plants on trays or in planters, only when required by plants.

Incorporated into a standard container (planter, trough, tray, etc), **Smart Valve®** can increase the interval between watering and maintenance visits to months. The plant's transpiration properties and the condition of the soil, determine how much water is required. **Smart Valve®** when needed delivers water automatically.


Smart Motors

<http://www.animatics.com/products/smartmotor.html>



Tech Support: 888-356-0357

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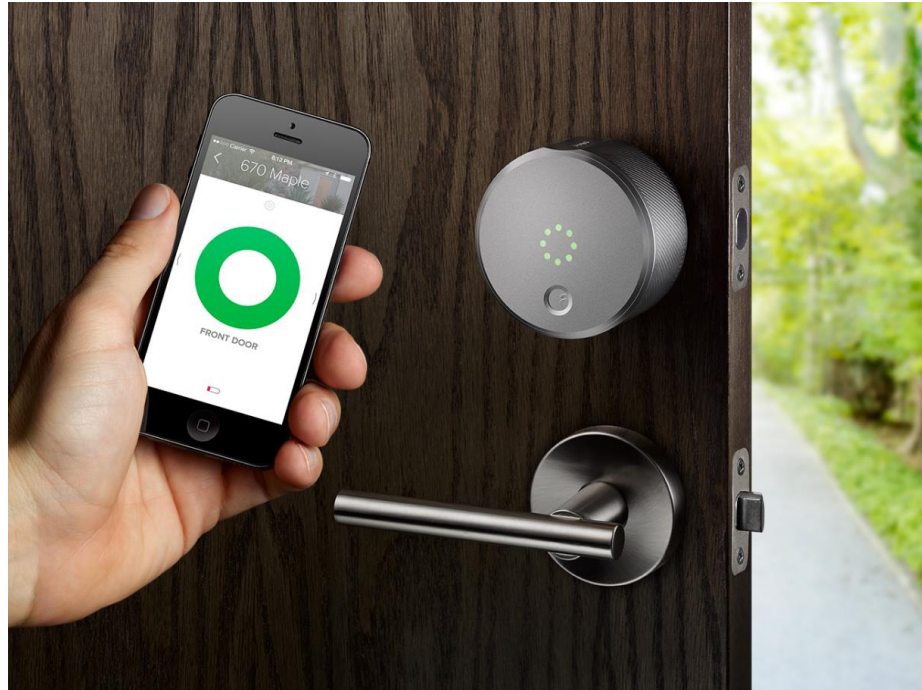
SmartMotor™ is a highly programmable, integrated servo motor system that is integrated with a motor, an encoder, an amplifier, a controller, RS232/RS485 communication, and IOs.

SmartMotor now features optional **COMBITRONIC** technology. To learn more what you can do with **COMBITRONIC**, please [click here](#).

[SmartMotor at a Glance](#) [Photo shots](#) [Case Studies](#) [Support Downloads](#) [CAD Files Download](#) [Knowledge Base](#) [Application Video](#)

Smart Lock

<https://techcrunch.com/2014/10/14/august-smart-lock-on-sale/>



Smart Actuator The actuator that connects with you



Outline :

- Smart monitoring ?
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- Data Communication

Local unit





Raspberry Pi

*Computer Laboratory de
l'Université de Cambridge*



ARDUINO

Massimo Banzi and al. Design Institute Ivrea, Italy

Comparaison:

https://www.robot-maker.com/shop/blog/10_Arduino-Raspberry-Pi.html

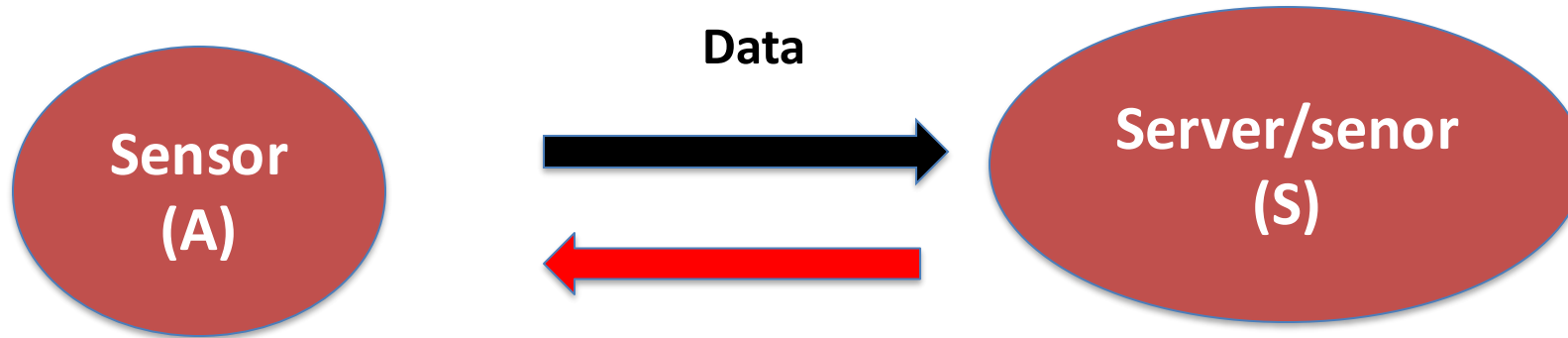
Arduino vs. Raspberry Pi - Which is best

Add0hms



Data Transmission

Data transmission



Data transmission



1) Bi-directionnel data transmission

- Verification
- Control
- Update

Data specification

- Size
- Frequency
- Real time
- Latency

Latency : the time necessary for a packet of data to get from one point to another.

