

# DEPLOYING INTERNET OF THINGS & BIG DATA FOR ALL

THE CHALLENGES OF THE  H2020 PROJECT

## WAZIHack Unlocked Series

IoT-Big Data, Real life application use cases

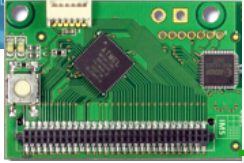
February 24th, 2017

iSpace, Accra, Ghana



PROF. CONGDUC PHAM  
[HTTP://WWW.UNIV-PAU.FR/~CPHAM](http://www.univ-pau.fr/~cpham)  
UNIVERSITÉ DE PAU, FRANCE

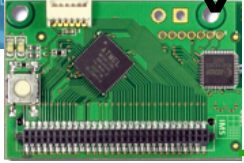




# INTERNET OF THINGS



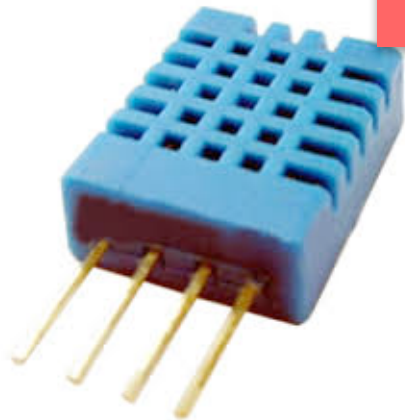


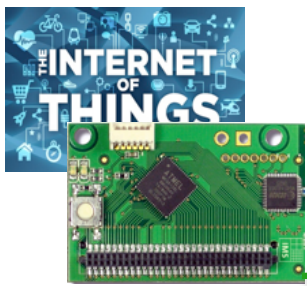


# VAST MAJORITY OF IOT: MEASURING THE PHYSICAL WORLD



# SENSING





# HUGE SOCIETAL NEEDS!



Irrigation



Livestock farming



Fish farming & aquaculture



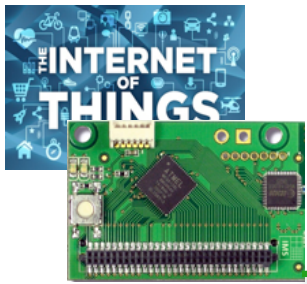
Storage & logistic



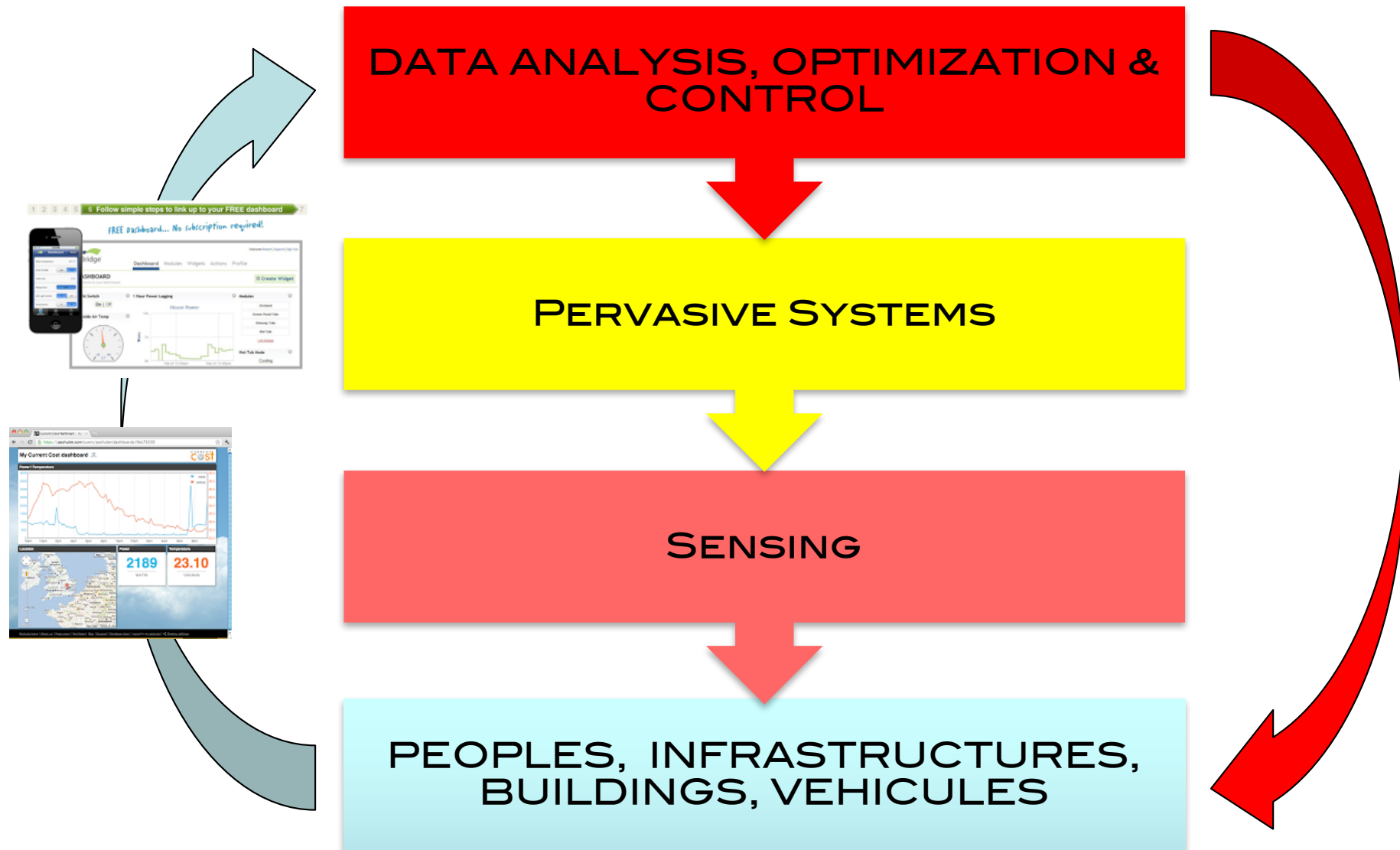
Agriculture

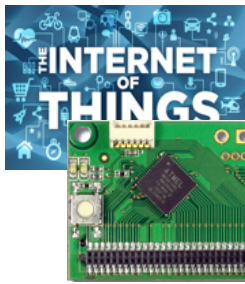


Fresh water

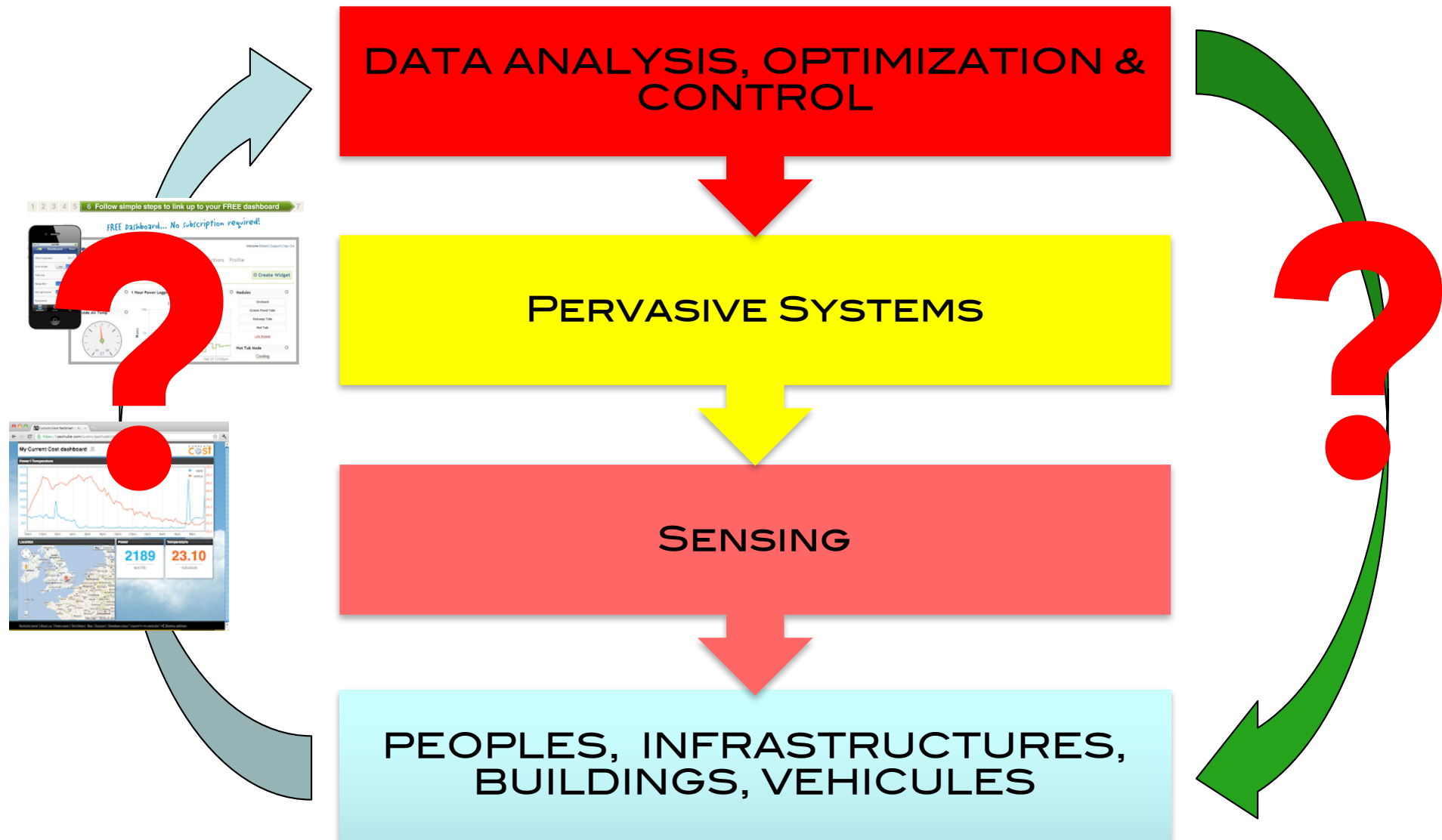


# CONTROL, OPTIMIZE & INSTRUMENT !





# 1<sup>ST</sup> ISSUE: COLLECT DATA

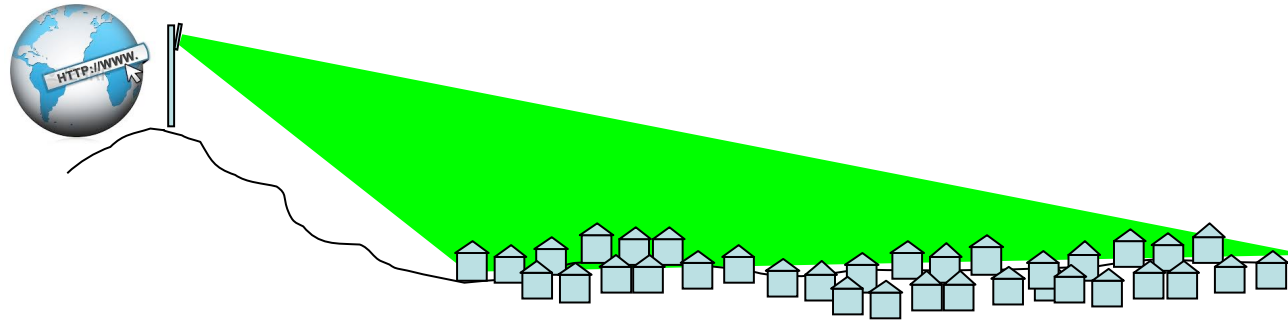
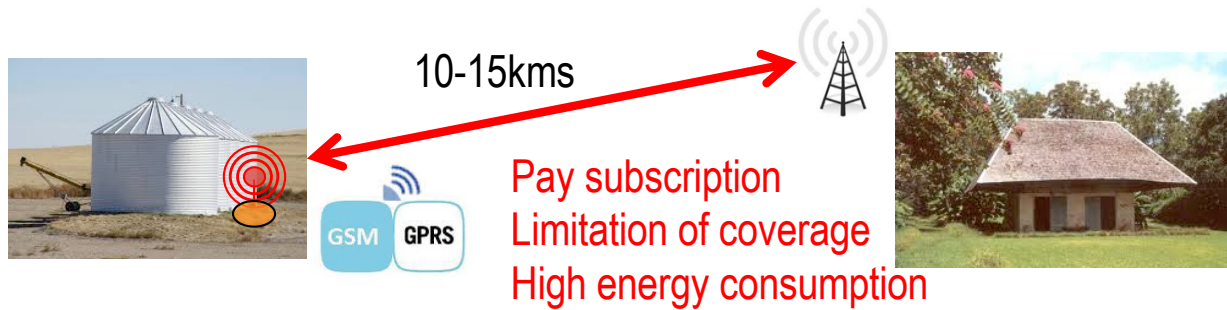




