Intel-IrriS

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION
IN THE MEDITERRANEAN AREA

Intelligent Irrigation System for Low-cost Autonomous Water Control in Small-scale Agriculture

Intel-IrriS

Introduction to IoT

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Prof. Congduc Pham
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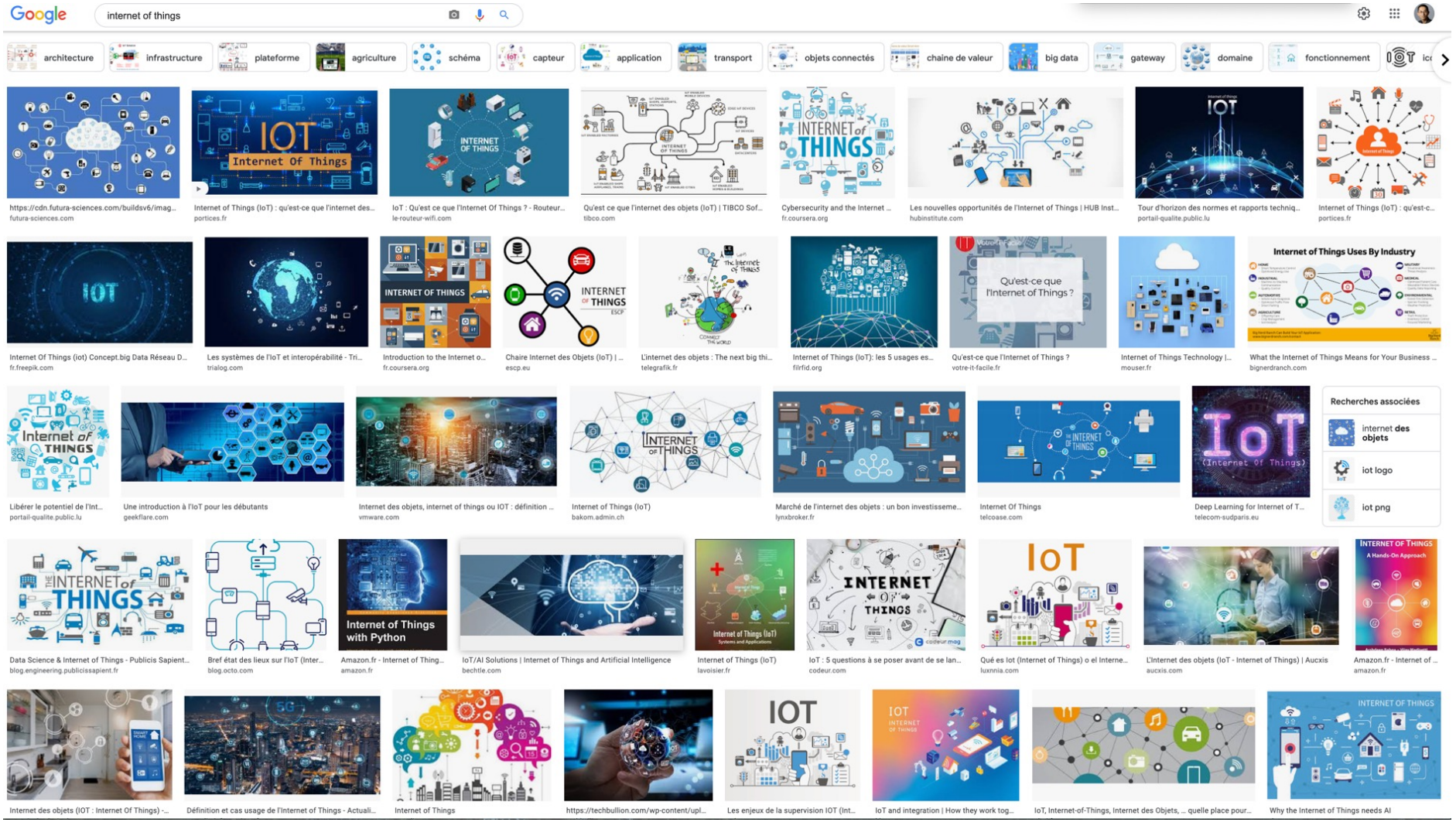
Université de Pau, France

UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR

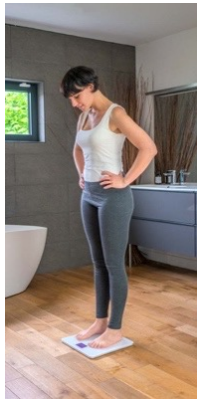
LIUPPA

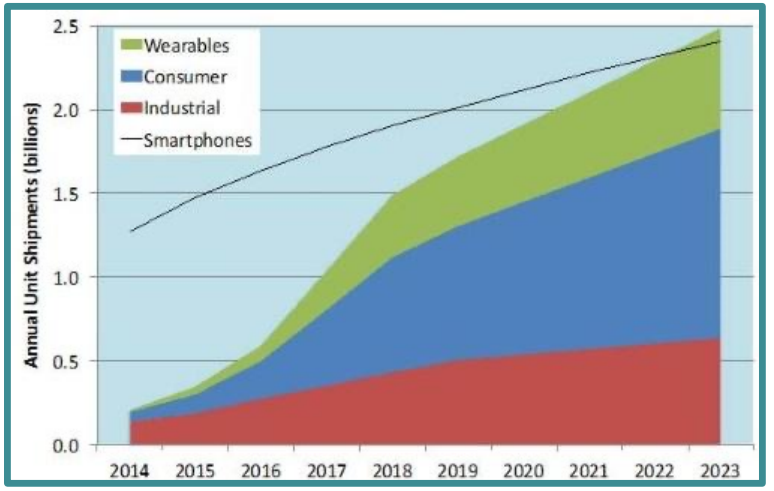
WAZIUP
IoT – from idea to reality
WAZIHUB

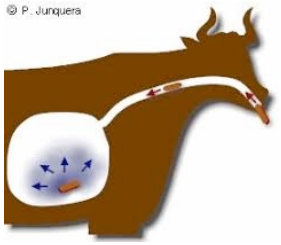
Googling for « Internet of Things »

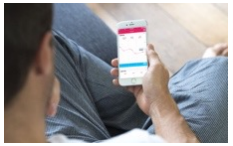


…shows communicating objects

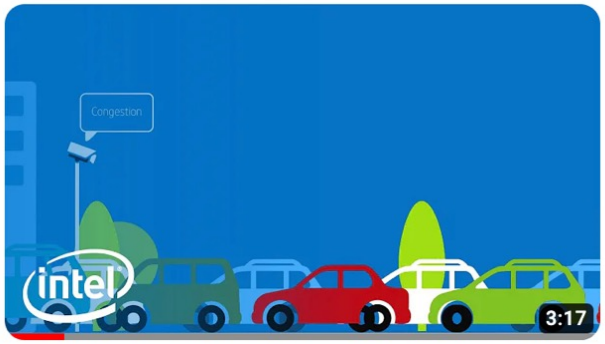








Also on YouTube: IoT teaser & tutorial videos



Intel IoT -- What Does The Internet of Things Mean?

591 k vues • il y a 8 ans

Intel

Fun, animated video answers: What does the Internet of Things mean? The Internet of Things (**IoT**) is an evolution of mobile, home ...

Intro | What is IoT | Transform our lives | Big picture | Example | Big Possibilities | Intelligent Traffic |... 9 chapitres

IOT Tutorial | IOT Tutorial For Beginners | IOT - Internet Of Things | IOT Course | Simplilearn

25 k vues • il y a 1 an

Simplilearn

This **IoT** tutorial video introduces you to **IoT** Technology and how it is revolutionizing the world today. Internet of things or **IoT** ...

Internet of Things (IoT) | What is IoT | How it Works | IoT Explained | Edureka

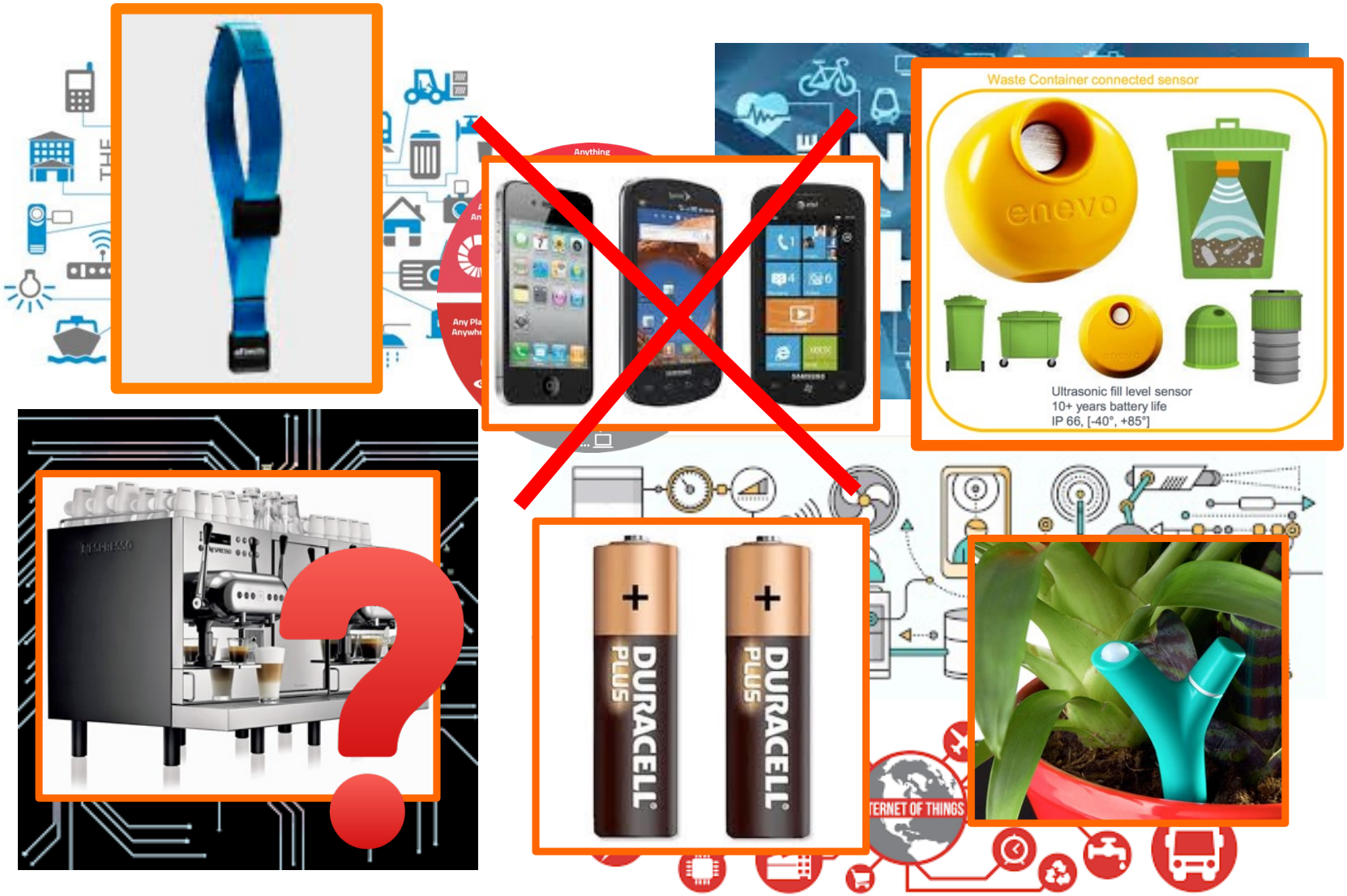
2,1 M de vues • il y a 4 ans

edureka!