Wired and wireless infrastructure ?

Wired infrastructure

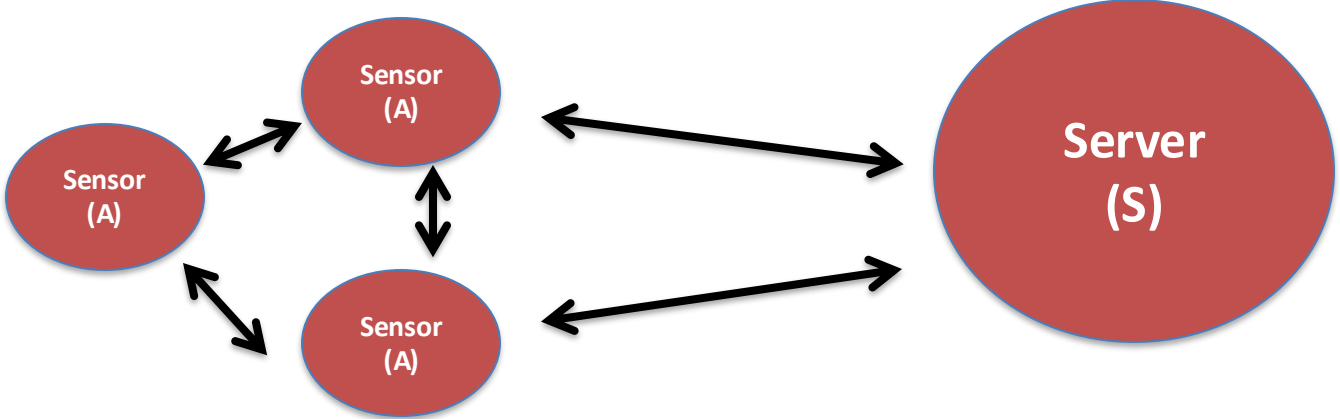
- Bidirectional (transmission and Control)
- Large data
- Increased security regarding wireless technology

Wireless infrastructure

- Used in the absence of wired infrastructure
- Ease installation
- Moderate amount of data
- Low / Medium sensitivity of the information (information security?)

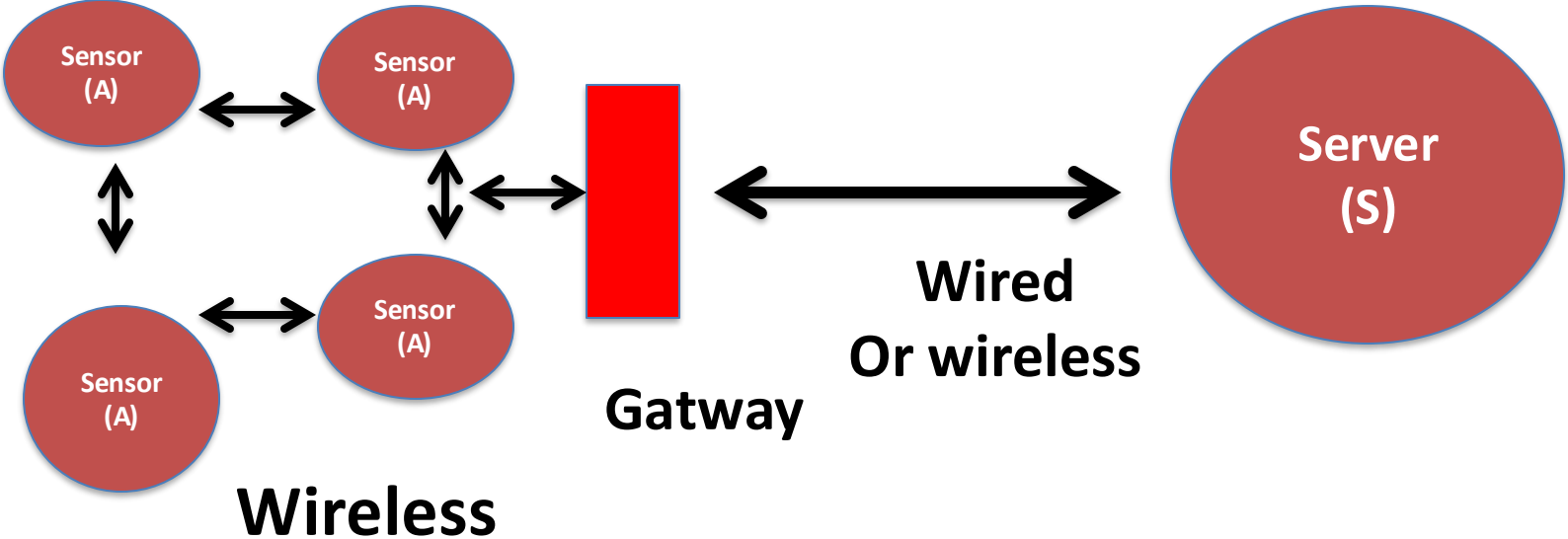
Sensors network

Connected sensors



Sensors network

Hybrid system



Reduce the energy consumption ?

- Protocol
- Frequency
- Embedded (in the smart sensors)
- Data variation

Data transmission security ?

Reliability:

The ability of a system to perform according to specifications without degradation or failure.