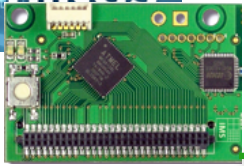


# LONG-RANGE SENSING

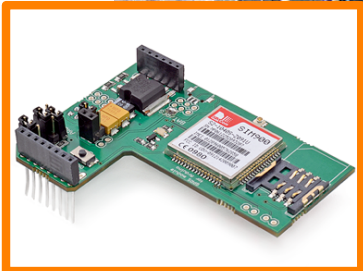
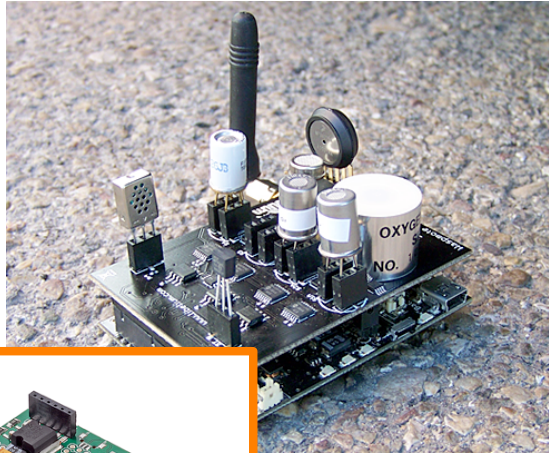
Moisture/  
Temperature of  
storage areas



Technology	2G	3G	LAN
Range (I=Indoor, O=Outdoor)	N/A	N/A	O: 300m I: 30m
Tx current consumption	200-500mA	500-1000mA	100-300mA
Standby current	2.3mA	3.5mA	NC



# ENERGY CONSIDERATION



18720 JOULES

TX power: 500mA

$$P = I \times V = 500 \times 3.3 = 1650\text{mW}$$

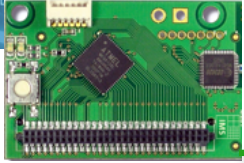
$$E = P \times t \rightarrow t = E/P$$

11345s or 3h9mins

Technology	2G	3G	LAN
Range (I=Indoor, O=Outdoor)	N/A	N/A	O: 300m I: 30m
Tx current consumption	200-500mA	500-1000mA	100-300mA
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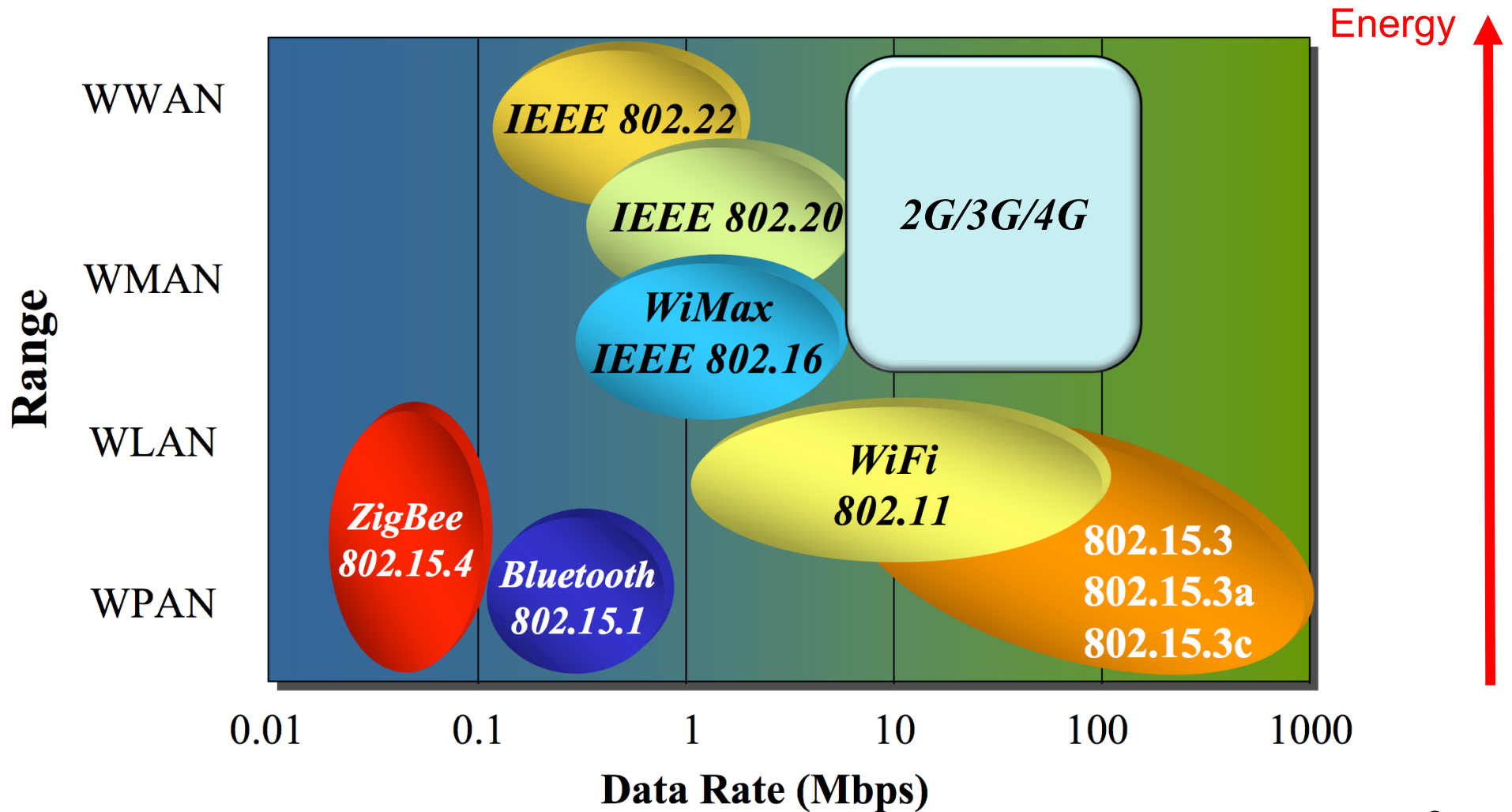
Haven't considered:

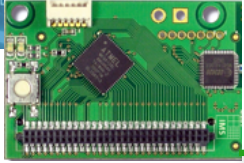
- Baseline power consumption of the sensor board
- RX consumption!
- Event capture consumption
- Event processing consumption