Subscribe to our channel to get video updates. Hit the subscribe button above. #Edureka #EdurekaIoT #InternetOfThings ...

Sous-titres

All communicating objects?



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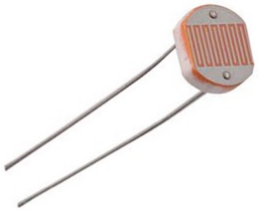
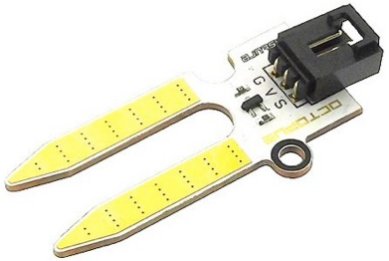
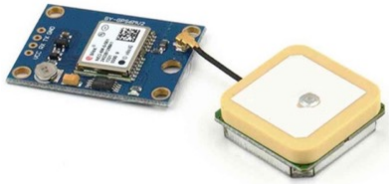
IoT=interactions with physical world

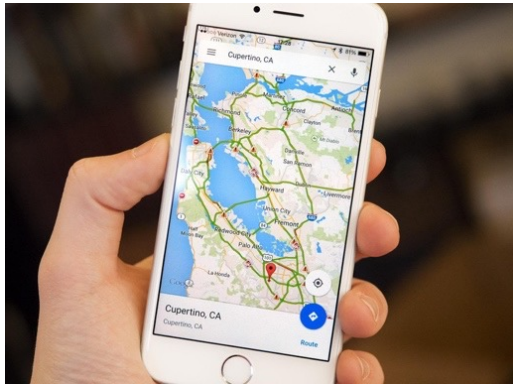
Q: Interactions? How?

Interaction: Sensors



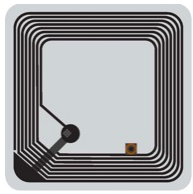






Interaction: RFID, NFC

- Radio-Frequency Identification (RFID)
- Near Field Contact (NFC)



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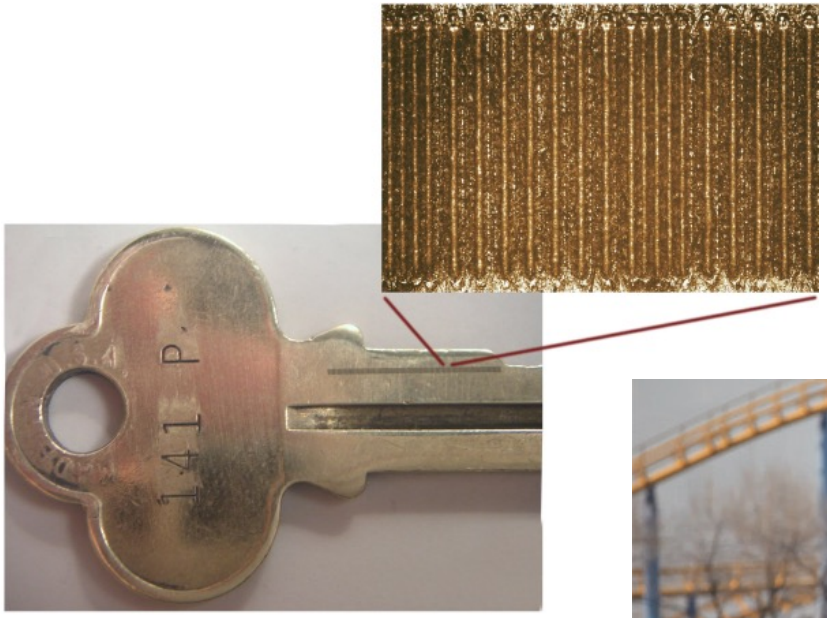
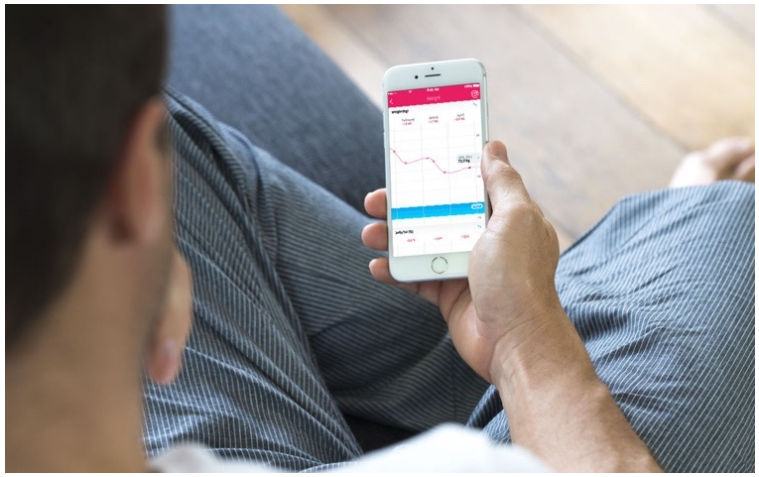
Interaction: always complex?

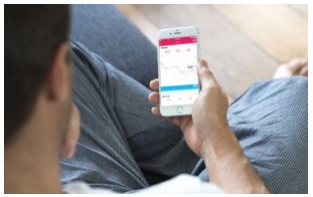


Home/consumer IoT products



Pictures from WiThing, https://www.withings.com/eu/fr/products/body

Local interaction is possible…



…but IoT added-values come from interactions & linked data!

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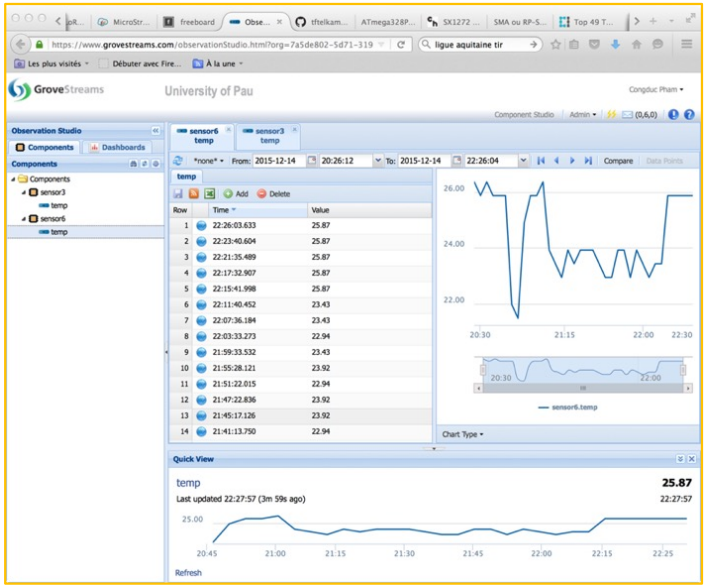
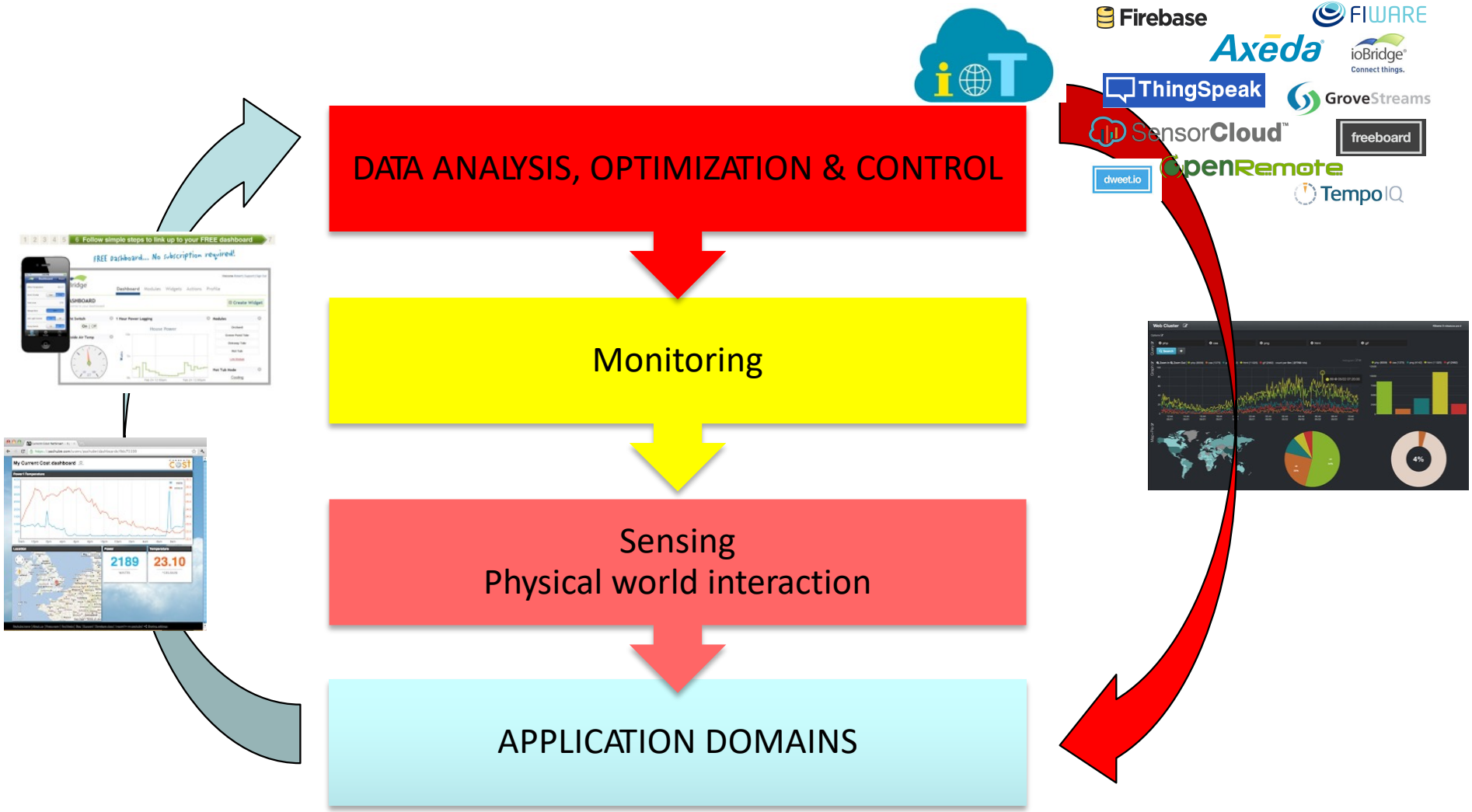
Clouds for IoT