Data transmission security

Cyber security

Technologies, processes and practices designed to protect networks, computers, programs, devices and data from attack, damage or unauthorized access.

Data transmission security

What to do in case of absence of data transmission?

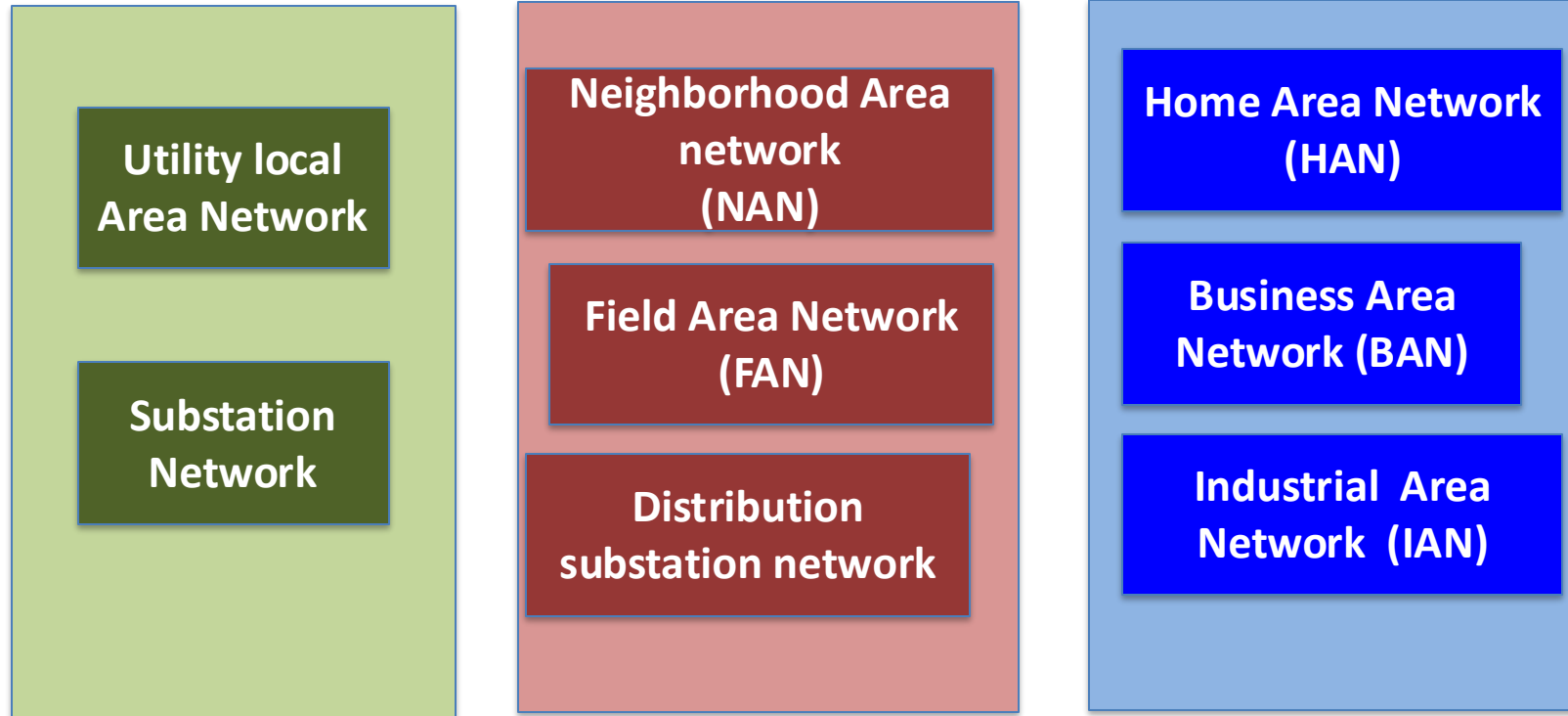
Analysis of the origin:

- Sensor's fault
- Communication fault
- Cyber attack

How Information Travels Wirelessly



Data transmission in the Electrical Grid



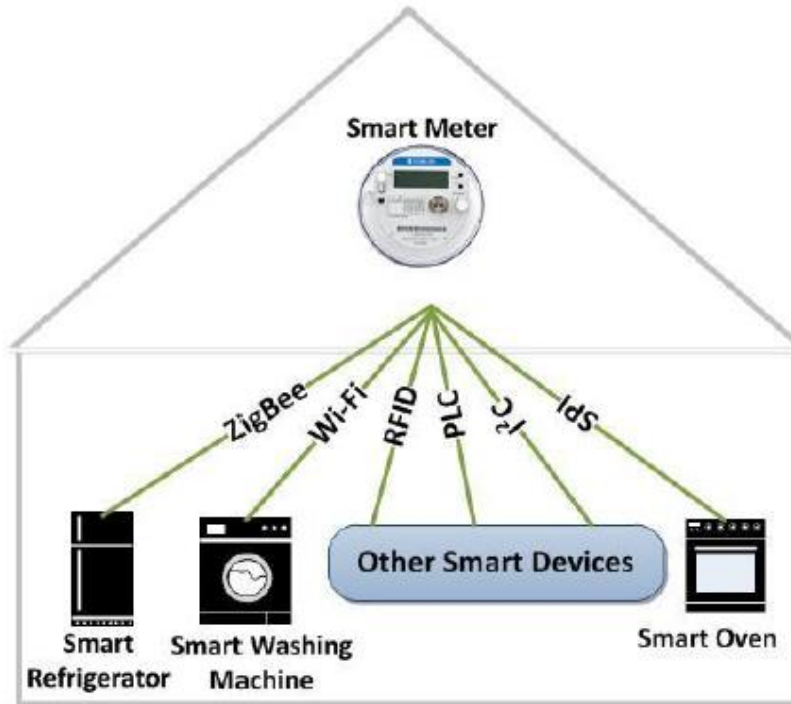
**Wide Area Network
(WAN)**

**Regional/metropolitan
area networks**

**Local Area Network
(LAN)**

**Consumer Area Network
(LAN)**

HOME AREA NETWORKS (HAN)