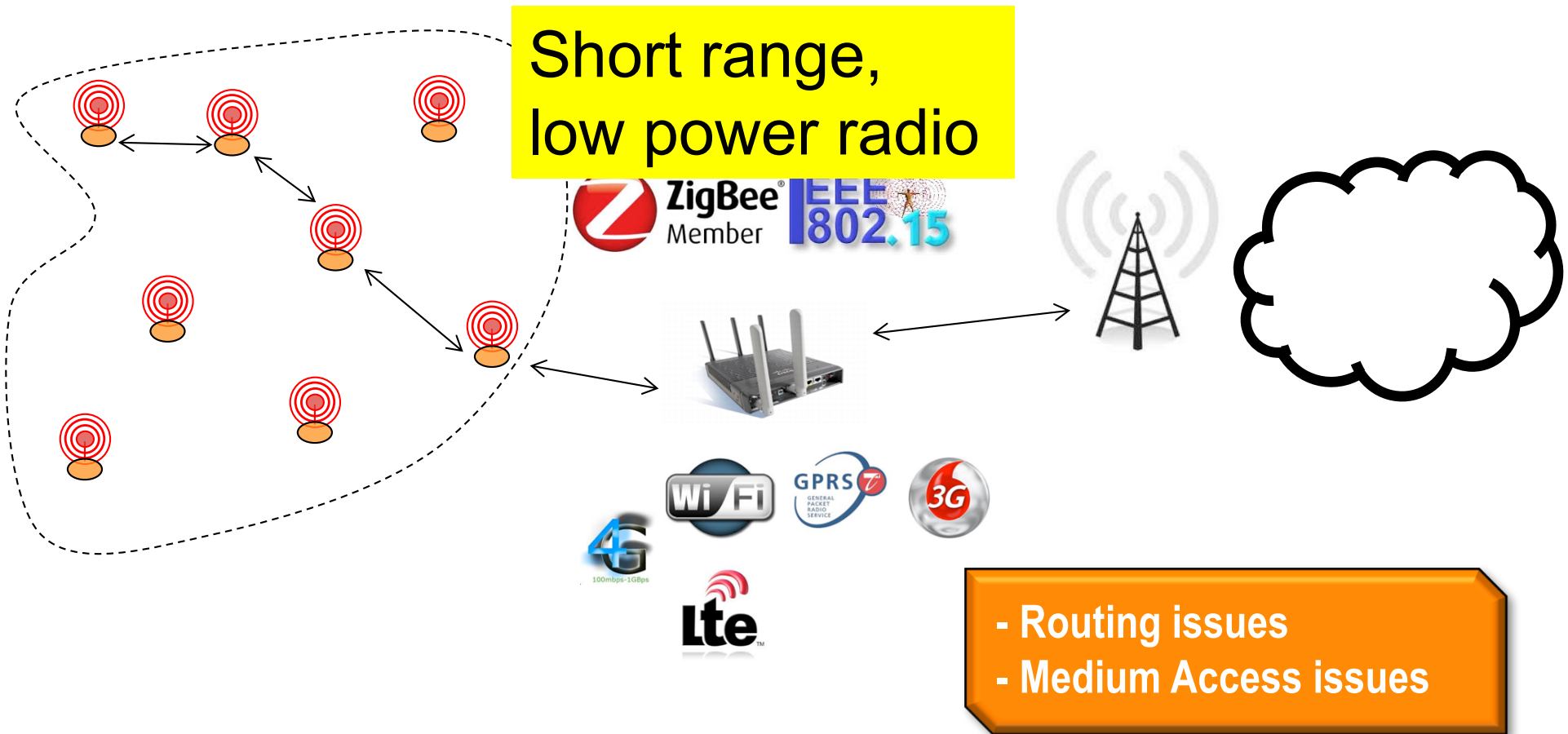
# THE WIRELESS SPACE

## Energy-Range dilemma





# LOWER ENERGY MEANS SHORTER RANGE!

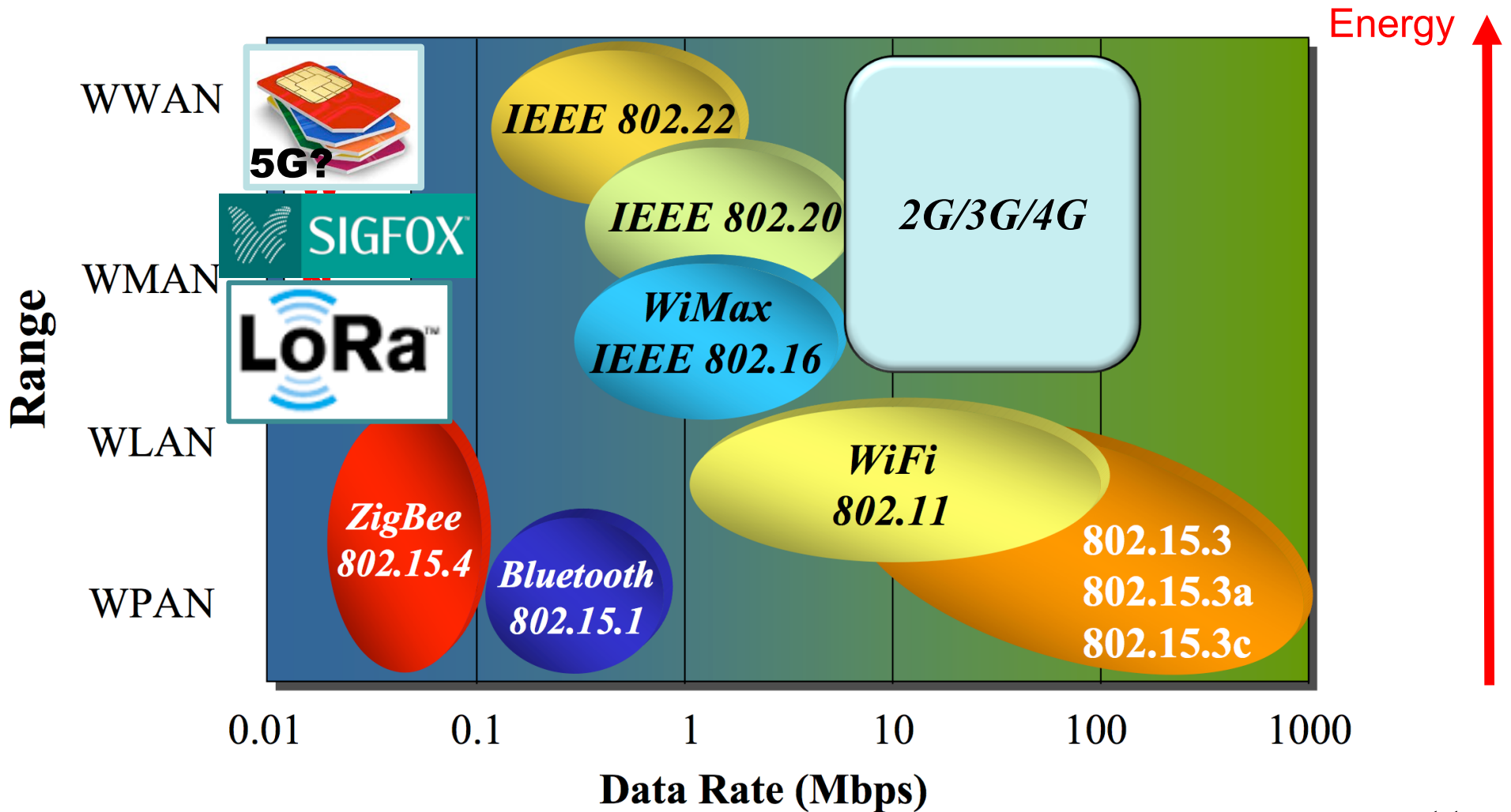






# LOW-POWER AND LONG-RANGE?

## Energy-Range dilemma





# LPWAN ARCHITECTURE

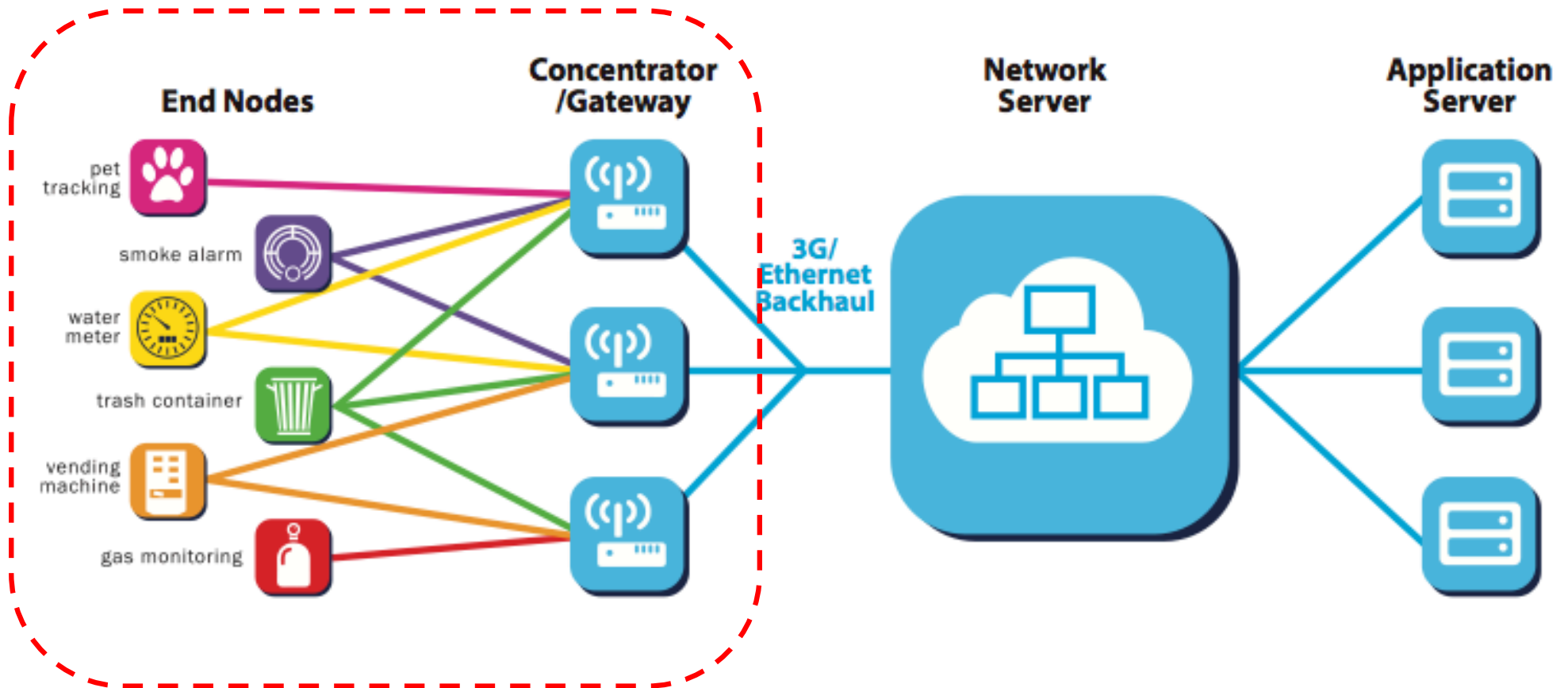


Figure from Semtech



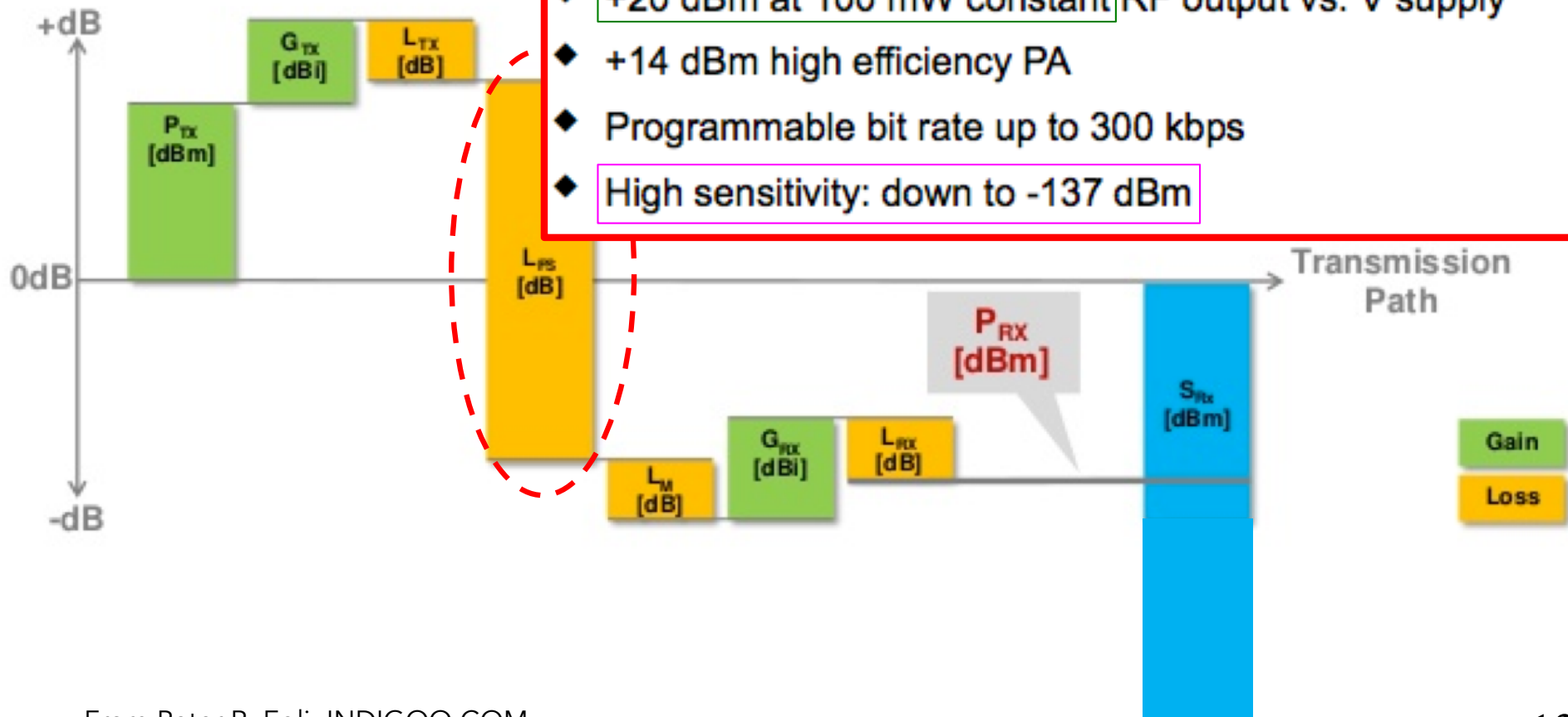
# LINK BUDGET OF LPWAN

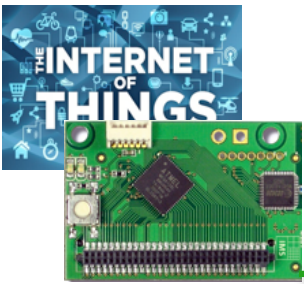


$$P_{RX} = P_{TX} + G_{TX} - L_{TX} - L_{PS} - L_M + G_{RX} - L_{RX} + S_{RX}$$

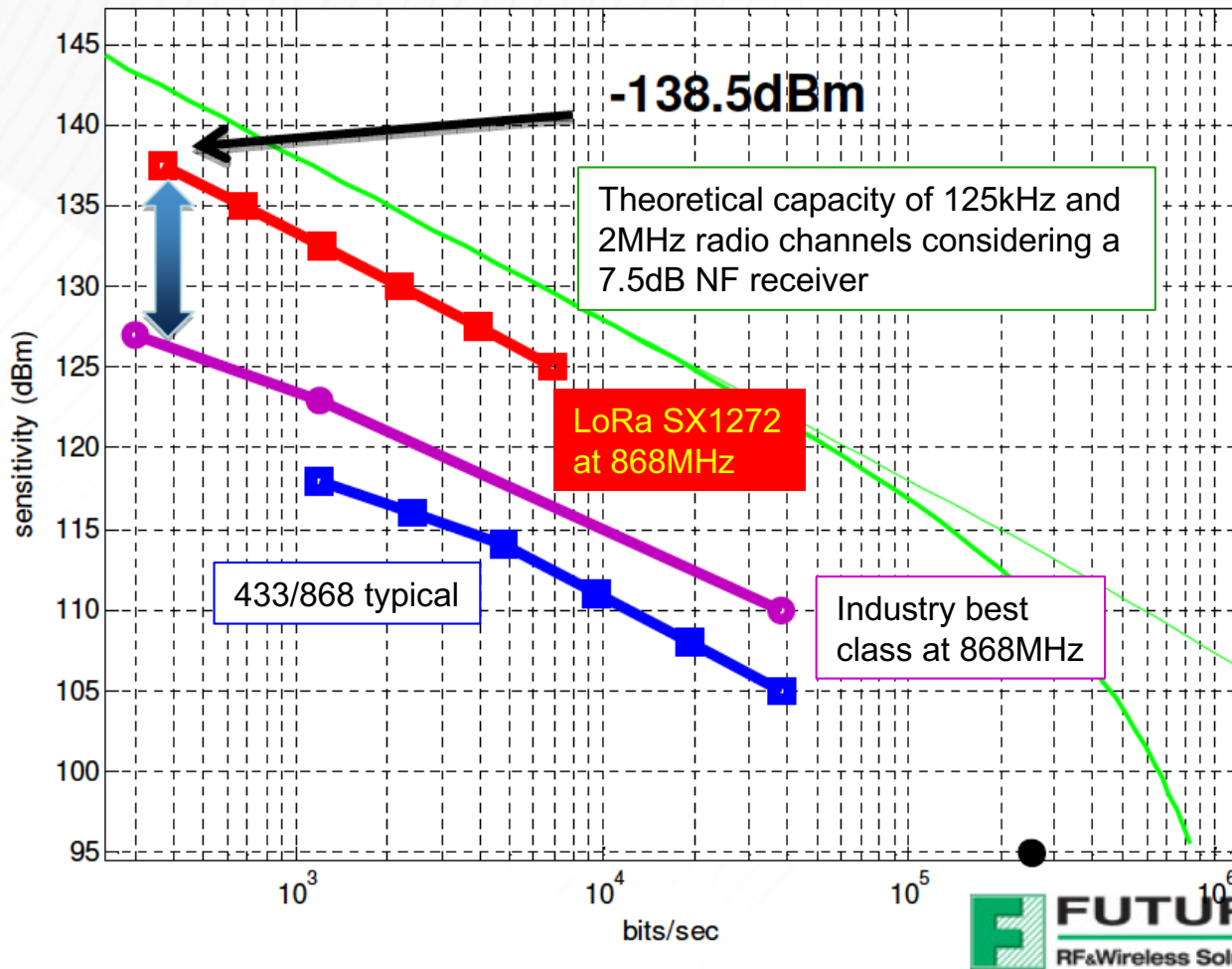
## KEY PRODUCT FEATURES

- ◆ LoRa™ Modem
- ◆ 157 dB maximum link budget
- ◆ +20 dBm at 100 mW constant RF output vs. V supply
- ◆ +14 dBm high efficiency PA
- ◆ Programmable bit rate up to 300 kbps
- ◆ High sensitivity: down to -137 dBm