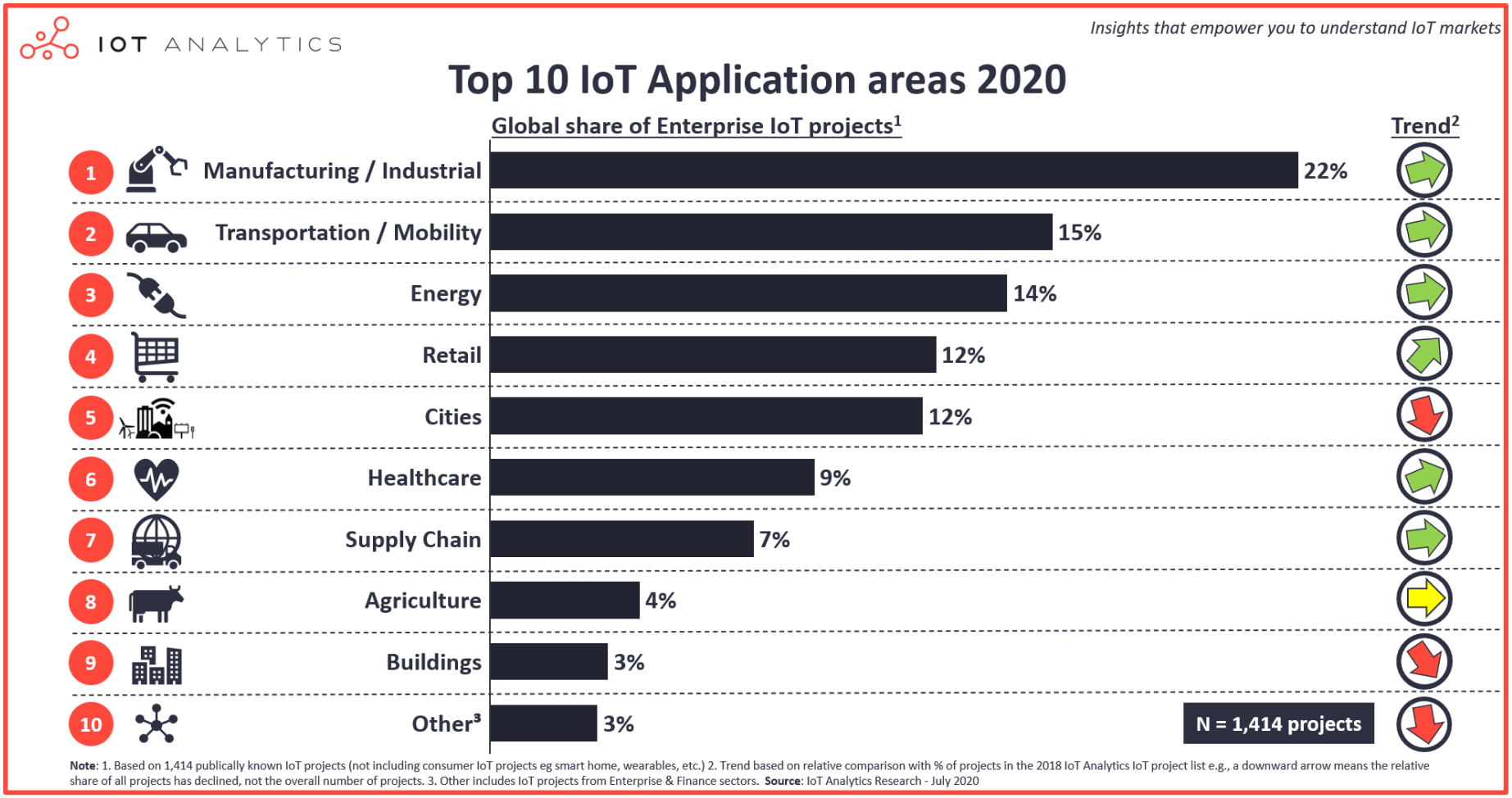
VS



Sense, Monitor, Optimize & Control

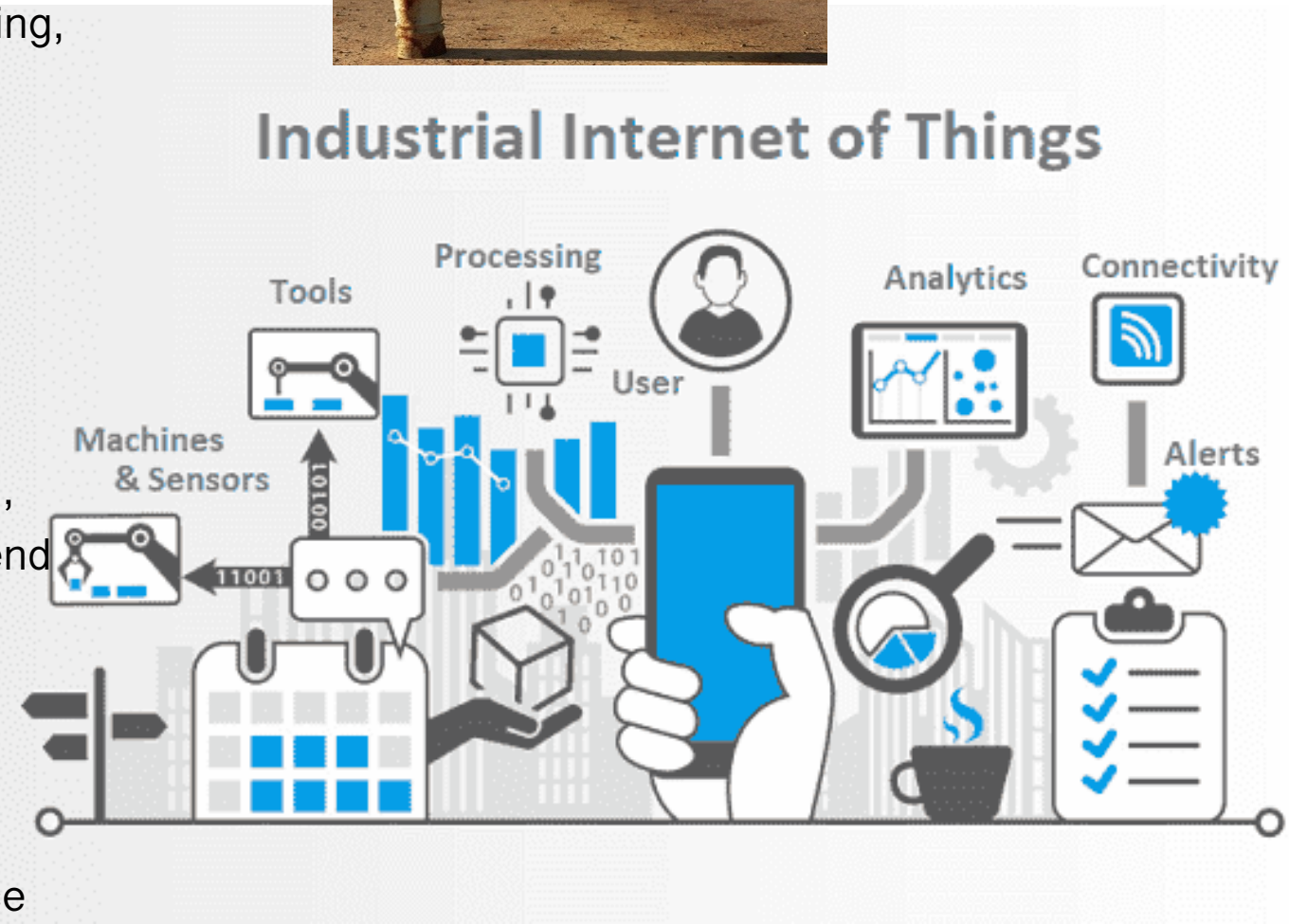


Top IoT applications, 2020



IoT in industry

- Infrastructure monitoring, Security & Safety
- Continuous process improvement, Process automation, Process optimization
- Smart logistics management, remote management, tracking,
- Connectivity to back-end system, integration of smart tools, Interoperability
- Data analysis, Supply Chain Optimization, Predictive maintenance



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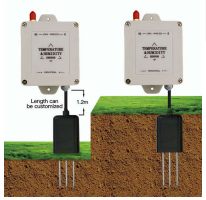
IoT for Smart Agriculture







Soil Monitoring

Connected Agriculture

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Is IoT the solution for your problem?

Q: How to enable municipal street sweepers to report illegal dumping, leaking pipes and emergencies?