Wireless technologies

- ZigBee,
- Wi-Fi,
- Bluetooth
- 6LoWPAN

ZigBee Technology

- Most used in HANs.
- Operates in the license-free frequency for short range
- Bidirectional

Advantages

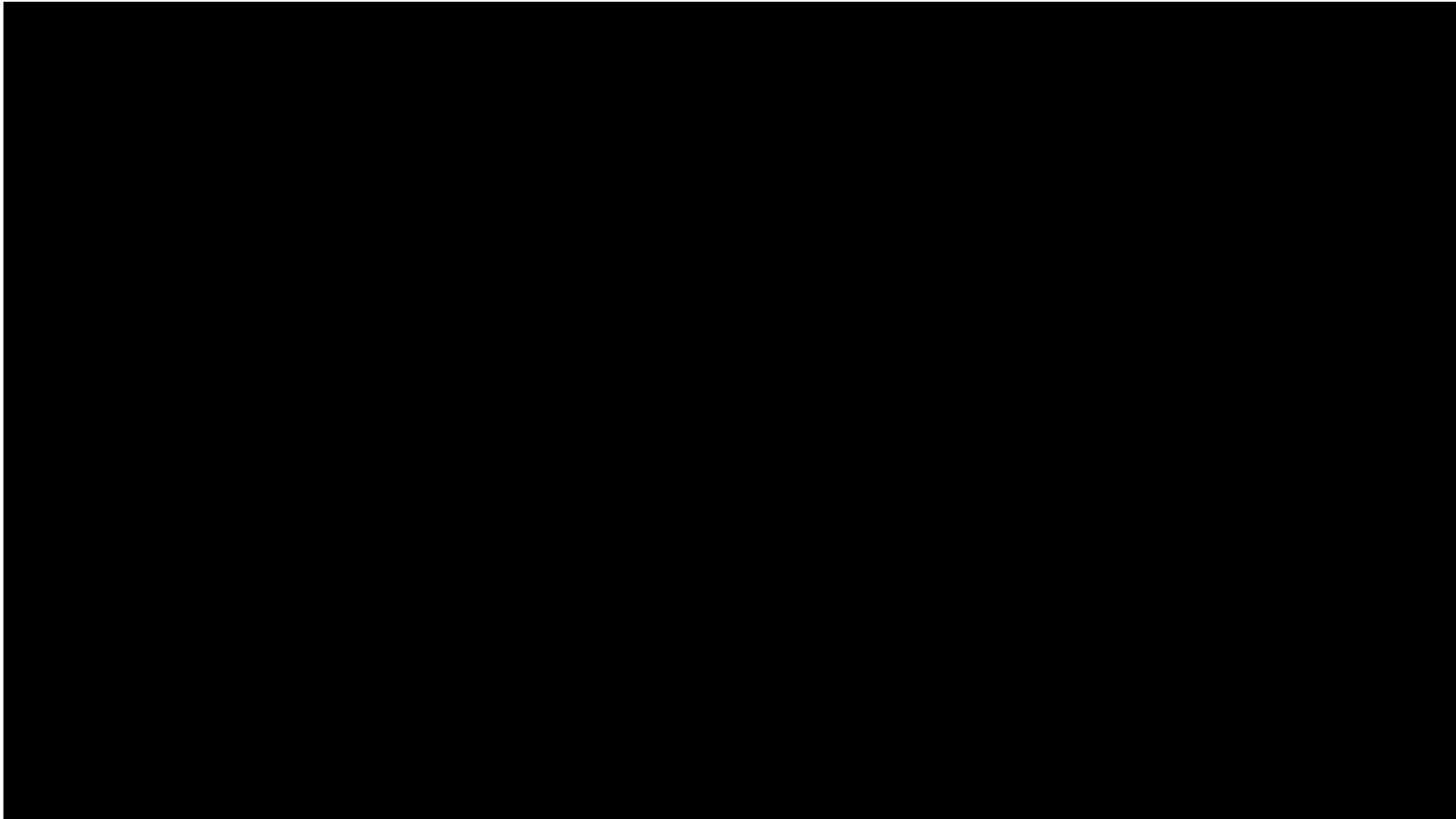
- Highly secured connection (128-bit AES encryption)
- Low power consumption; batteries for longer lifetime (100-1000 days)
- Could be used in large network