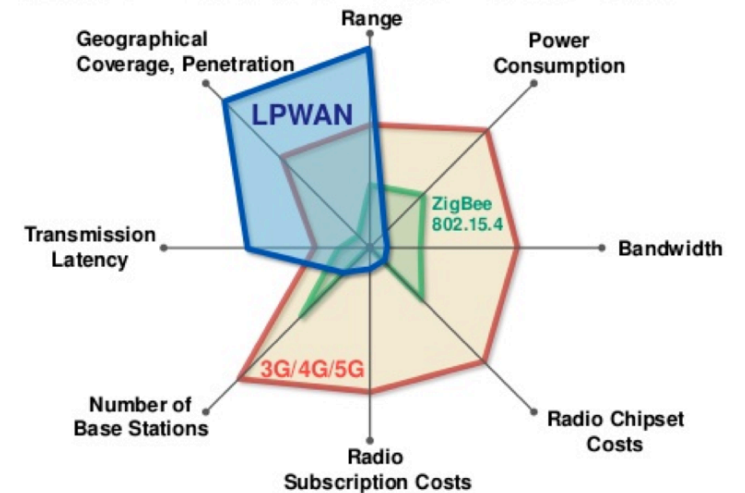




# THE LONG-RANGE REVOLUTION



Sensitivity: lowest input power with acceptable link quality, typically 1% PER



From Peter R. Egli, INDIGOO.COM

**The lower the receiver sensitivity, the longer is the range!**

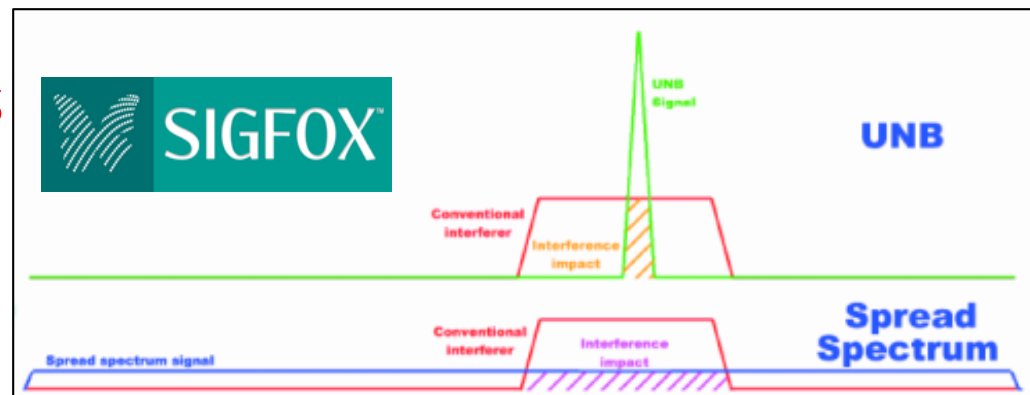
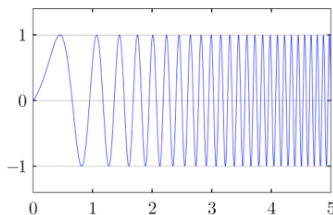


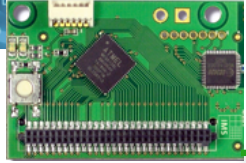


# INCREASING RANGE?

- ❑ Generally, robustness and sensitivity can be increased when transmitting (much) slower
- ❑ A [Sigfox message is sent relatively slowly in a very narrow band of spectrum (hence ultra-narrow-band) using Gaussian Frequency-Shift Keying modulation]. **Max throughput= $\sim 100$ bps**
- ❑ LoRa also increases time-on-air when maximum range is needed. But LoRa uses spread spectrum instead of UNB.

**300bps-37.5kbps**





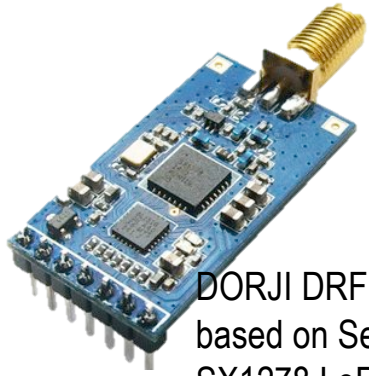
# ENERGY CONSUMPTION COMPARAISON



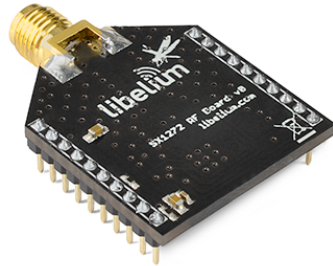
Tables from Semtech

Technology	2G	3G	LAN	ZigBee	Lo Power WAN
Range (I=Indoor, O=Outdoor)	N/A	N/A	O: 300m I: 30m	O: 90m I: 30m	Same as 2G/3G
Tx current consumption	200-500mA	500-1000mA	100-300mA	18mA	18mA-40mA
Standby current	2.3mA	3.5mA	NC	0.003mA	0.001mA
Energy harvesting (solar, other)	No	No	No	Possible	Possible
Battery 2000mAh (LR6 battery)	4-8 hours(com) 36 days(idle)	2-4 hours(com) X hours(idle)	50 hours(com) X hours(idle)	60hours (com)	120 hours(com) 10 year(idle)

# LORA MODULES FROM SEMTECH'S SX127X CHIPS



DORJI DRF1278DM is based on Semtech SX1278 LoRa 433MHz



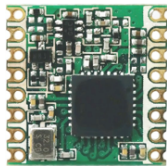
Libelium LoRa is based on Semtech SX1272 LoRa 863-870 MHz for Europe



inAir9 based on SX1276



Froggy Factory LoRa module (Arduino)



HopeRF RFM series



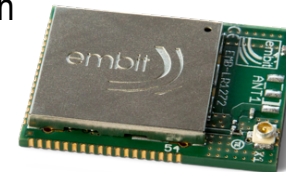
HopeRF HM-TRLR-D



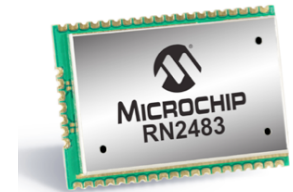
LinkLabs Symphony module



IMST IM880A-L is based on Semtech SX1272 LoRa 863-870 MHz for Europe



Embit LoRa



LoRa™ Long-Range Sub-GHz Module (Part # RN2483)

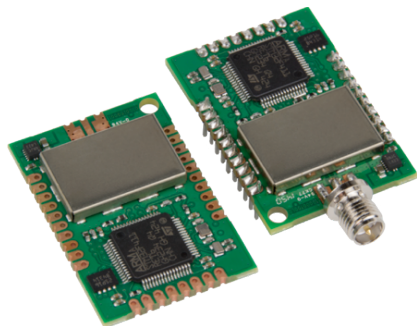
Microship RN2483



habSupplies



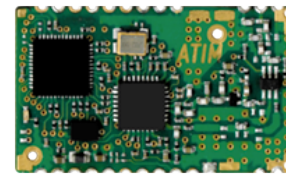
Adeunis ARF8030AA- Lo868



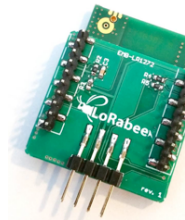
Multi-Tech MultiConnect mDot



AMIHO AM093



ARM-Nano N8 LoRa module from ATIM



SODAQ LoRaBee Embit

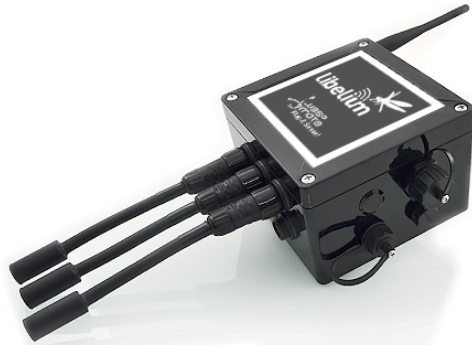


SODAQ LoRaBee RN2483

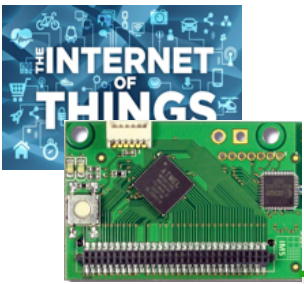




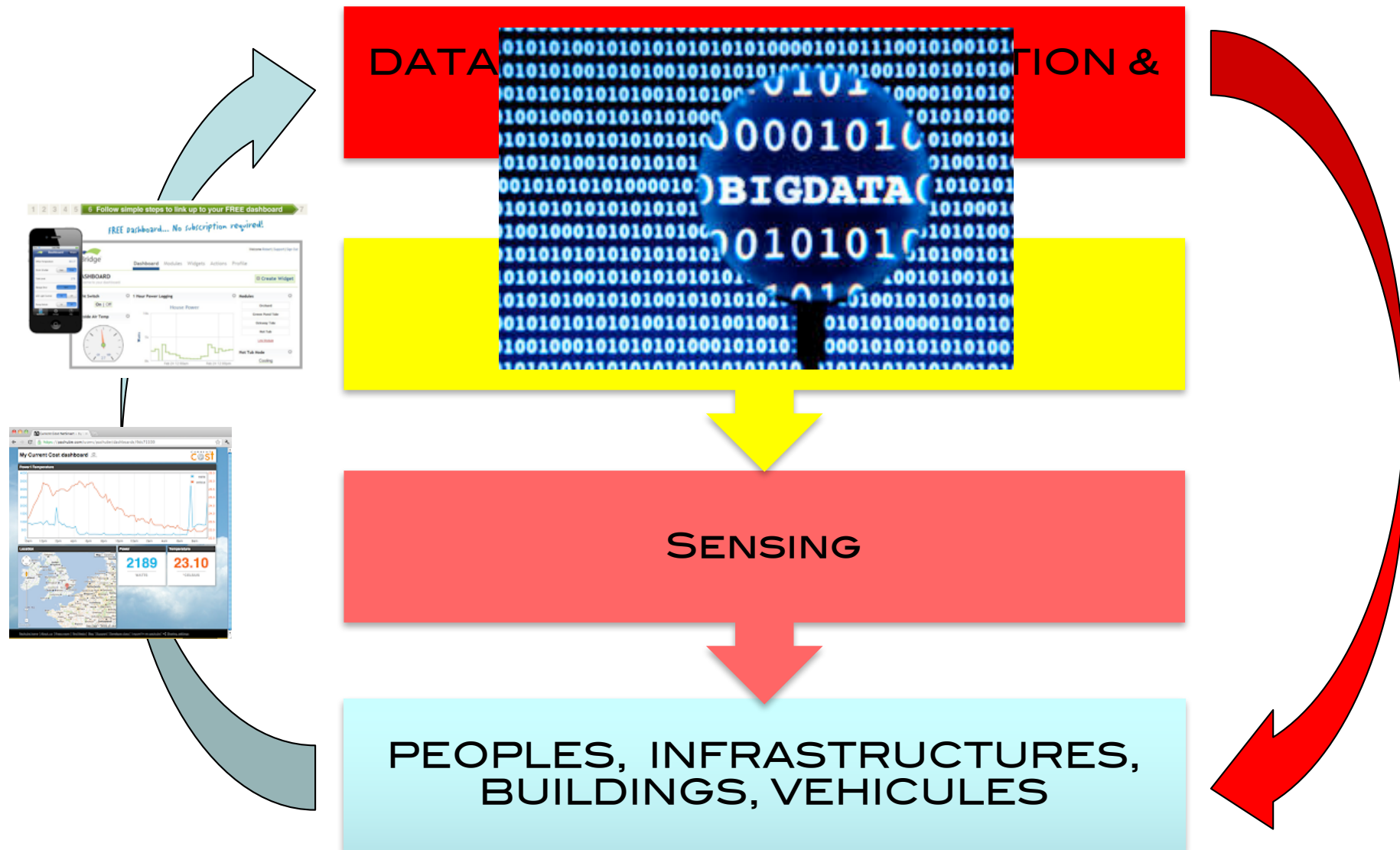
# MATURATION OF THE IOT MARKET...

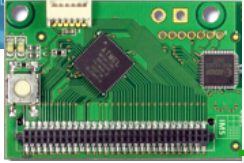




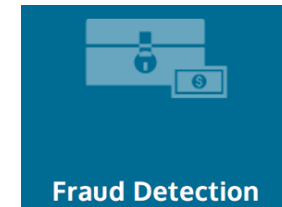


# CONTROL, OPTIMIZE & INSTRUMENT !

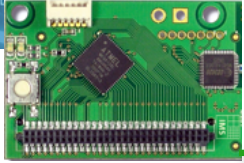




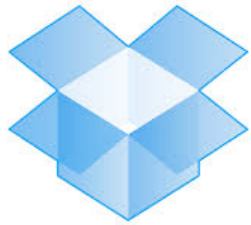
# BIG DATA ANALYTICS



Graphics from <http://www.vitria.com/iot-analytics/>



# DEDICATED IOT CLOUD



Dropbox



Firestore



FIWARE

Axēda®



ThingSpeak



GroveStreams



SensorCloud™

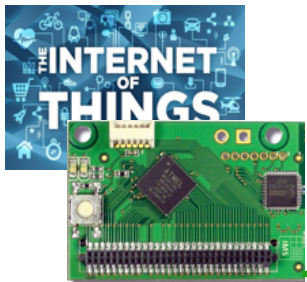
freeboard



OpenRemote



TempoIQ



# USING ThingSpeak



ThingSpeak Channels Apps Blog Support

User: cpham

**Test LoRa UPPA**

Channel ID: **66583**  
Author: **cpham**  
Test of LoRa gateway at University of Pau, France

Test, lora, uppa

19.6



ThingSpeak Channels Apps Blog Support Account Sign Out

### Test LoRa UPPA

Channel ID: **66583** Test of LoRa gateway at University of Pau, France  
Author: **cpham** Test, lora, uppa  
Access: Public