"smartphone"
Hum, they only have 2 hands…

ITU Telecom World 2018
Phathwa Senene at MTN booth

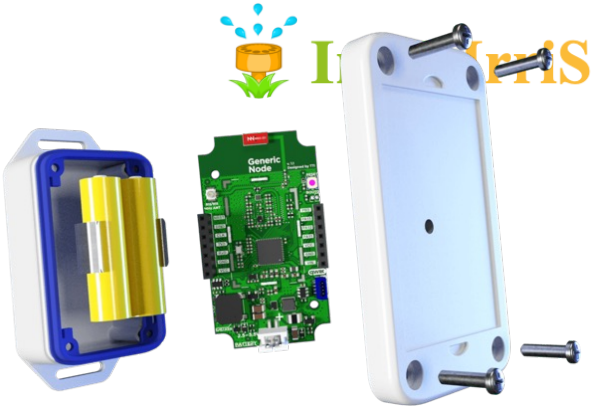
IOT

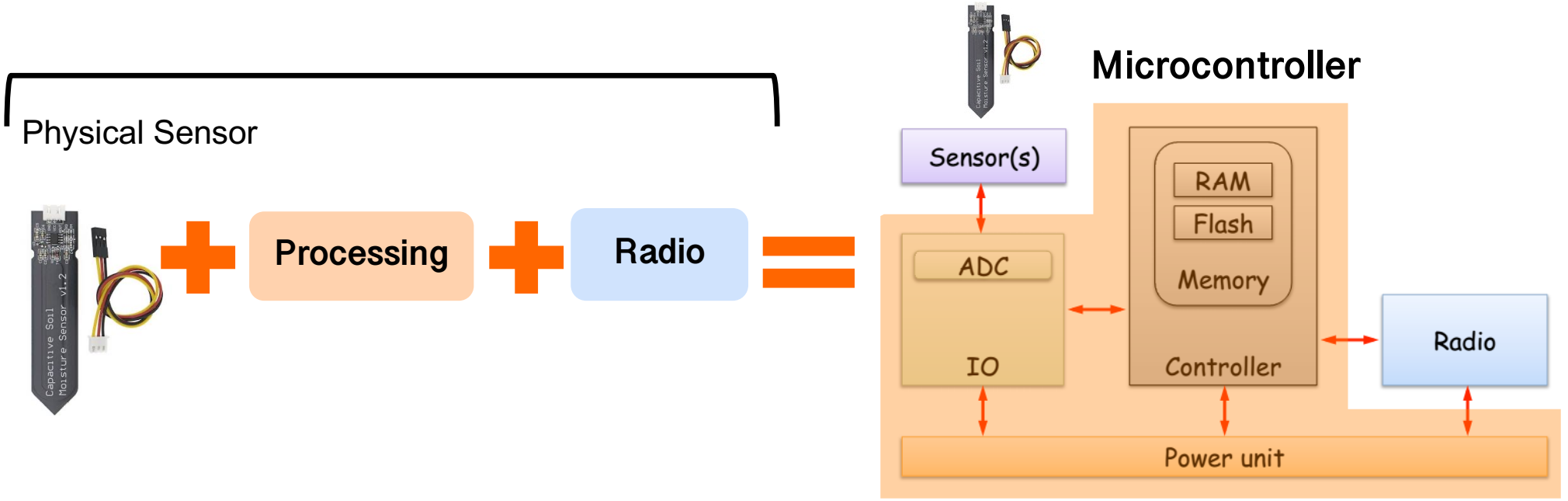
TECHNOLOGY ?

CONCEPT ?

Typical IoT device

- IoT device can be viewed as a simple Embedded System

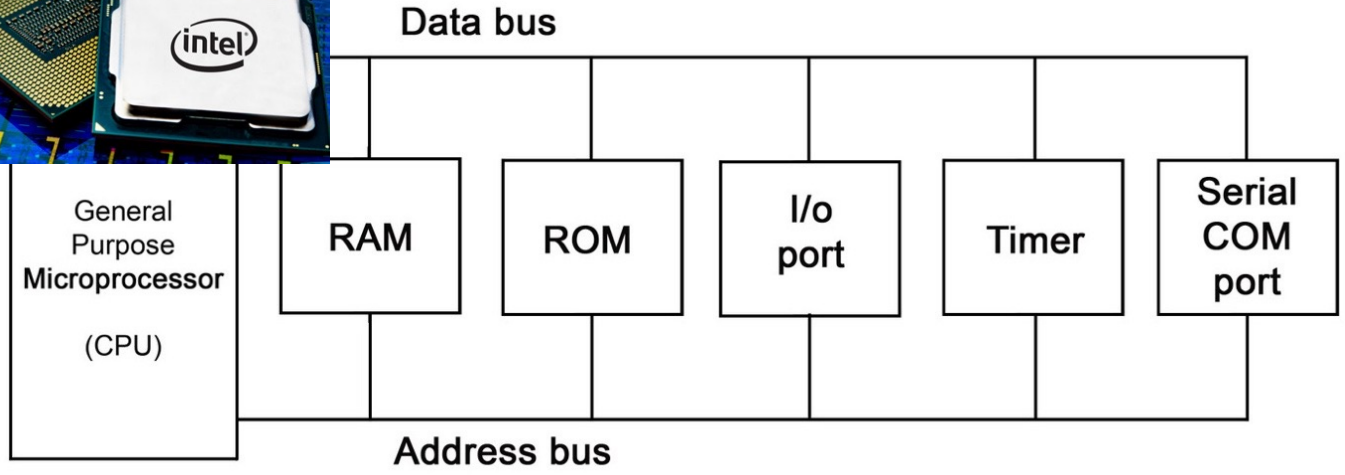




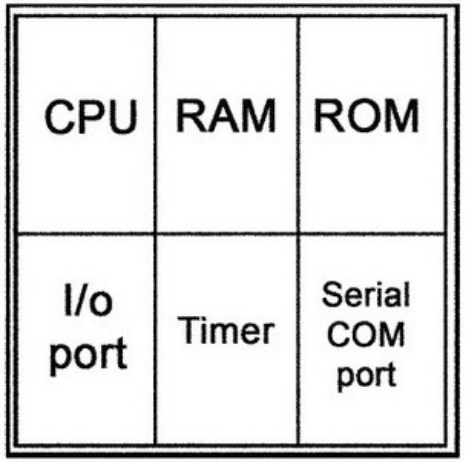
Q: uprocessor vs ucontroller?

Microprocessors & Microcontrollers

- A microprocessor unit (MPU) is a processor on one silicon chip
- A microcontroller unit (MCU) is a microprocessor with some added circuitry on one silicon chip
- Microcontrollers are used in embedded computing and most IoT devices are based on microcontrollers



VS

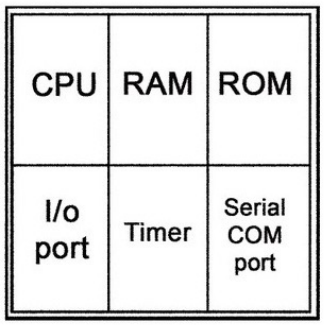


(Single chip)

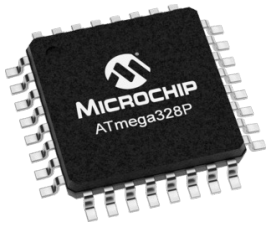
From "An Embedded System Overview" by Dr. Eng. Amr T. Abdel-Hamid

From µcontroller to µcontroller board

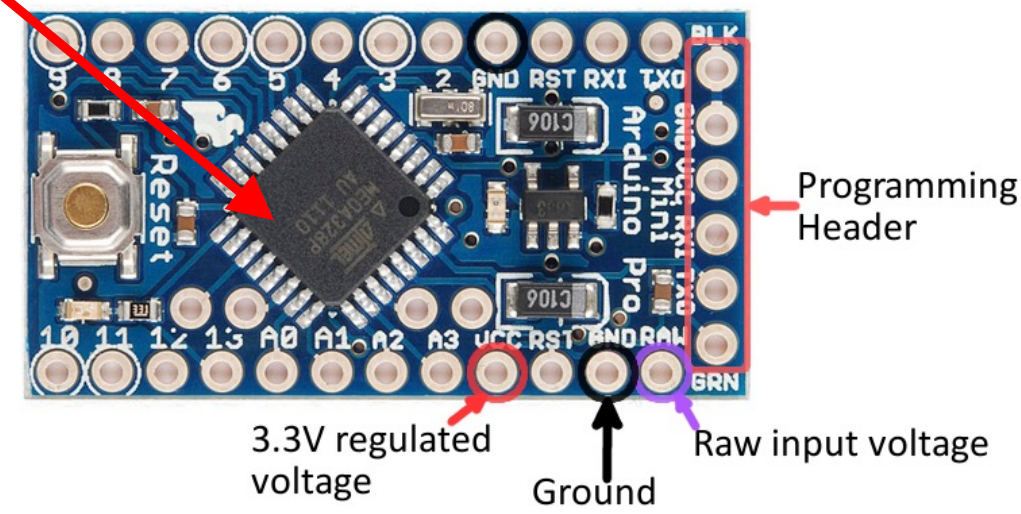
- A µcontroller can be standalone…



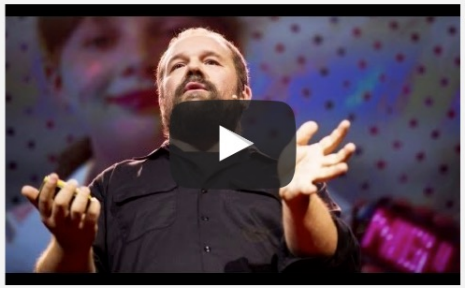
(Single chip)



- But, it is usually mounted on a board with additional electronics parts
  - Leds, Voltage regulators
  - Easy access to pins
  - Reset button
  - Serial-USB interface



Arduino's success story starting in 2005



WHAT IS ARDUINO?

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects.

ARDUINO BOARD

Arduino senses the environment by receiving inputs from many sensors, and affects its surroundings by controlling lights, motors, and other actuators.

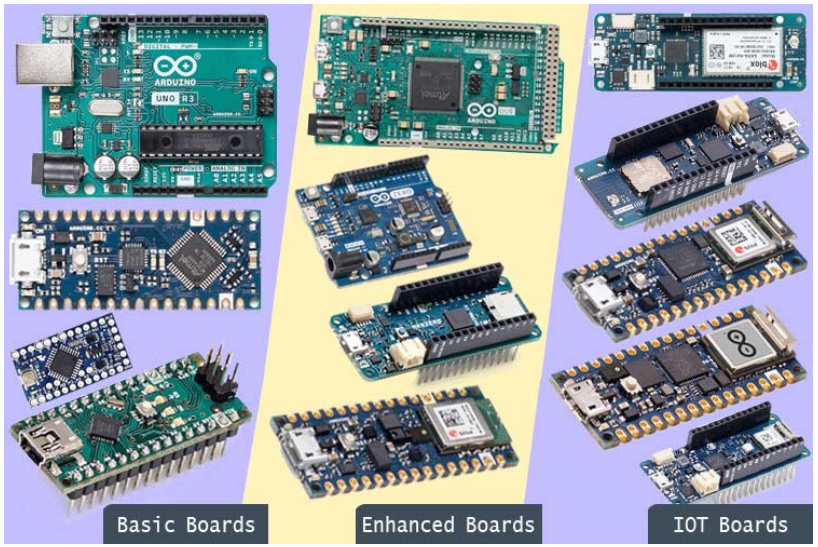
```
void setup() {
 }

void loop() {
 }
```

ARDUINO SOFTWARE

You can tell your Arduino what to do by writing code in the Arduino programming language and using the Arduino development environment.

17 years later: the incredibly large microcontroller board ecosystem!