Disadvantages

- Requires additional devices (cost)
- Low data transmission rates

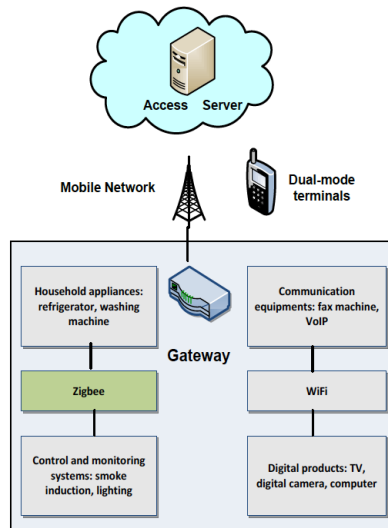


Smart Home Demonstration by the Zigbee Alliance



Wi-Fi Technology

- Bidirectional radio frequency (RF)
- Utilized for high-rate, information-related devices such as computers, TV, digital camera, data download



Advantages

- Highly secured connection (128-bit AES encryption)
- does not require a special gateway because it inherits the Internet protocol

Disadvantages

- Consumes high power compared to ZigBee (The battery lifetime extends from 0.5-5 days)
- Sensitive to electromagnetic radiation

Bluetooth® technology

- simple, secure, low power, low cost
- Used in billions of devices: mobile phones, computers, medical devices, home entertainment,...

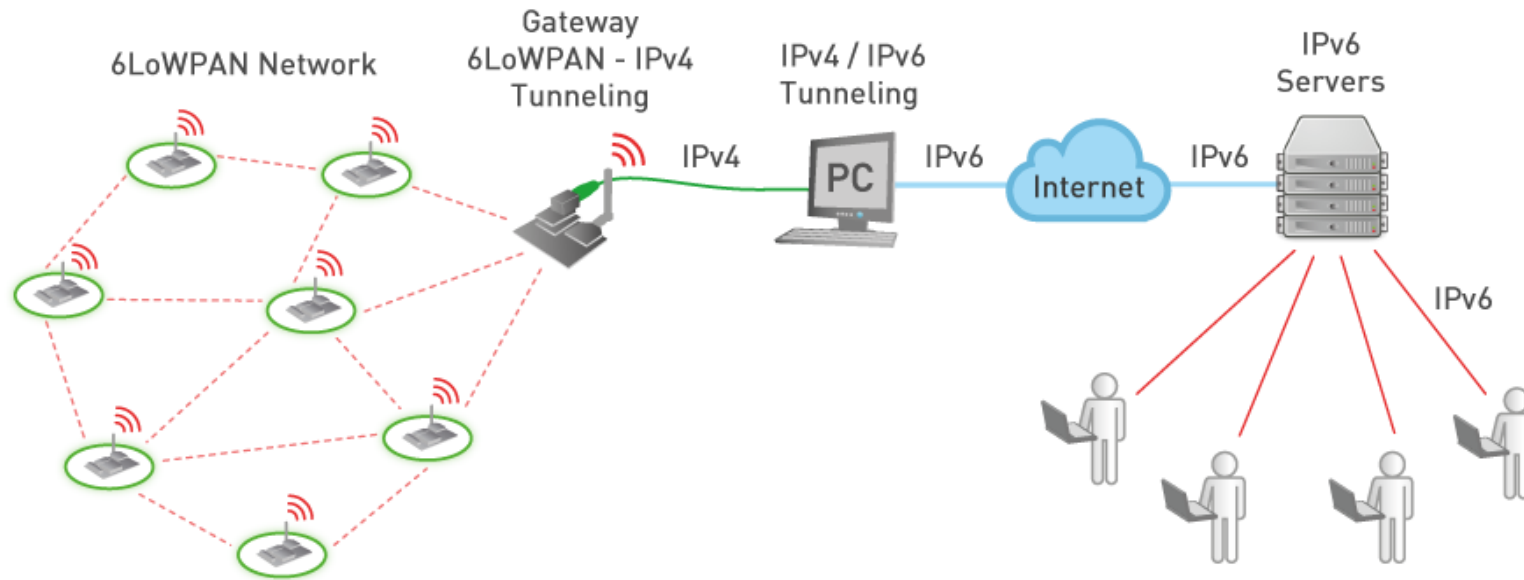
Range (distance)

- Class 3 : range up to 1 meter
- Class 2 radios : most commonly found in mobile devices, range of 10 meters
- Class 1 radios: used primarily in industrial use cases, range of 100 meters

6LoWPAN

IPv6 Low power Wireless Personal Area Networks

- Created for the Internet of Things
- Every node has its own IPv6 address, allowing it to connect directly to the Internet using open standards.



Neighborhood Area (NAN)