Private View Public View Channel Settings API Keys Data Import / Export

Add Visualizations Data Export MATLAB Analysis MATLAB Visualization More Apps

**Field 1 Chart**

Date	value
09:34	19.5
09:35	20.1
09:36	19.8
09:37	19.6
09:38	19.4

**Field 2 Chart**

Date	src
09:34	10
09:35	10
09:36	10
09:37	10
09:38	10

**Field 3 Chart**

Date	seq
09:34	0
09:35	2
09:36	3
09:37	3.5
09:38	4

**Field 4 Chart**

Date	duration
09:34	6
09:35	6
09:36	6
09:37	6
09:38	6

**Field 5 Chart**

Date	SNR
09:34	4
09:35	4
09:36	4
09:37	4
09:38	4

**Field 6 Chart**

Date	RSSI
09:34	-52.5
09:35	-47.5
09:36	-52.5
09:37	-53.5
09:38	-54.5





# USING



# GroveStreams



Browser address bar: <https://www.grovestreams.com/observationStudio.html?org=7a5de802-5d71-319>

Page Title: University of Pau

User: Congduc Pham

Component Studio | Admin | (0,6,0)

### Observation Studio

Components | Dashboards

Components

- Components
  - sensor3
    - temp
  - sensor6
    - temp

sensor6 temp | sensor3 temp

\*none\* | From: 2015-12-14 20:26:12 | To: 2015-12-14 22:26:04 | Compare | Data Points

#### temp

Row	Time	Value
1	22:26:03.633	25.87
2	22:23:40.604	25.87
3	22:21:35.489	25.87
4	22:17:32.907	25.87
5	22:15:41.998	25.87
6	22:11:40.452	23.43
7	22:07:36.184	23.43
8	22:03:33.273	22.94
9	21:59:33.532	23.43
10	21:55:28.121	23.92
11	21:51:22.015	22.94
12	21:47:22.836	23.92
13	21:45:17.126	23.92
14	21:41:13.750	22.94

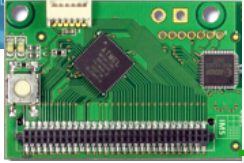
Chart Type

#### Quick View

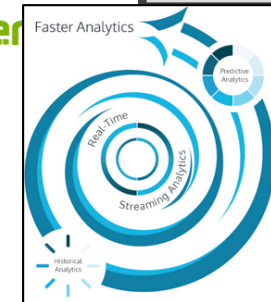
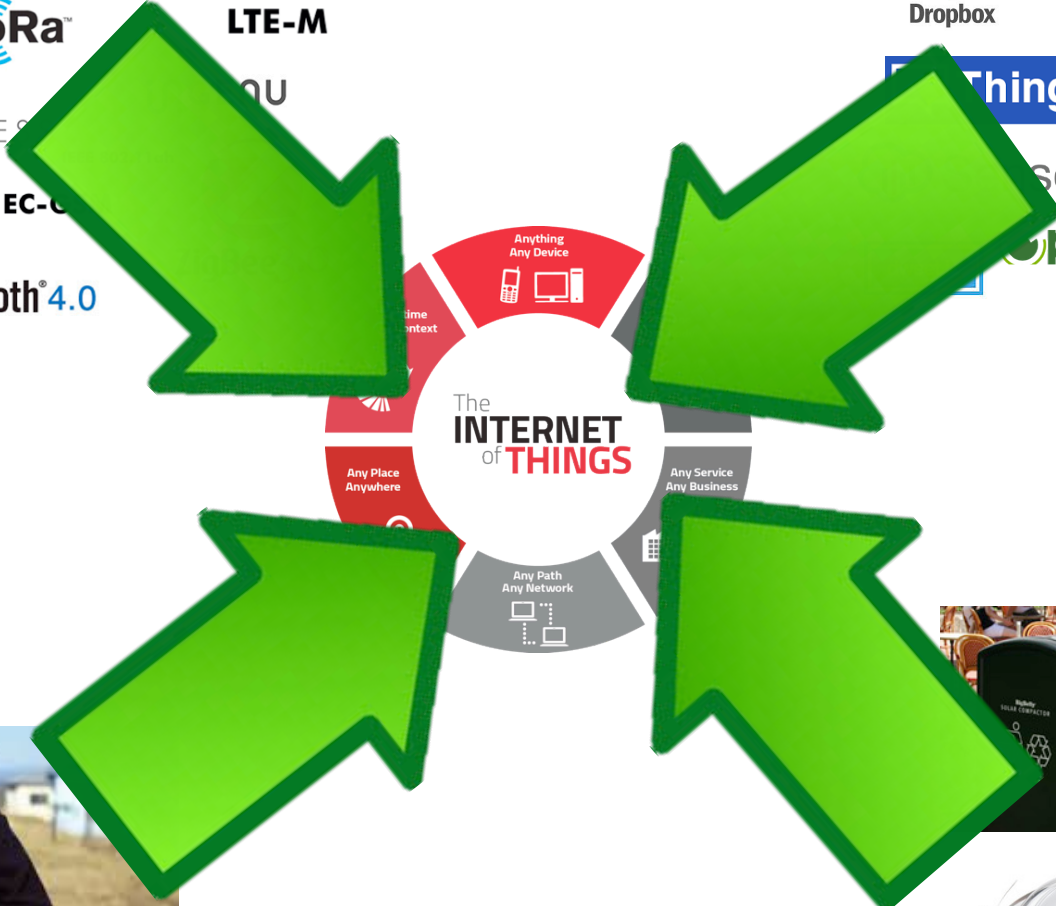
temp **25.87**

Last updated 22:27:57 (3m 59s ago) 22:27:57

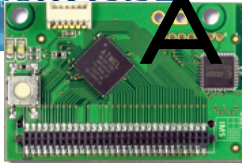
Refresh



# IOT BECOMES REALITY!

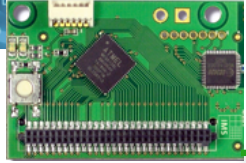






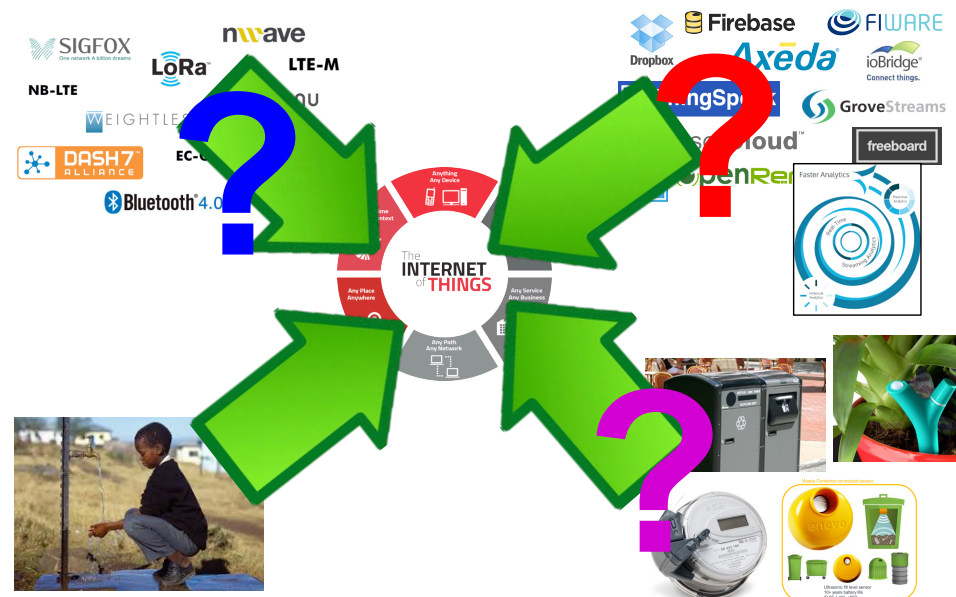
# A REALITY FOR EVERYBODY?





# IoT FOR ALL?

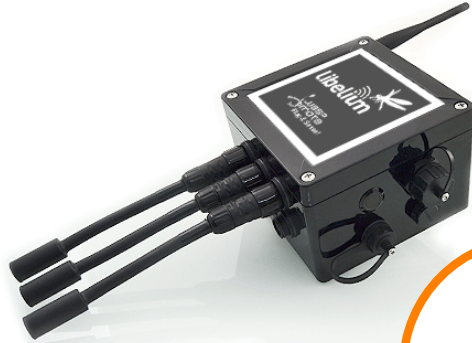
- ❑ Many areas and countries are still far from being ready to enjoy the smallest benefit of IoT
  - ❑ lack of infrastructure
  - ❑ high cost of hardware
  - ❑ complexity in deployment
  - ❑ lack of technological eco-system and background







# MATURATION OF THE IOT MARKET...



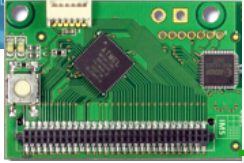
... but not adapted for rural developing countries context & environment

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

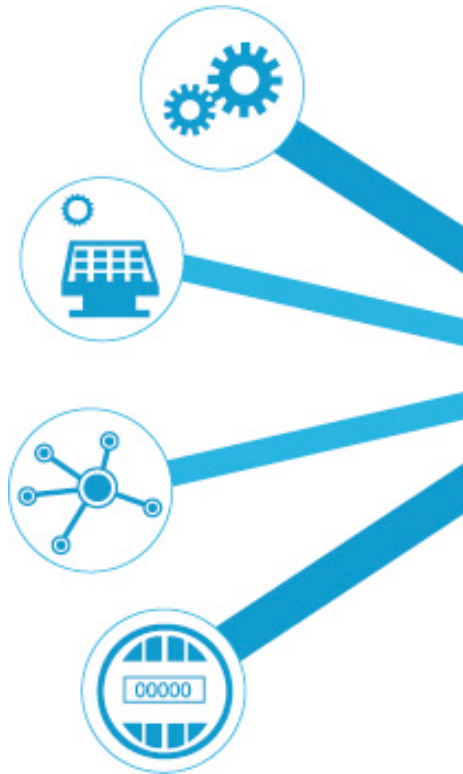


Ultrasonic fill level sensor  
10+ years battery life  
IP 66, [-40°, +85°]





# INTERNET, CLOUD & BIG DATA ANALYTICS



Internet connectivity is weak and expensive!

Nearly impossible in remote/rural areas



Predictive Maintenance



Outage Management



Fraud Detection



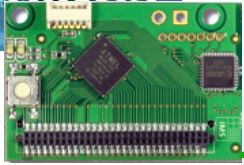
Demand/Supply Optimization



Customer Engagement

Graphics from <http://www.vitria.com/iot-analytics/>



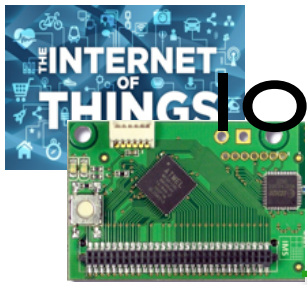


# WAZIUP: LOW-COST IOT



[ABOUT »](#) [TECHNOLOGIES »](#) [COMMUNITY](#) [NEWS & EVENT »](#) [DOWNLOADS](#) [DEV KIT](#) [FAQ](#) [CONTACT](#)

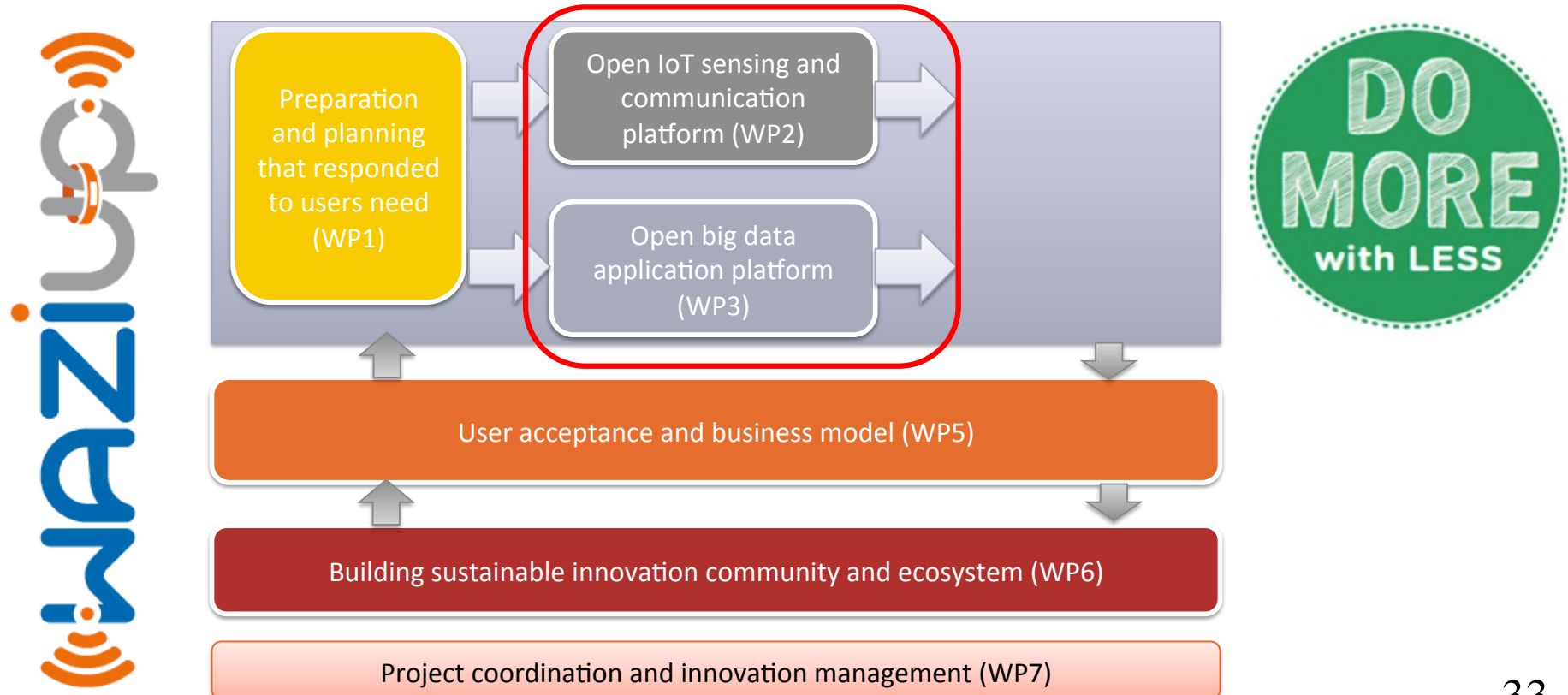
**AFFORDABLE  
TECHNOLOGIES  
TO  
EMPOWER  
RURAL ECONOMIES**



# IoT FOR RURAL APPLICATIONS IN DEVELOPPING COUNTRIES



- ❑ WAZIUP is an EU H2020 project (2016-2019)
- ❑ contributes to long-range IoT & open big data with WP2 & WP3