STM32 Nucleo-32

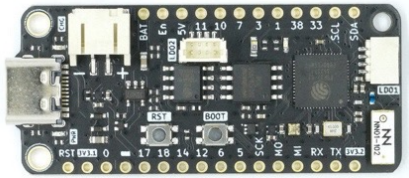
Teensy 3.2

LinkIt
Smart7688 duo

Adafruit Feather

uPesy ESP32

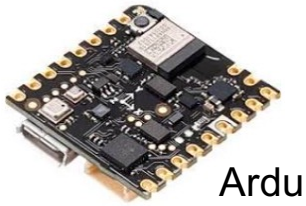
ePulse Feather Low Power ESP32



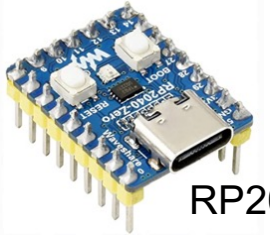
FeatherS3 – ESP32-S3

Heltec ESP32

XIAO SAMD21



Arduino Nicla
Sense ME



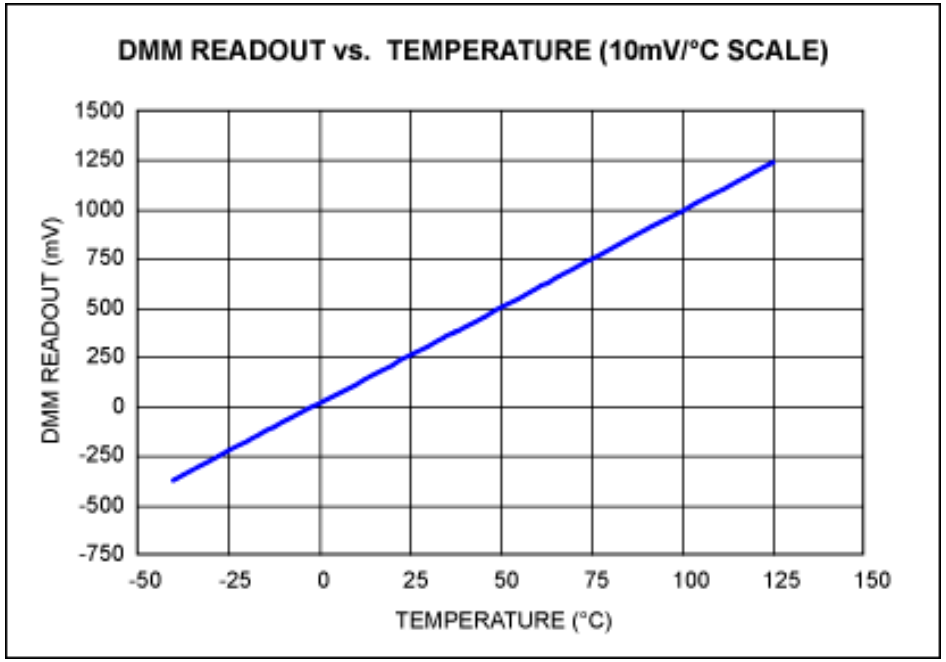
RP2040
zero

DFRobot
Beetle

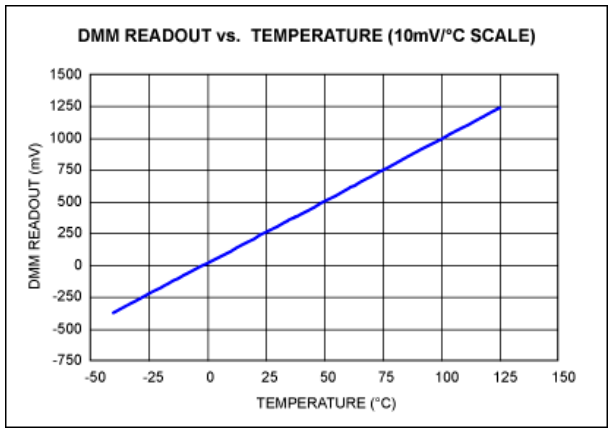
QT Py ESP32-C3

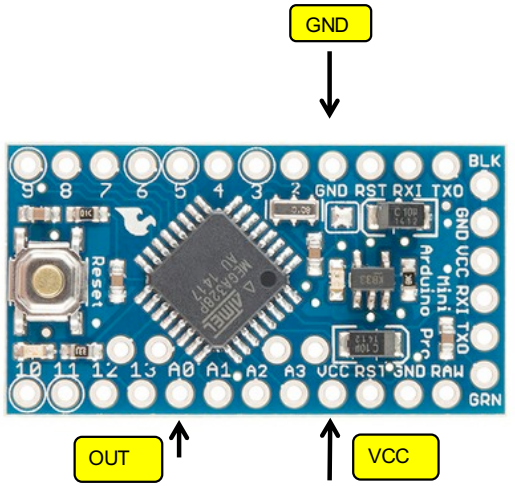
Interacting with the real world?

- Taking the simple analog sensors example
- Analog sensors provides a voltage output that varies according to a physical parameter, e.g. temperature, humidity, luminosity,…



Digitalizing the physical world!





Microcontrollers have Analog/Digital (A/D) converter to map a voltage to a numerical value. **A/D with 10-bit resolution give numerical values in [0, 2^{10}-1] = [0, 1023]**

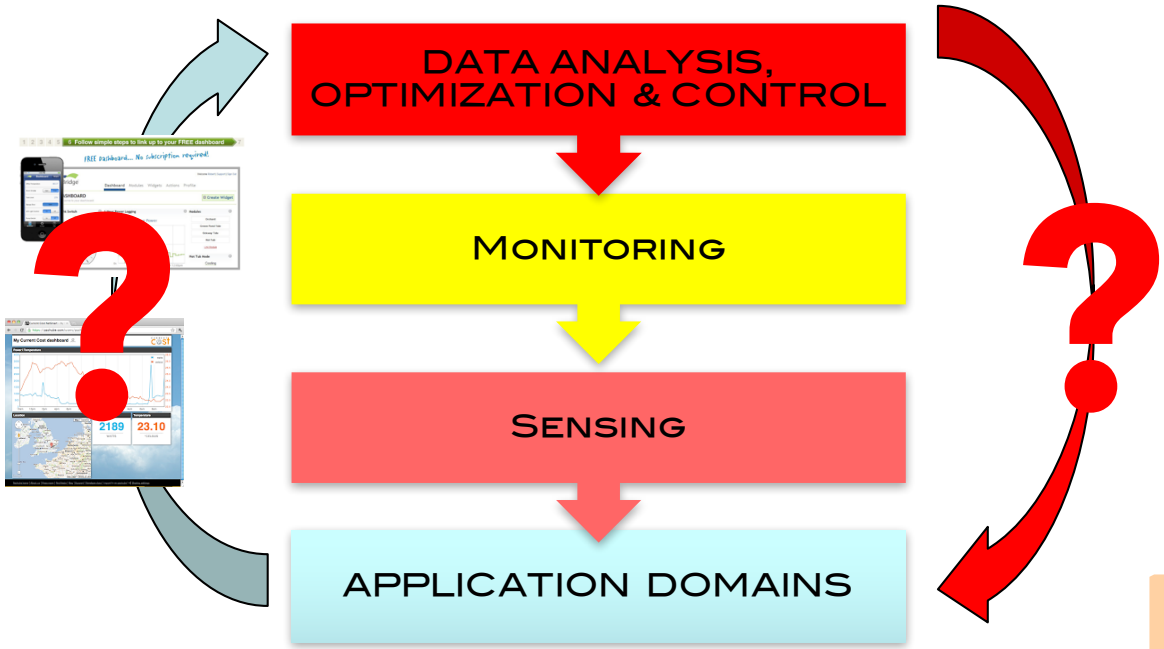
Vcc usually refers to the operating voltage of a given microcontroller. Vcc is typically 3.3V.

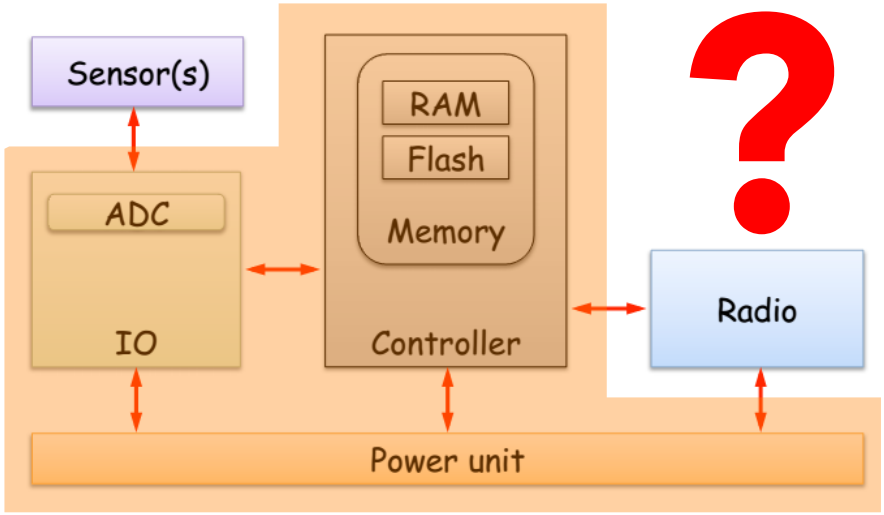
If 0=0V and 1023=3300mV then **3300mV/1024=3.22mV is the granularity of the measure**

Reading a digital value of 100 means 100*3.22mV=322mV

If the sensor output is 10mV/1°C then the physical temperature is 322mV/10mV=32.2°C

How to collect data?