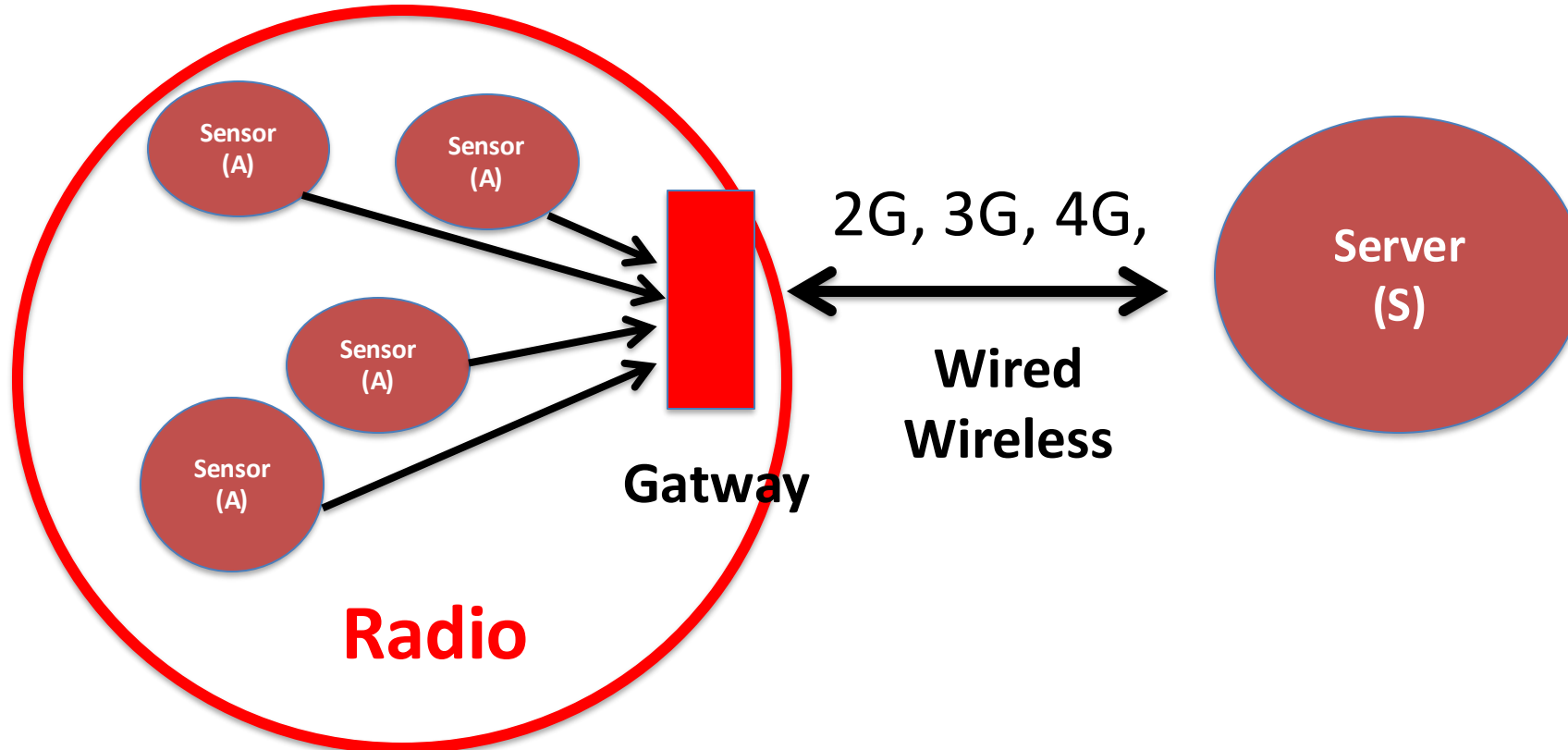
- **Radio transmission**
- **LoRa System**
- **SIGFOX**