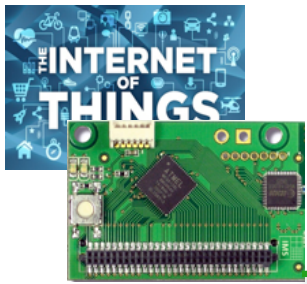




# OBJECTIVES



- ❑ To develop/adapt **low-cost and energy-efficient hardware** (e.g. sensor/actuator) that fit to African context
- ❑ Design and development of IoT long-range communication **framework (device+gateway)**
- ❑ To develop and validate the **open IoT and Big data** and advanced analytic application platform
- ❑ To offer **open sources WAZIUP** (hardware and software) platform for developer and SMEs communities



# LOW-COST HARDWARE



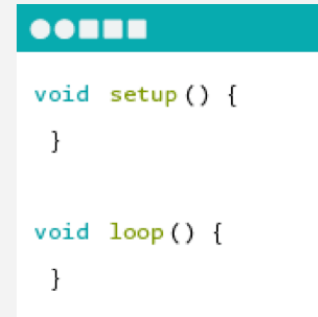
## WHAT IS ARDUINO?

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



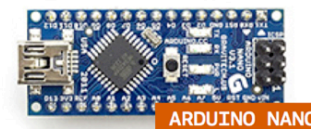
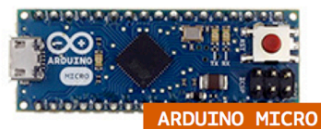
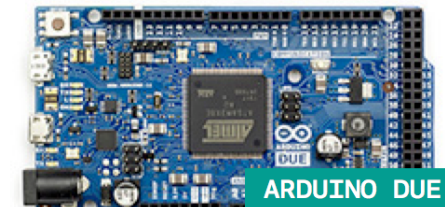
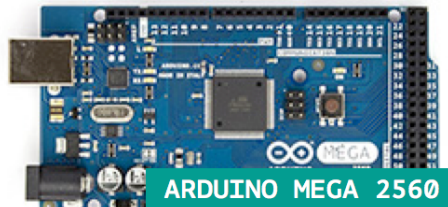
## ARDUINO BOARD

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



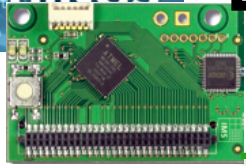
## ARDUINO SOFTWARE

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

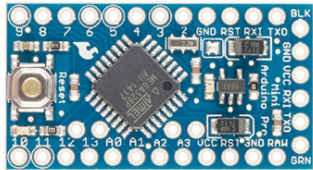




# LARGE ECOSYSTEM, STILL GROWING!



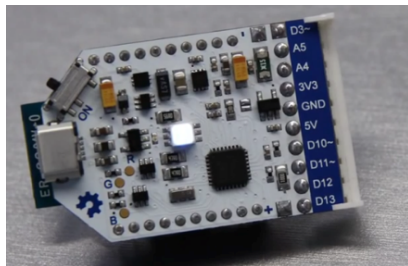
Arduino Pro Mini



LoPy

<http://blog.atmel.com/2015/12/16/rewind-50-of-the-best-boards-from-2015/>

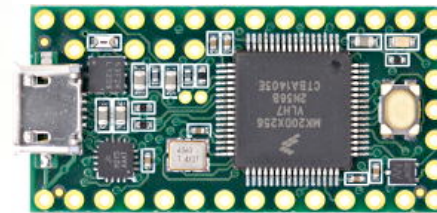
<http://blog.atmel.com/2015/04/09/25-dev-boards-to-help-you-get-started-on-your-next-iot-project/>



Theairboard



Expressif ESP32



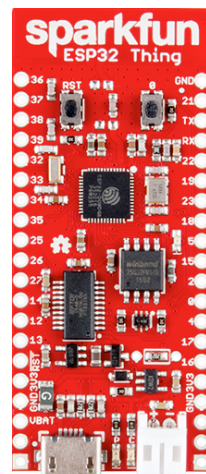
Teensy 3.2



STM32  
Nucleo-32



Adafruit Feather



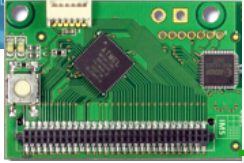
Sparkfun ESP32 thing



Tessel



Tinyduino



# WHY GO FOR ARDUINO?



A photograph of a blue PCB board with a black ATMEGA328P microcontroller, labeled "GREAT WALL". It has two 5-pin headers and a USB Type-B connector.

Avec la bootloader 1 pcs **Pro Mini ATMEGA328 Pro Mini 328 Mini ATMEGA328 3.3 V / 8 MHz pour Arduino**

[View original title in English](#)

★★★★★ 4.9 (417 Votes) | 434 Commandes

Prix : **€ 1,49** / Kit

Trouvez plus de deals sur l'App ▾

Livraison : **€ 0,29 vers France via China Post Ordinary Small Packet Plus** ▾  
Livraison : 15-34 jours (envoyé en 7 jours ouvrables)

Quantité :  Kit (55350 Kits available)

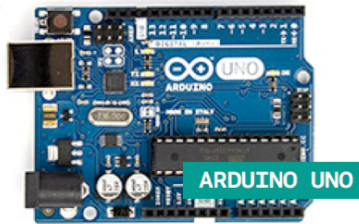
Montant total : **€ 1,78**

**Acheter maintenant** **Ajouter au panier**

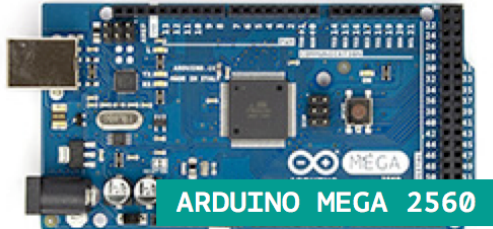
- ❑ Cheap, open, and easy to use/program
- ❑ huge developer communities
  - ❑ Hardware is not the main important issue
  - ❑ Software is!