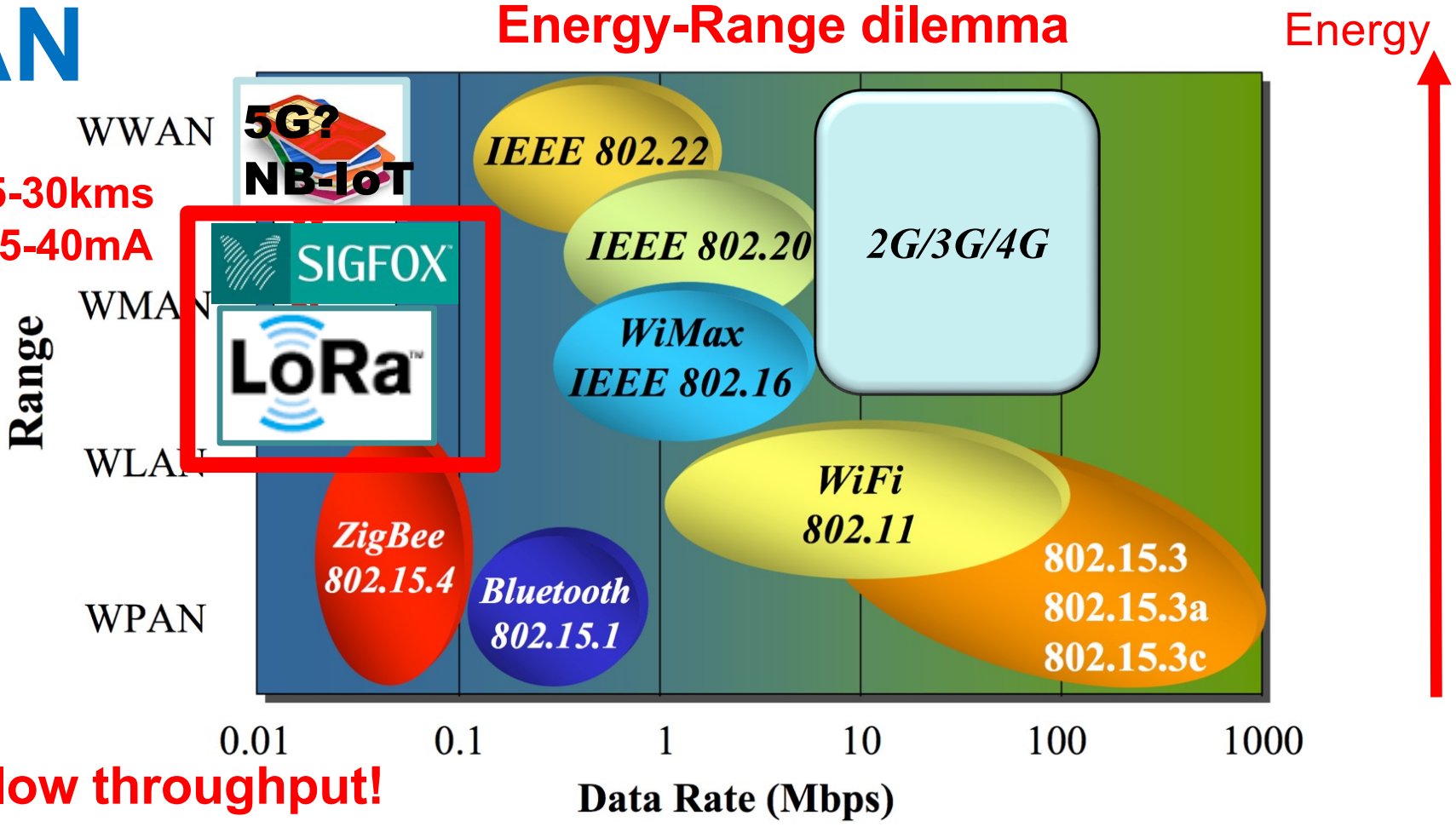


Microcontroller

Low-power & long-range radios

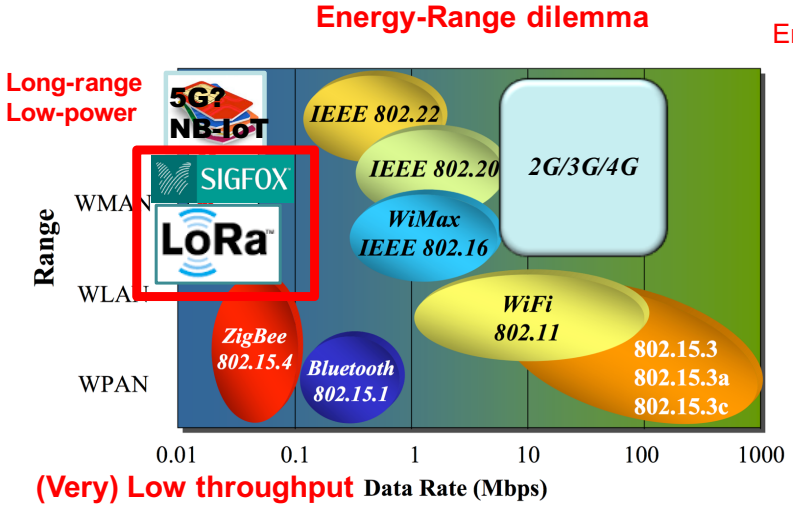
LPWAN

Long-range: 5-30kms
Low-power: 15-40mA



Very low throughput!

Energy consumption comparison



Energy

2G	3G	LAN	ZigBee	Lo Power WAN
N/A	N/A	O: 300m I: 30m	O: 90m I: 30m	Same as 2G/3G
200-500mA	500-1000mA	100-300mA	18mA	18mA-40mA
2.3mA	3.5mA	NC	0.003mA	0.001mA

2500mAh

TX power: 500mA. Mean consumption: (8sx500+3592sx0.005)/3600=1.11mA

2500/1.11=2252h = 93 days = 3 months ☹

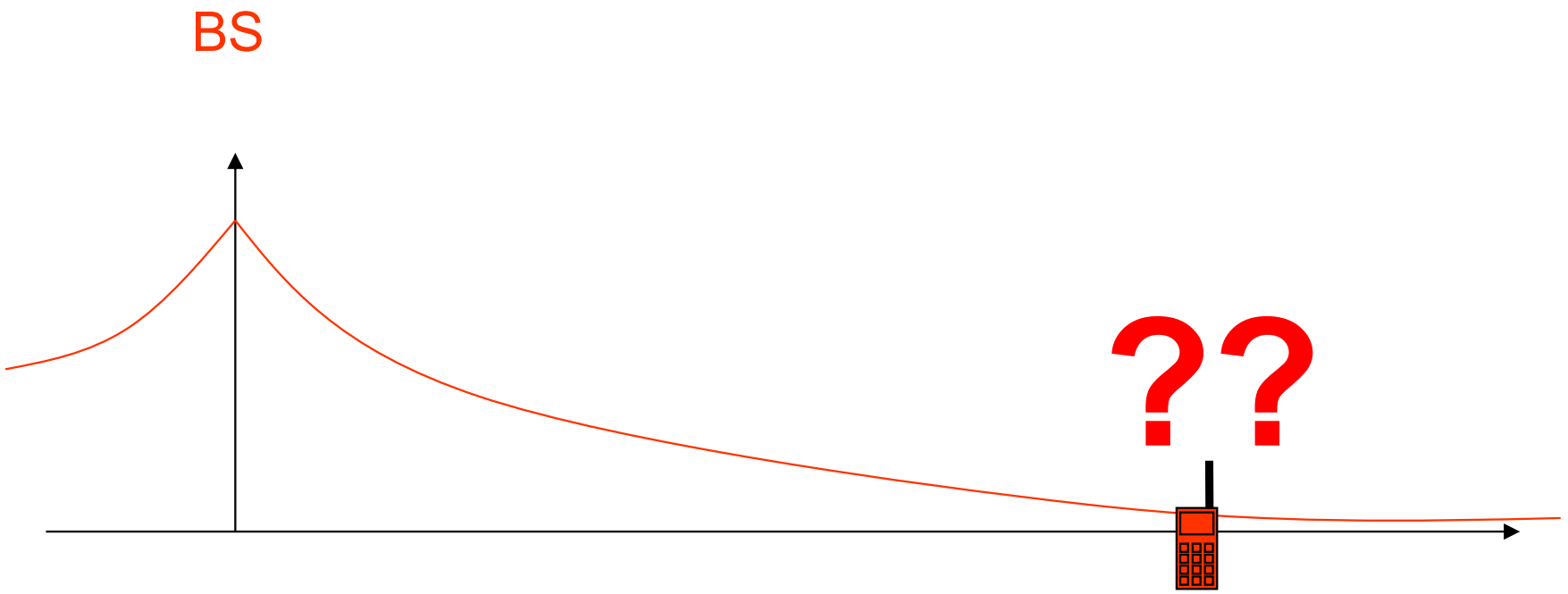
In most cellular networks, the device is still maintaining communication with BS even if it is inactive