Radio Transmission Sub 1GHz

*Radio transceivers and
proprietary protocols*



- Requires internet gateway



Radio Transmission

Sub 1GHz

*Radio transceivers and
proprietary protocols*

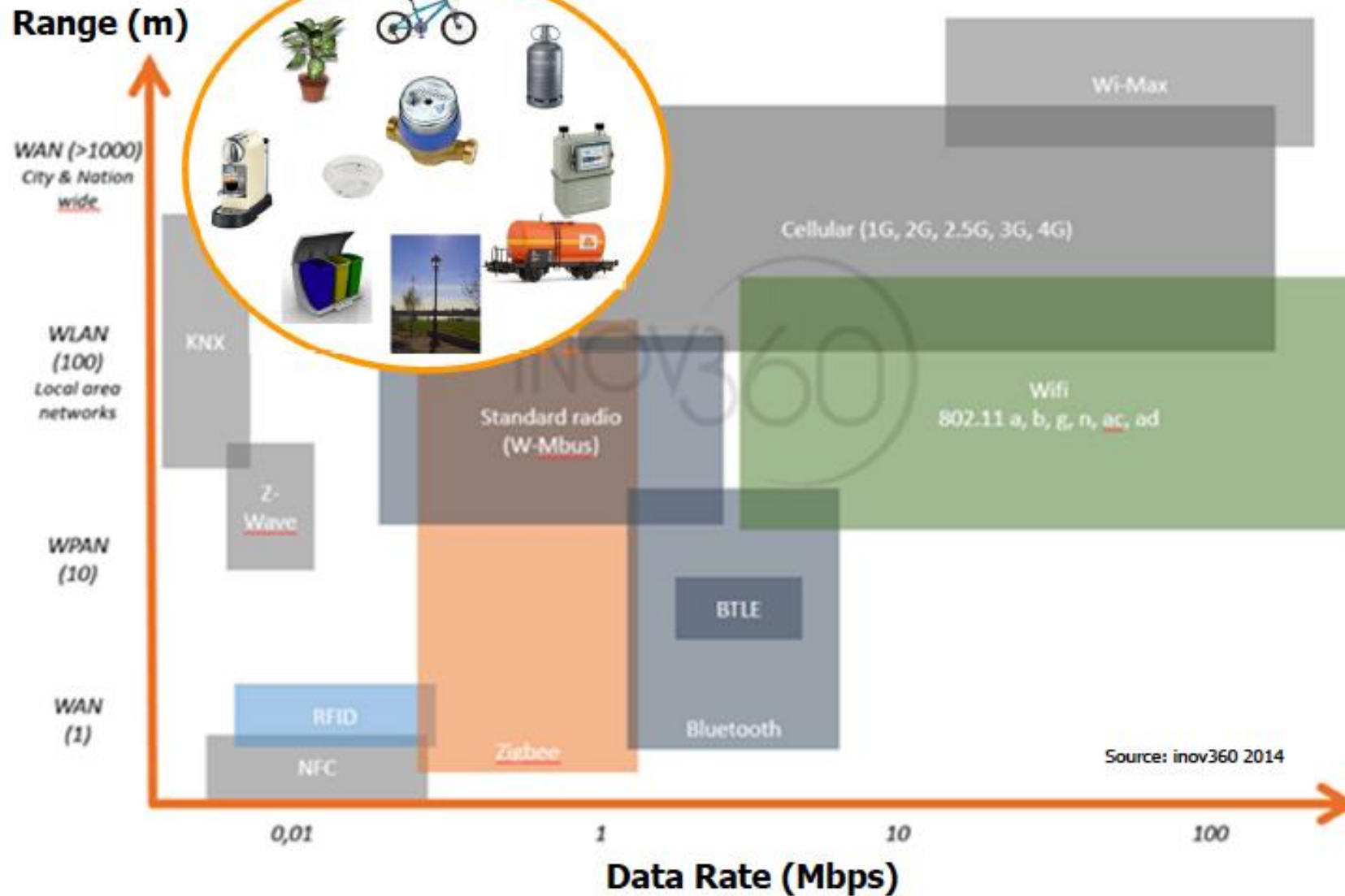


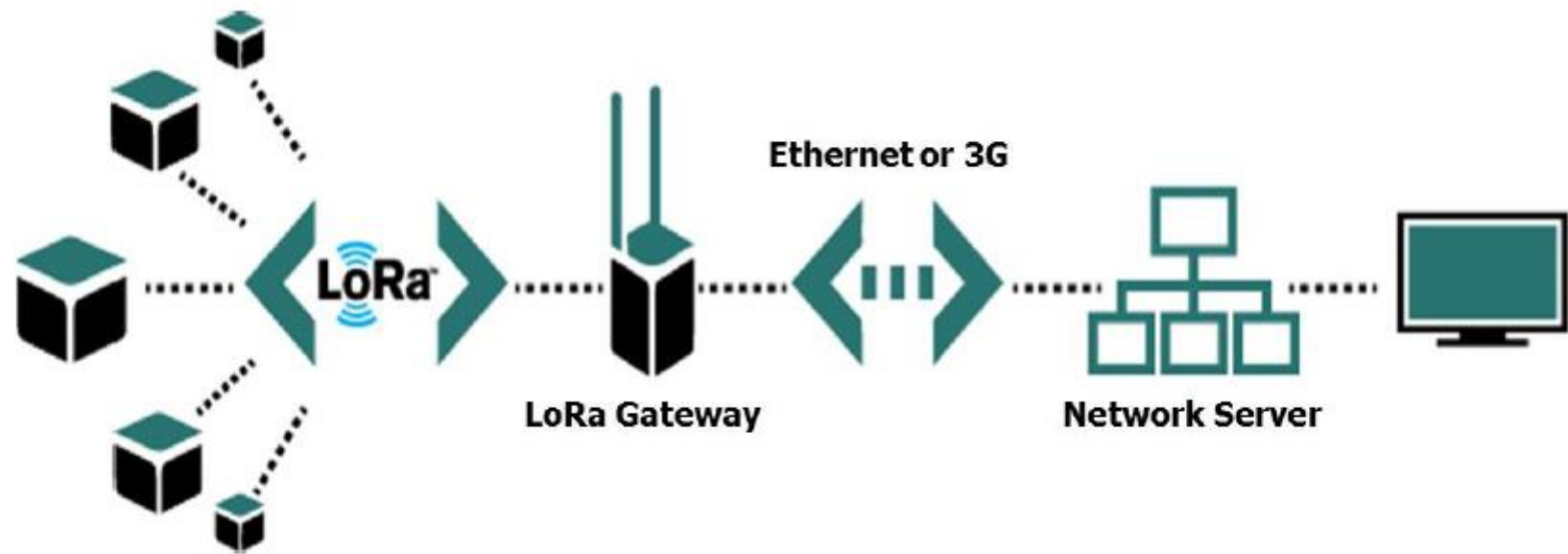
- Proprietary system
- Low frequency band 433, 868, 915 MHz
- Can reach high distance : up to 25 km
- Used by many utilities for Neighborhood Area network (NAN)