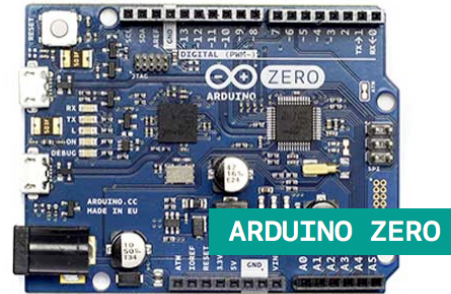
# SW/HW BUILDING BLOCKS INTEGRATION



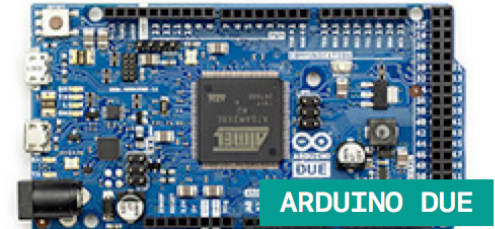
ARDUINO UNO



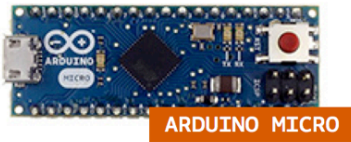
ARDUINO MEGA 2560



ARDUINO ZERO



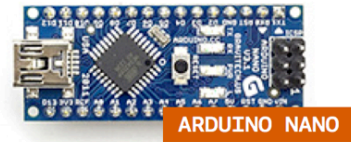
ARDUINO DUE



ARDUINO MICRO



ARDUINO PRO MINI



ARDUINO NANO



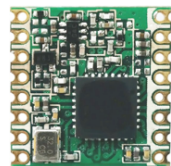
Ideetron Nexus



Teensy3.1/3.2



LoRa radios that our library already supports



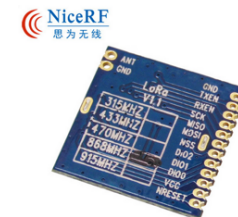
HopeRF RFM92W/95W



Libelium LoRa

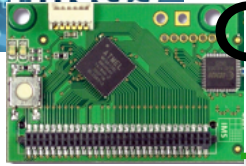


Modtronix inAir9/9B



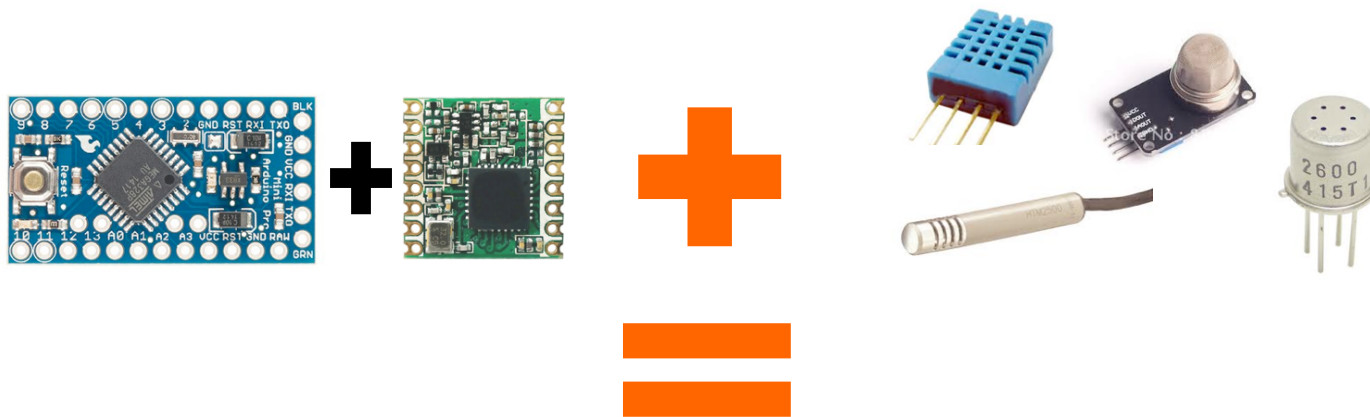
NiceRF LoRa1276

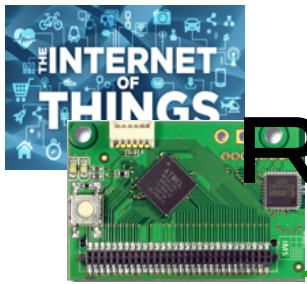
Long-Range communication library



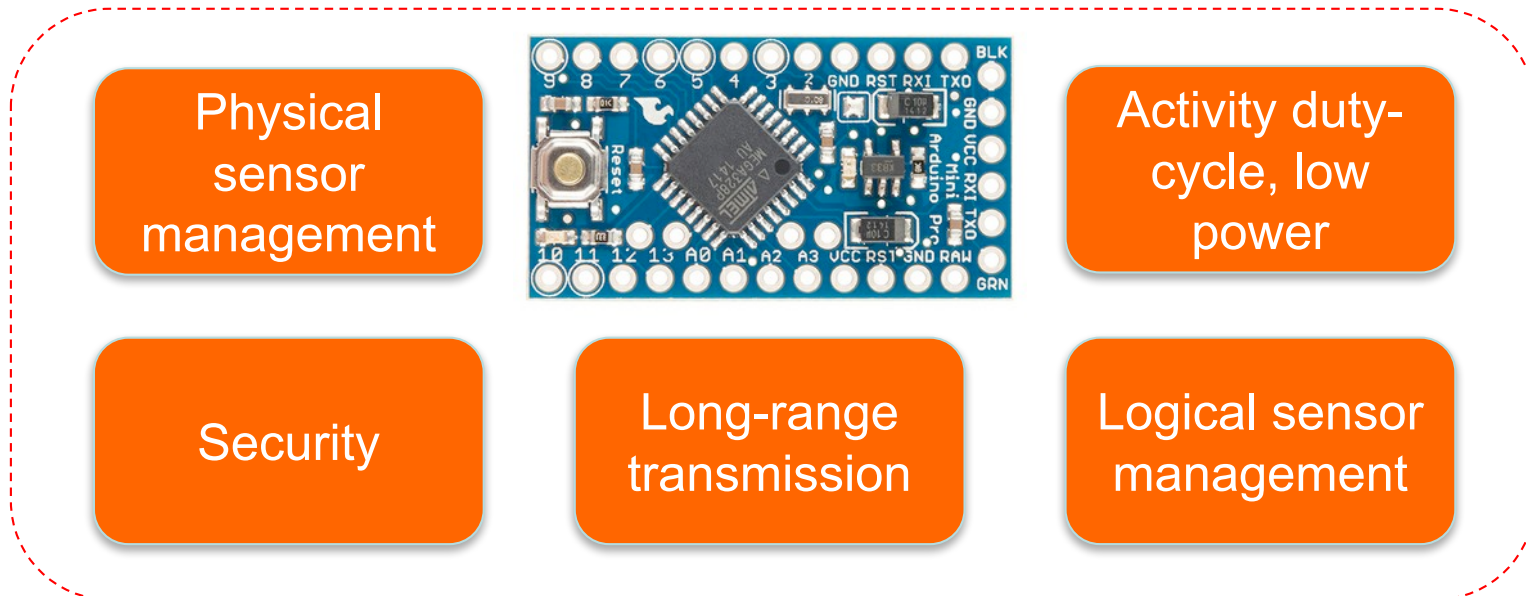
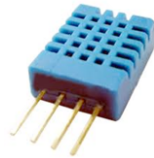
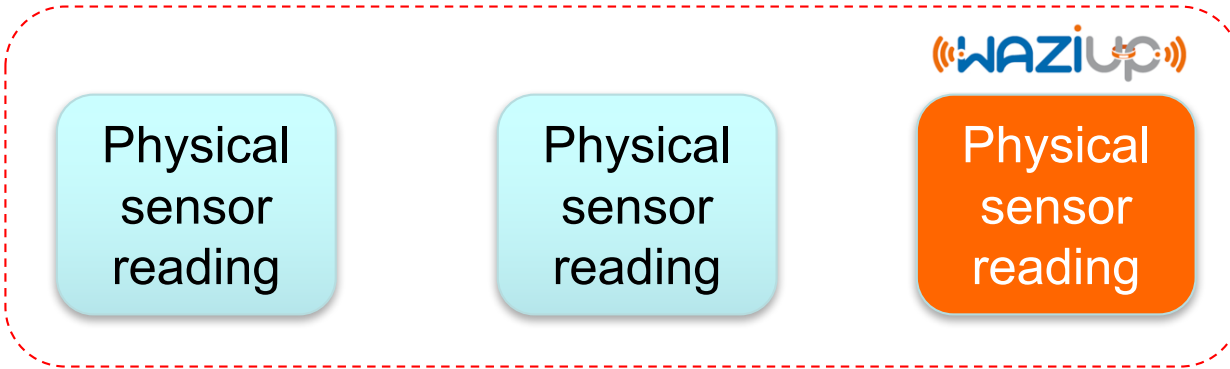
# GENERIC SENSING IOT DEVICE

- ❑ Build low-cost, low-power, Long-range enabled generic platform
- ❑ Methodology for low-cost platform design
- ❑ Technology transfers to user communities, economic actors, stakeholders,...

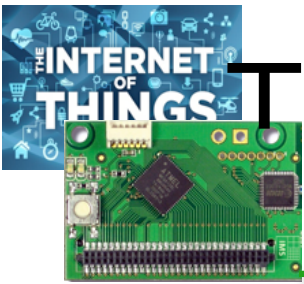




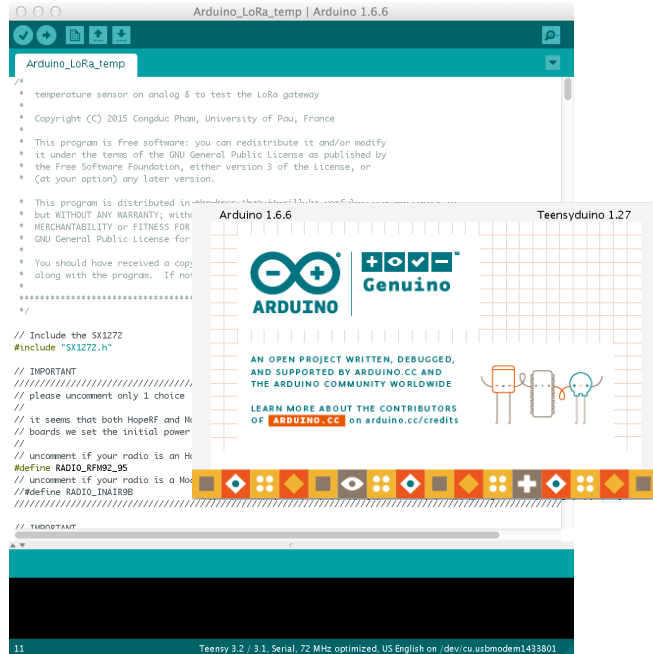
# READY-TO-USE TEMPLATES







# TEMPLATES ARE AVAILABLE ON GITHUB



CongducPham / LowCostLoRaGw

Watch 6 Star 13 Fork 11

Code Issues 6 Pull requests 0 Pulse Graphs

Low-cost LoRa gateway with SX1272 and Raspberry

11 commits 1 branch 0 releases 0 contributors

Branch: master New pull request New file Find file HTTPS https://github.com/Congdu Download ZIP

Congduc Pham modified some low-power info Latest commit a46b0f7 10 days ago

Arduino	modified some low-power info	10 days ago
Raspberry	modified some low-power info	10 days ago
.DS_Store	changes in the SX1272 lib, gateway and temperature example	2 months ago
README.md	modified some low-power info	10 days ago

Arduino_LoRa_Gateway	modified some low-power info	10 days ago
Arduino_LoRa_temp	modified some low-power info	10 days ago
libraries/SX1272	Added Teensy support	21 days ago

First, you will need the Arduino IDE 1.6.6 or later (left). Then get the LoRa library from our github: <https://github.com/CongducPham/LowCostLoRaGw> (right).

Get into the Arduino folder and get both Arduino\_LoRa\_temp and SX1272 folder. Copy Arduino\_LoRa\_temp into your "sketch" folder and SX1272 into "sketch/libraries"





# COMPILING

```

Arduino_LoRa_temp | Arduino 1.6.6
-----
Arduino_LoRa_temp
/*
 * temperature sensor on analog 8 to test the LoRa gateway
 * Copyright (C) 2015 Congduc Pham, University of Pau, France
 *
 * This program is free software: you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation, either version 3 of the License, or
 * (at your option) any later version.
 *
 * This program is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with the program. If not, see <http://www.gnu.org/licenses/>.
 */
*****

// Include the SX1272
#include "SX1272.h"

// IMPORTANT
// please uncomment only 1 choice
//
// it seems that both HoperF and Modtronix board use the PA_BOOST pin and not the RFO. Therefore, for these
// boards we set the initial power to 'x' and not 'H'. This is the purpose of the define statement
//
// uncomment if your radio is an HoperF RFM92W or RFM95W
#define RADIO_RF92_95
// uncomment if your radio is a Modtronix inAir98 (the one with +20dBm features), if inAir9, leave comment
// #define RADIO_INAIR98

// IMPORTANT
-----
11 Teensy 3.2 / 3.1, Serial, 72 MHz optimized, US English on /dev/cu.usbmodem1433801
    
```

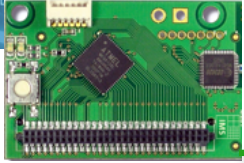
The screenshot shows the Arduino IDE interface with the 'Tools' menu open. The 'Board' dropdown is expanded, showing the selection of 'Arduino Pro or Pro Mini' and 'Processor: ATmega328 (3.3V, 8 MHz)'. The 'Programmer' dropdown is also open, showing 'AVRISP mkII' selected.

Open the Arduino\_LoRa\_temp sketch and select the Arduino Pro Mini board with its 3.3V & 8MHz version.

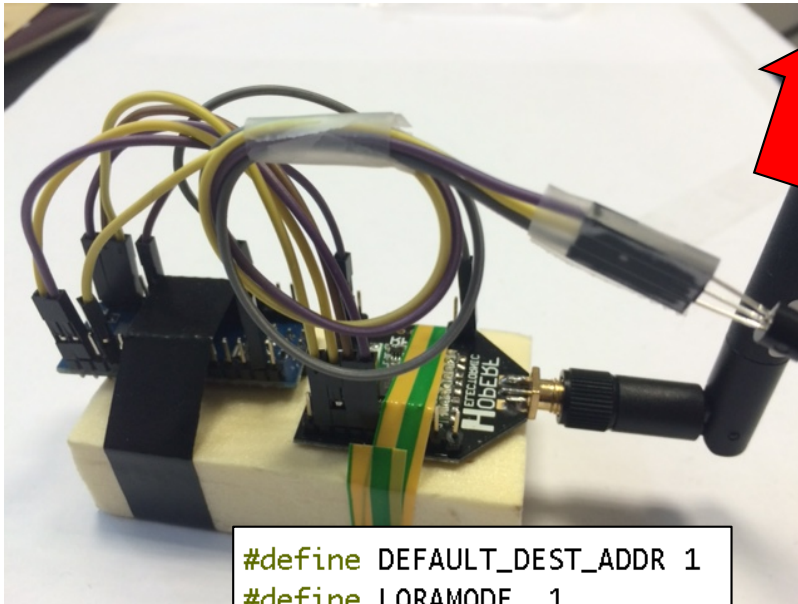
Then, click on the « verify » button





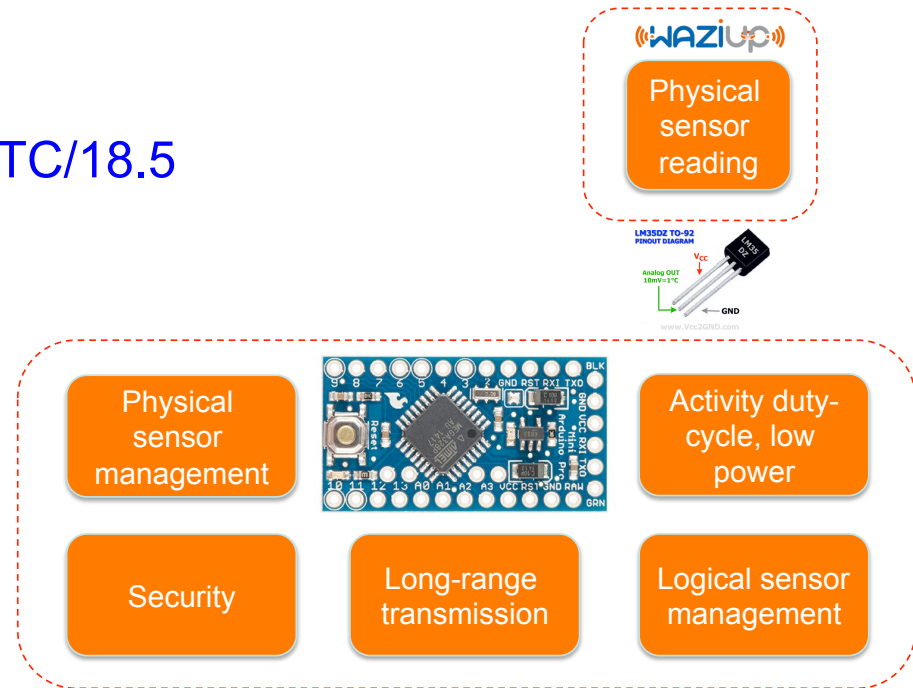


# BASIC EXAMPLE WITH TEMPERATURE SENSOR



!!##TC/18.5

```
#define DEFAULT_DEST_ADDR 1
#define LORAMODE 1
#define node_addr 6
```



The default configuration in the Arduino\_LoRa\_temp example is:

Send packets to the gateway (one or many if in range)