TX power: 40mA. Mean consumption: (2sx40+3598sx0.005)/3600=0.027mA

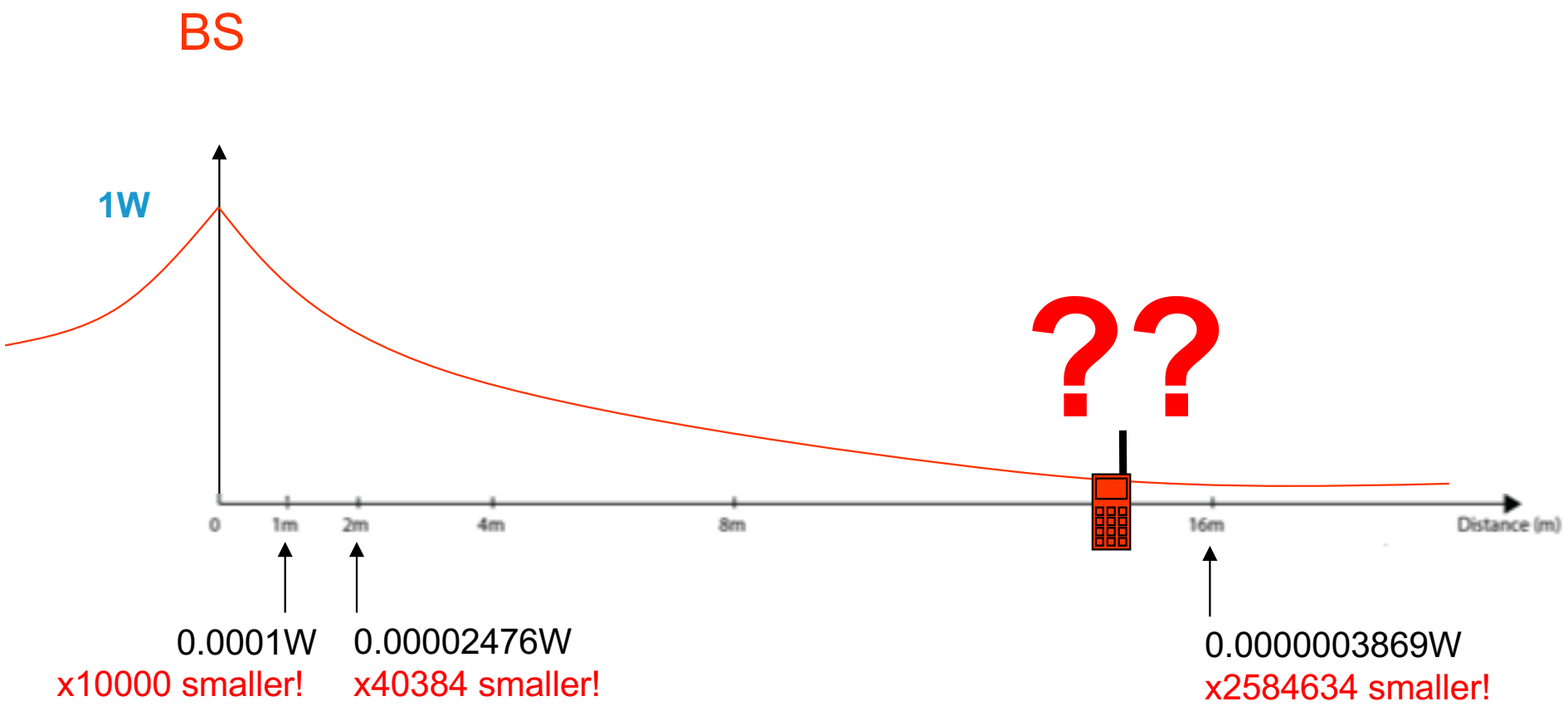
2500/0.027=92592h = 3858 days = 10 y. ☺

LPWAN does not need to maintain connection if not in used

1st challenge: signal attenuation



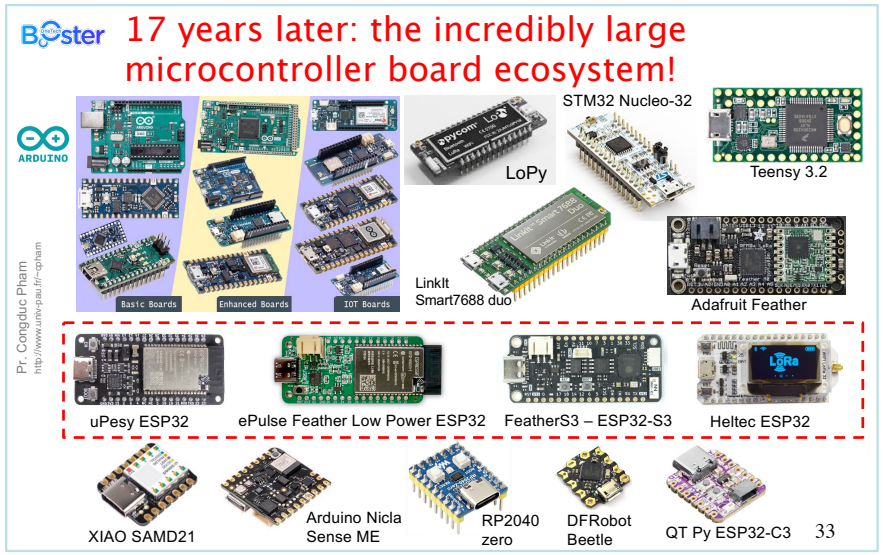
Attenuation is the main problem!

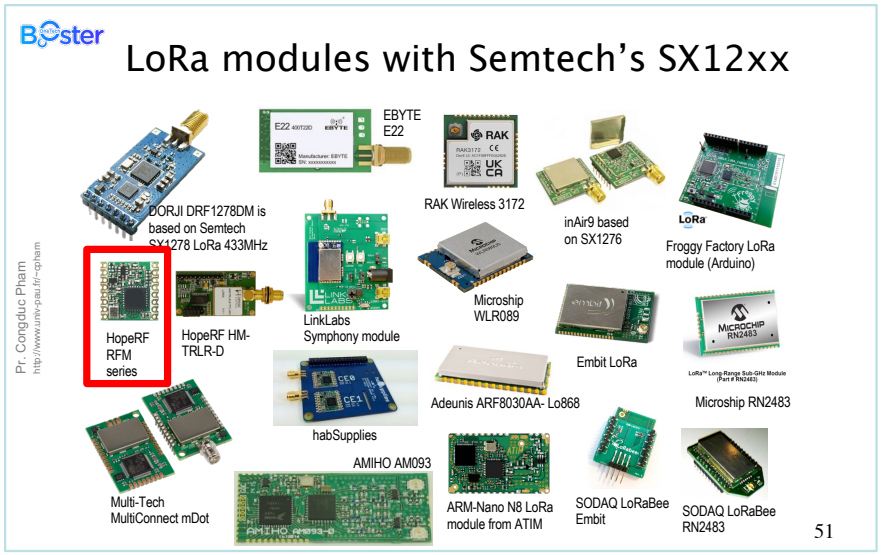


IoT for everybody?

Too expensive
Too integrated
Highly specialized
Difficult to customize
Difficult to upgrade

Convergence of technologies





Too expensive
Too integrated
Highly specialized
Difficult to customize
Difficult to upgrade

Do-It-Yourself (DIY) IoT
Off-the-shelves parts
Generic platform
Open-source
Modular design

INTEL-IRRIS starter-kit

- "Intelligent Irrigation in-the-box", "plug-&-sense", fully autonomous
- From idea to reality!

< 90€

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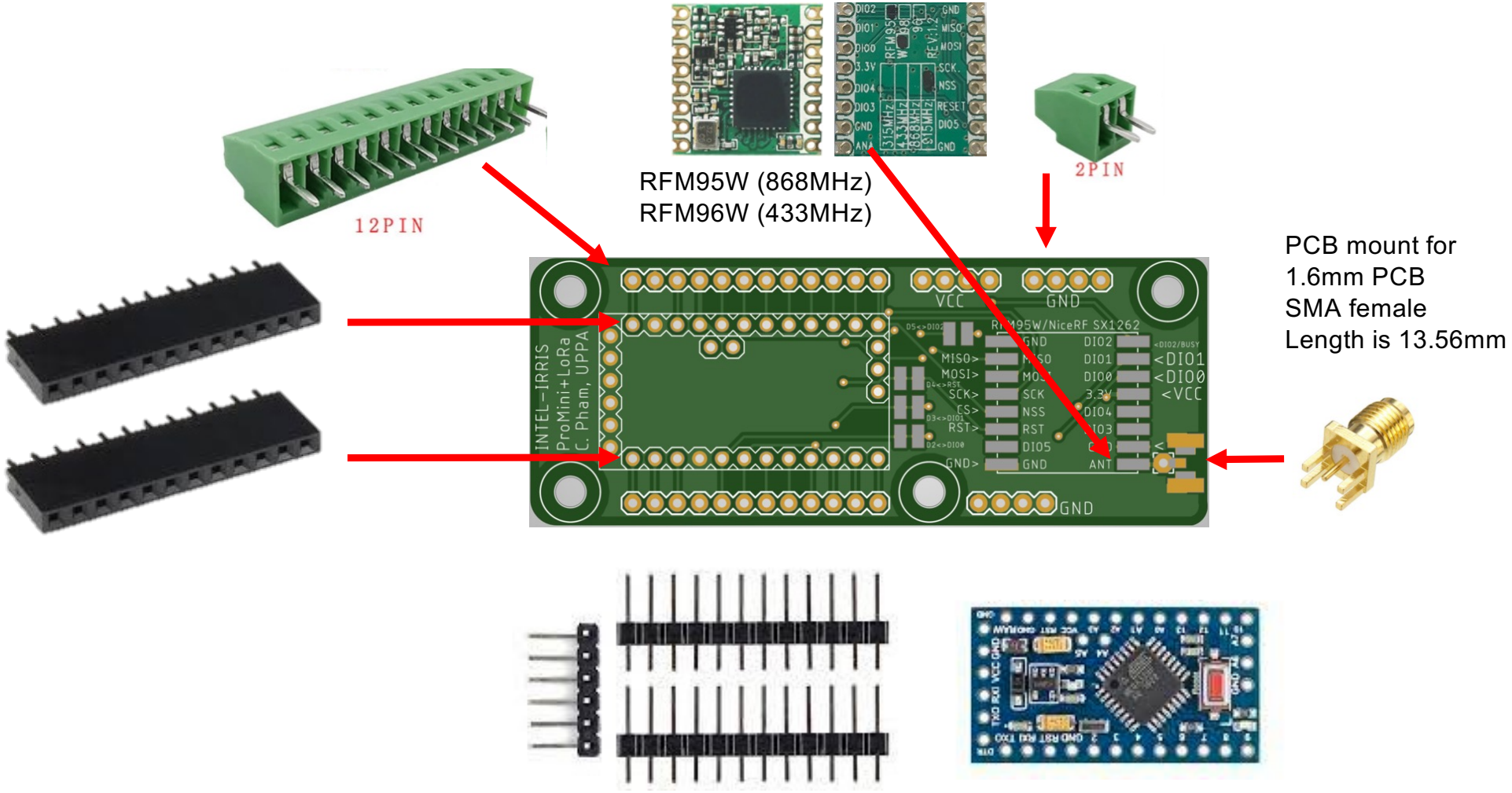
http://www.univ-pau.fr/~cpham