<https://www.lora-alliance.org/>

Existing Communication Technologies





LoRa

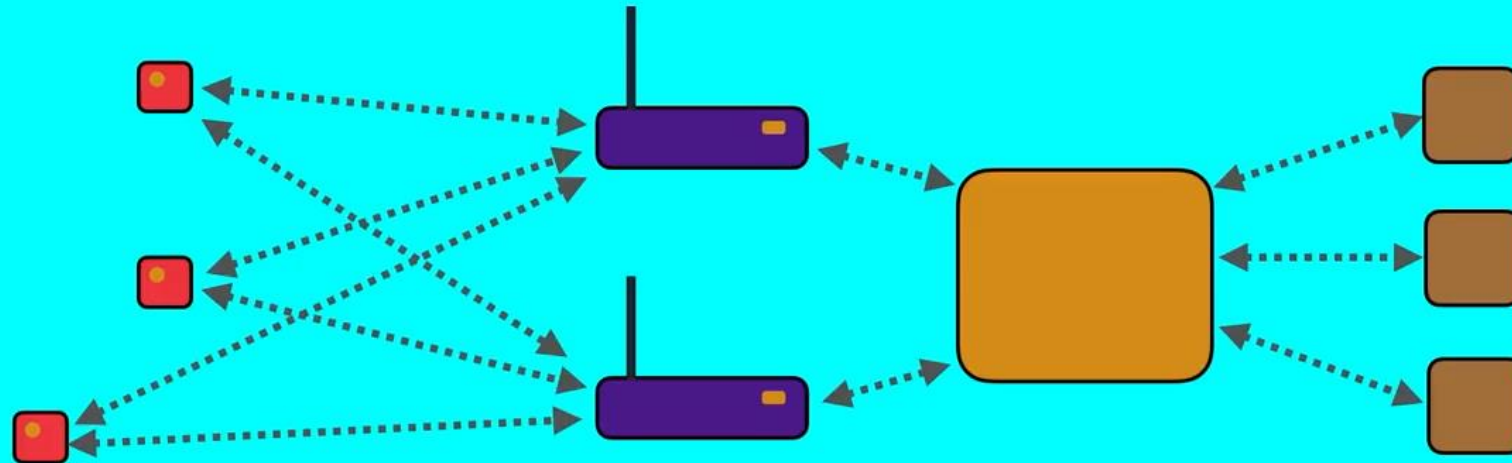


What is LoRa and LoRaWAN

mobilefish.com

LORA / LORAWAN TUTORIAL 2

What is LoRa & LoRaWAN



What is LoRa (2020) Learn Technology in 5 Minutes





<http://www.sigfox.com>

SIGFOX :

National network for transmission of “small – size” data.

implemented as follows:

- SIGFOX compatible modems are integrated within the physical objects.
- The modems send data to SIGFOX servers.
- The SIGFOX servers verify the data integrity and transmit it to customers' system.

SigFox

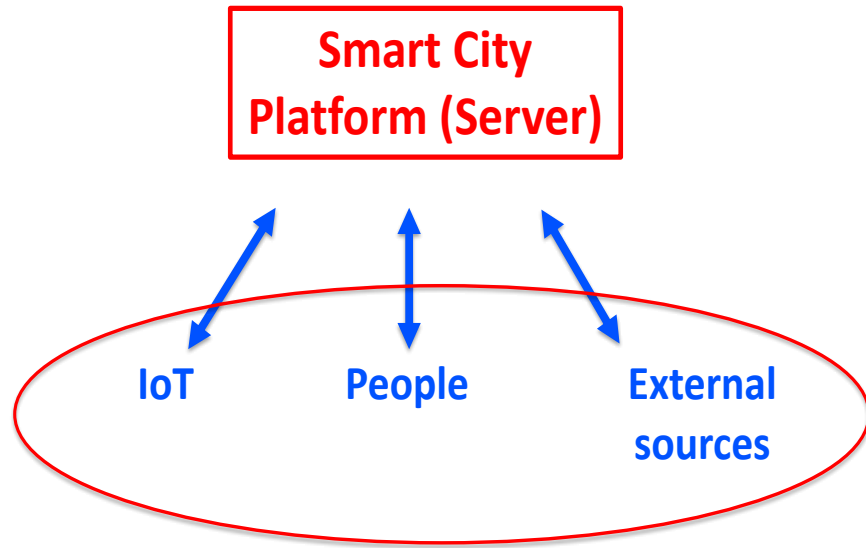
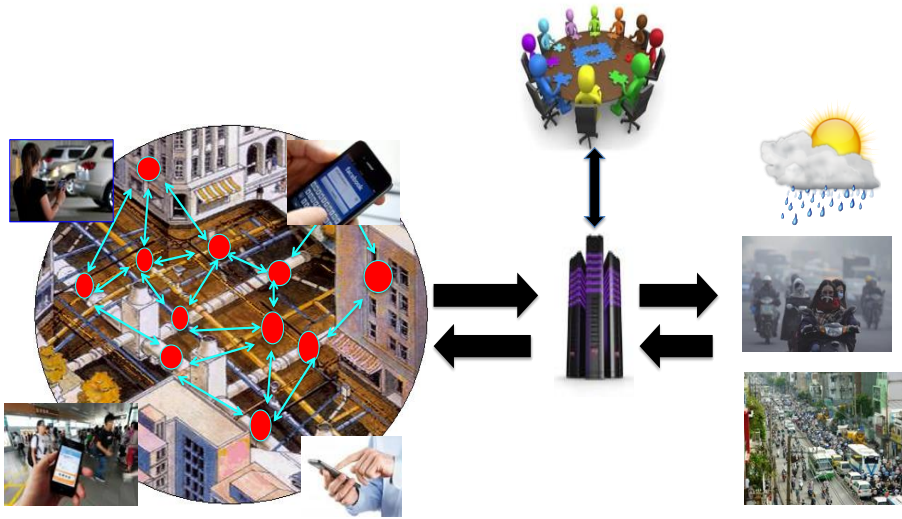


Sigfox™ Solutions for IoT

ON Semiconductor®



Conclusion



Selection of adequate

- Sensors
 - Human interaction
 - Systems interaction
 - Connectors
 - Data transmission
-
- Efficiency
 - Reliability
 - Security
 - Maintenance
 - Energy consumption

Thank you