Soil sensor: electronic parts

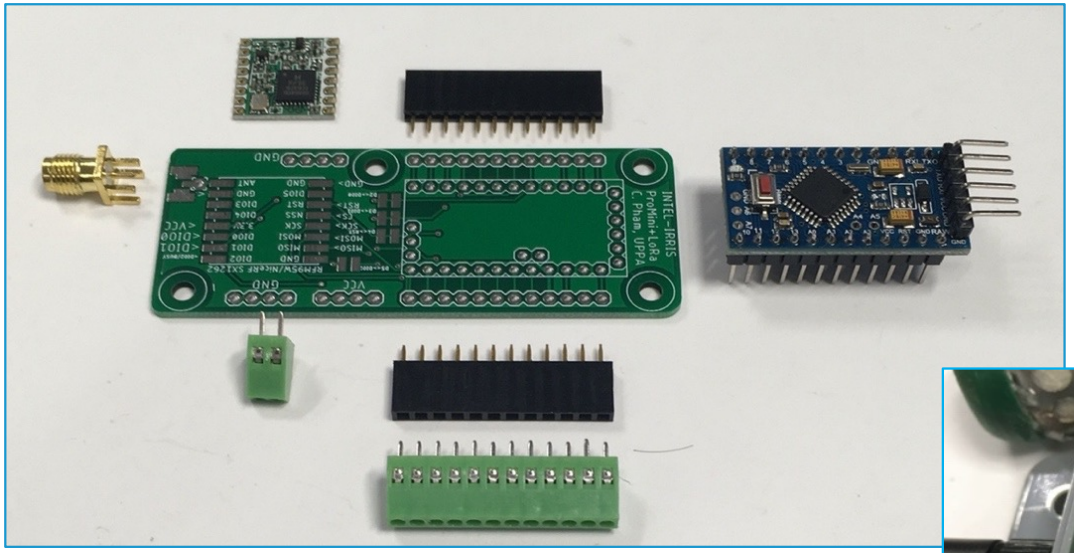
starter-kit version

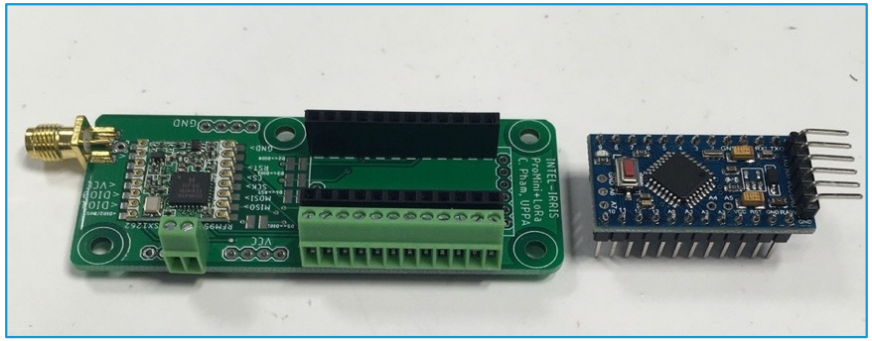


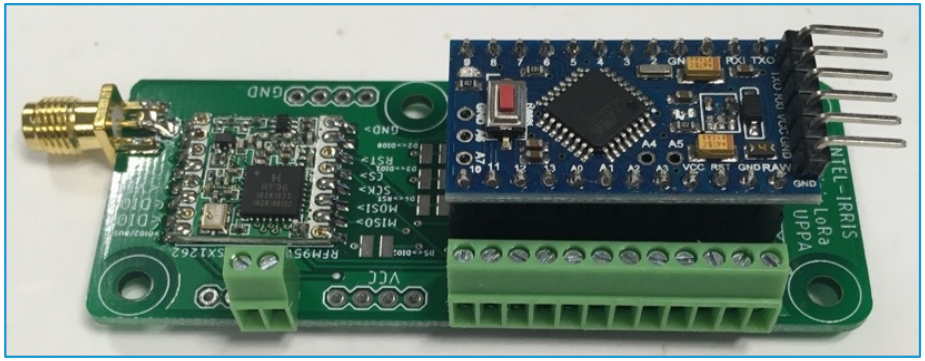
Arduino ProMini 3.3V 8MHz

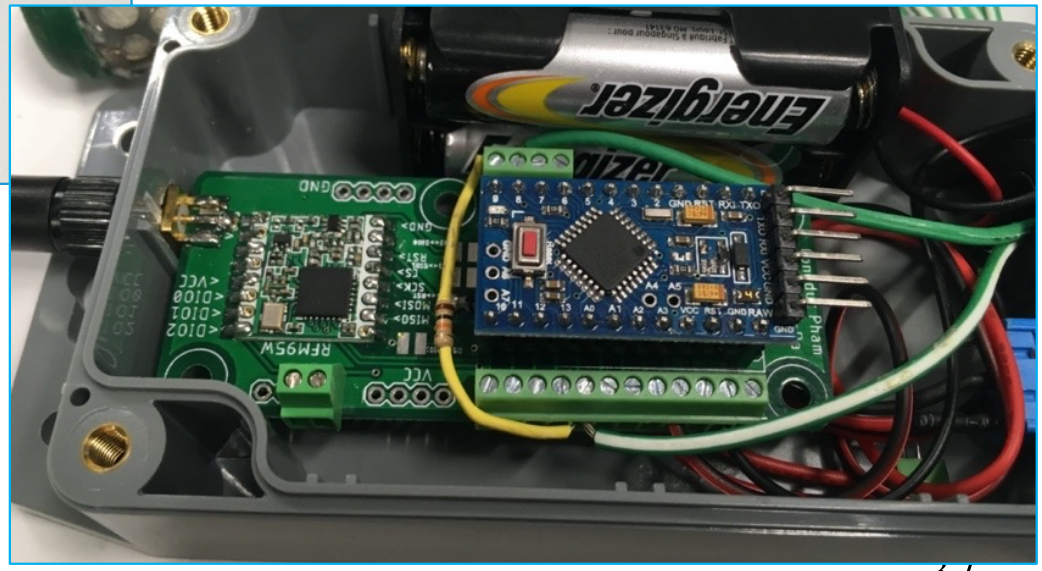
Simple & Modular design

- Simple integration on PCB of off-the-shelves components





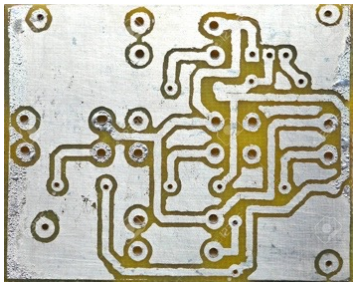




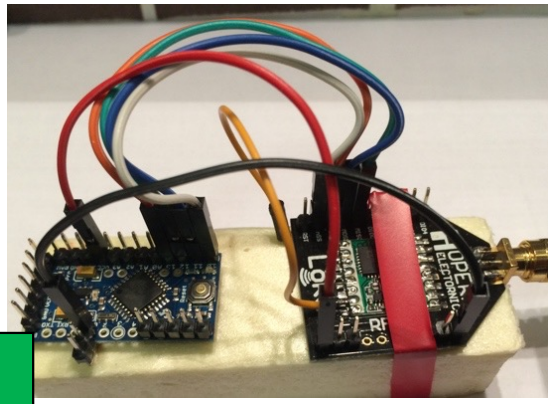
What is a PCB?

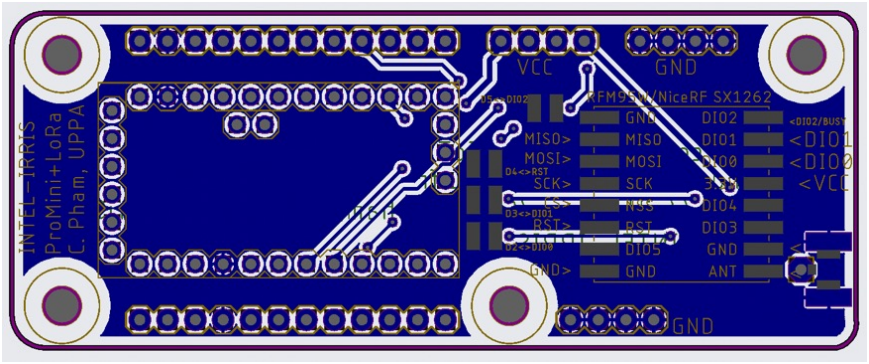
- PCB=Printed Circuit Board
- Copper paths replace Dupont wires

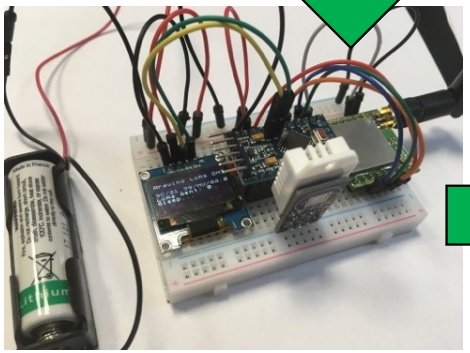
Raw PCB copper board

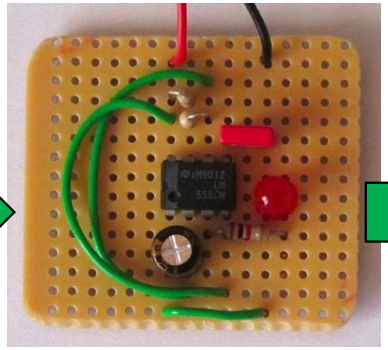


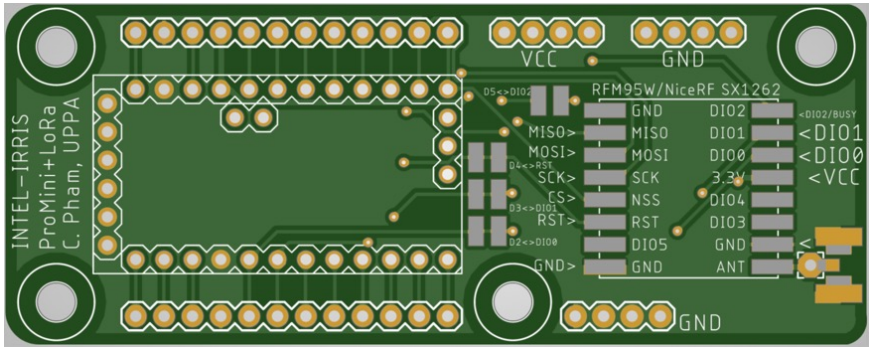
Removing copper to create wire path











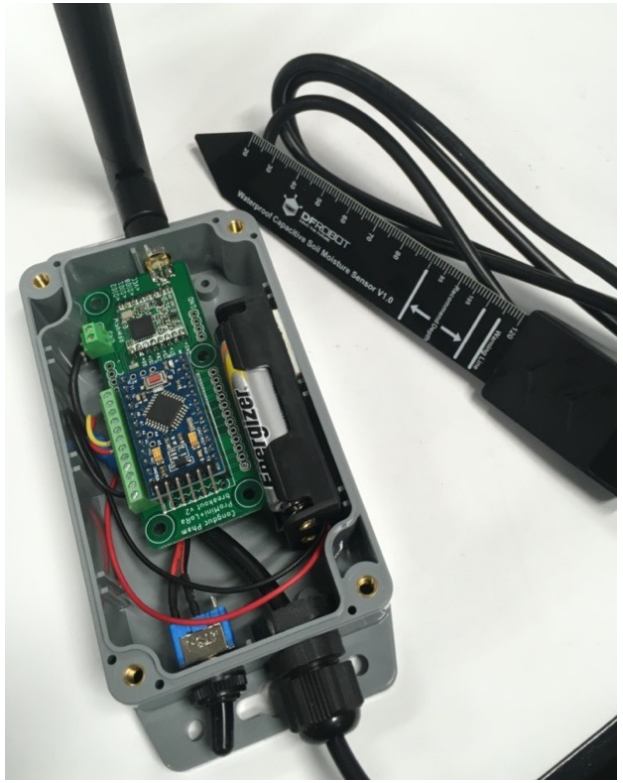
Breadboard

Stripboard

A generic sensor platform

- Low-cost: < 20€
- Off-the-shelves composants
- Easily duplicated
- Assembling by local partners
- Can connect several sensors
- Can be adapted by local partners
- Can be improved by local entrepreneurs
- Can increase capacity-building for local innovation

Final integration – DIY



Low-cost soil moisture device

SEN0308
capacitive sensor

Watermark WM200
Water tension sensor

A soil temperature sensor can be added