LoRa mode 1

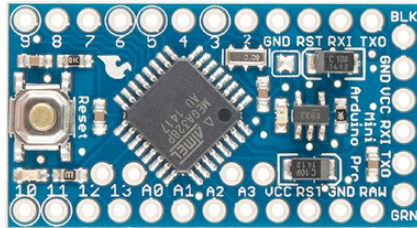
Node short address is 6



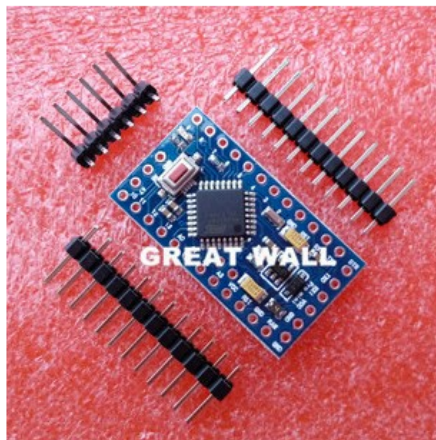
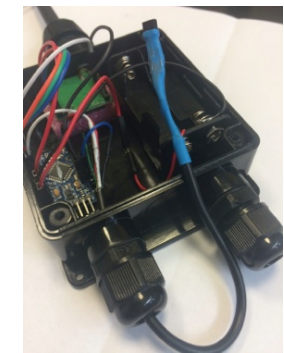
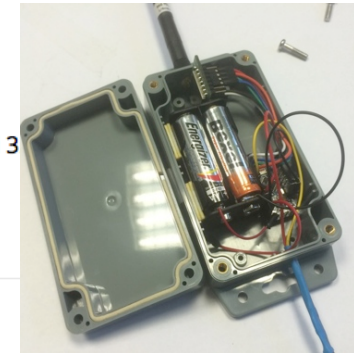
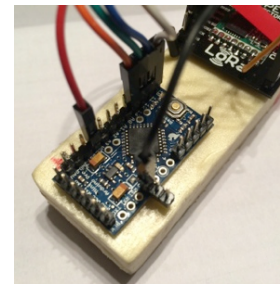
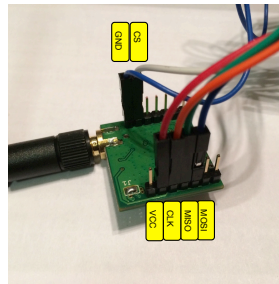
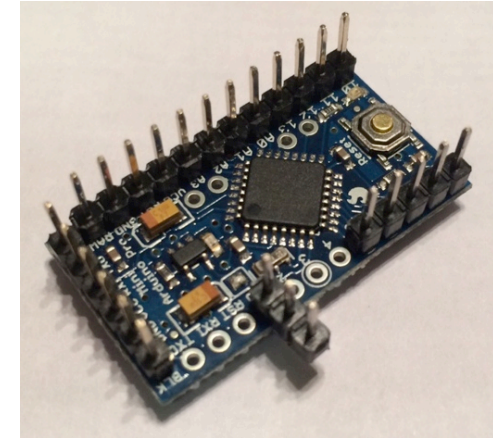
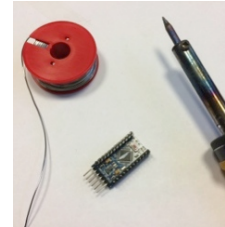
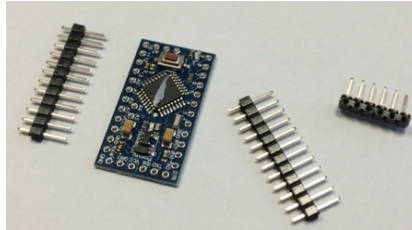


# EASY INTEGRATION AND CUSTOMIZATION

## Arduino Pro Mini



3.3v and 8MHz version



Avec la bootloader 1 pcs Pro Mini ATMEGA328 Pro Mini 3 MHz pour Arduino

[View original title in English](#)

★★★★★ 4.9 (417 Votes) | 434 Commandes

Prix : € 1,49 / Kit

Trouvez plus de deals sur l'App

Livraison : € 0,29 vers France via China Post Ordinary Small Pack

Livraison : 15-34 jours (envoyé en 7 jours ouvrables)

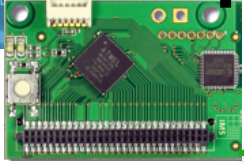
Quantité :  Kit (55350 Kits available)

Montant total : € 1,78

Acheter maintenant

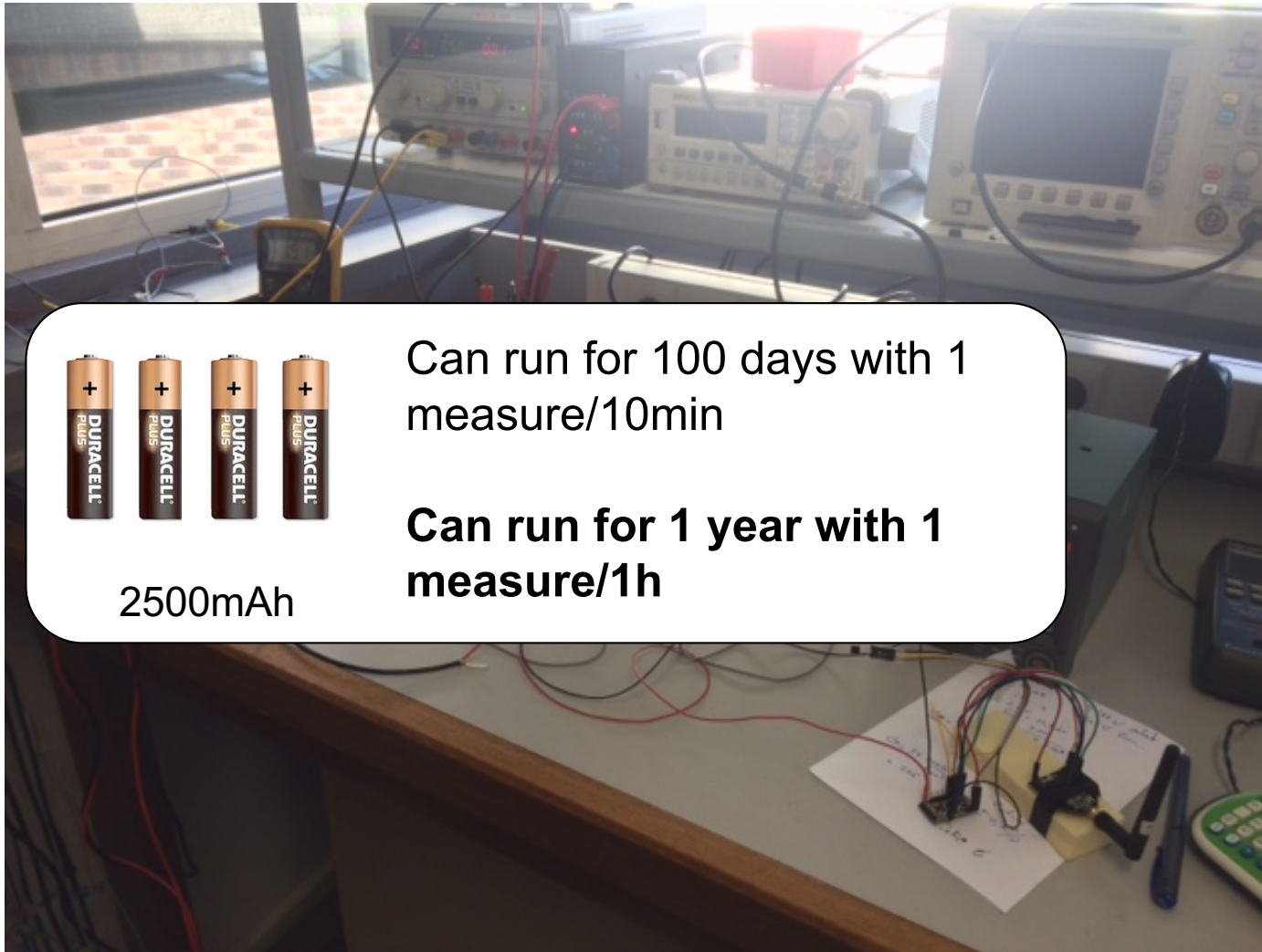
Ajouter au panier





# RUNNING FOR 1 YEAR WITH LOW-POWER MODE!

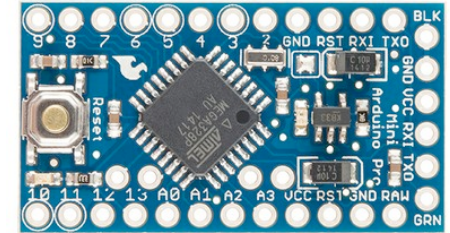
## Low-Power library from RocketScream



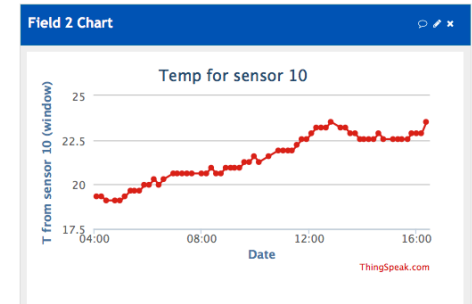
2500mAh

Can run for 100 days with 1 measure/10min

Can run for 1 year with 1 measure/1h



Wakes-up every 10min, take a measure (temp) and send to GW

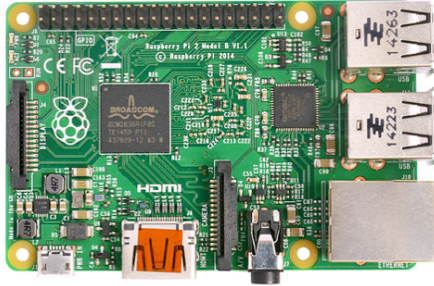
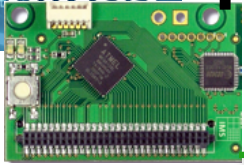


**146µA in deep sleep mode, 93mA when active and sending**

Thanks to T. Mesplou and P. Plouraboué for their help



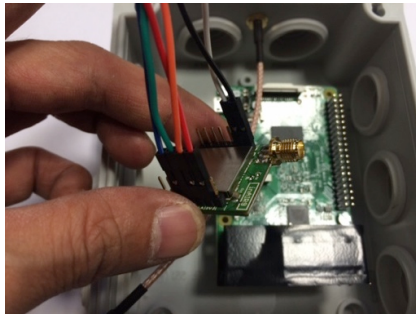
# RASPBERRY-BASED LORA GATEWAY



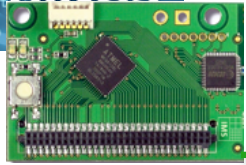
We can use all model of Raspberry. The most important usefull feature is the Ethernet interface for easy Internet connection. Then WiFi and Bluetooth can be added with USB dongles. RPI3 provides built-in Ethernet, WiFi and Bluetooth!



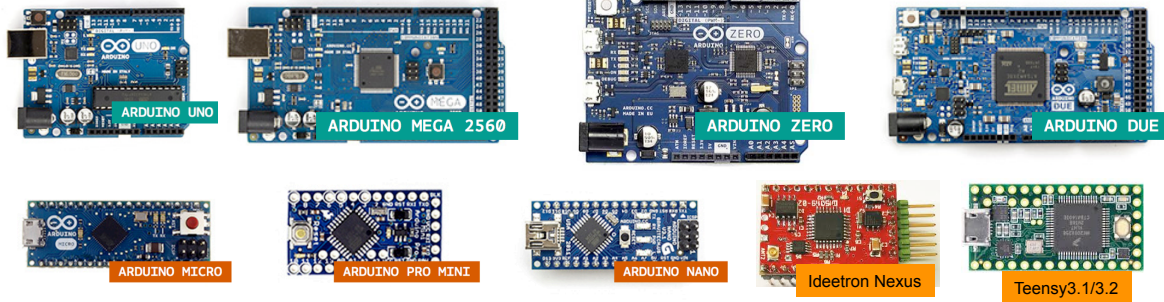
Less than 50€



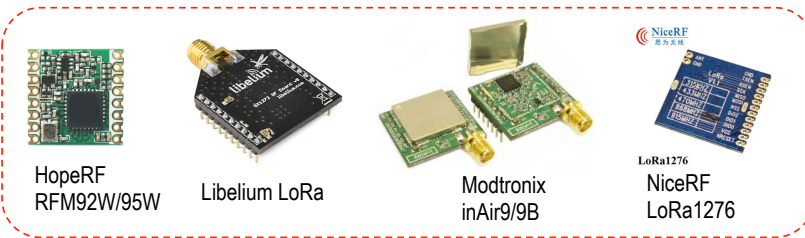




# SIMPLICITY!



LoRa radios that our library already supports



Long-Range communication library

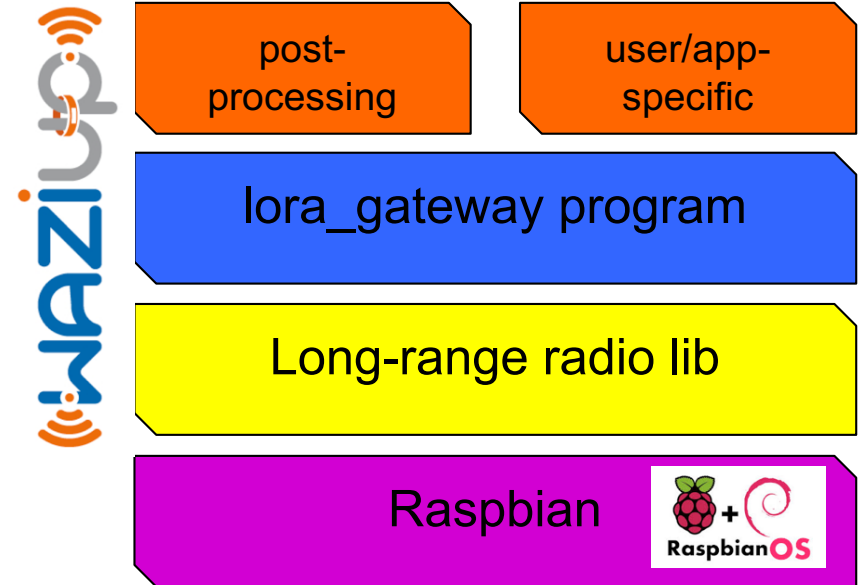
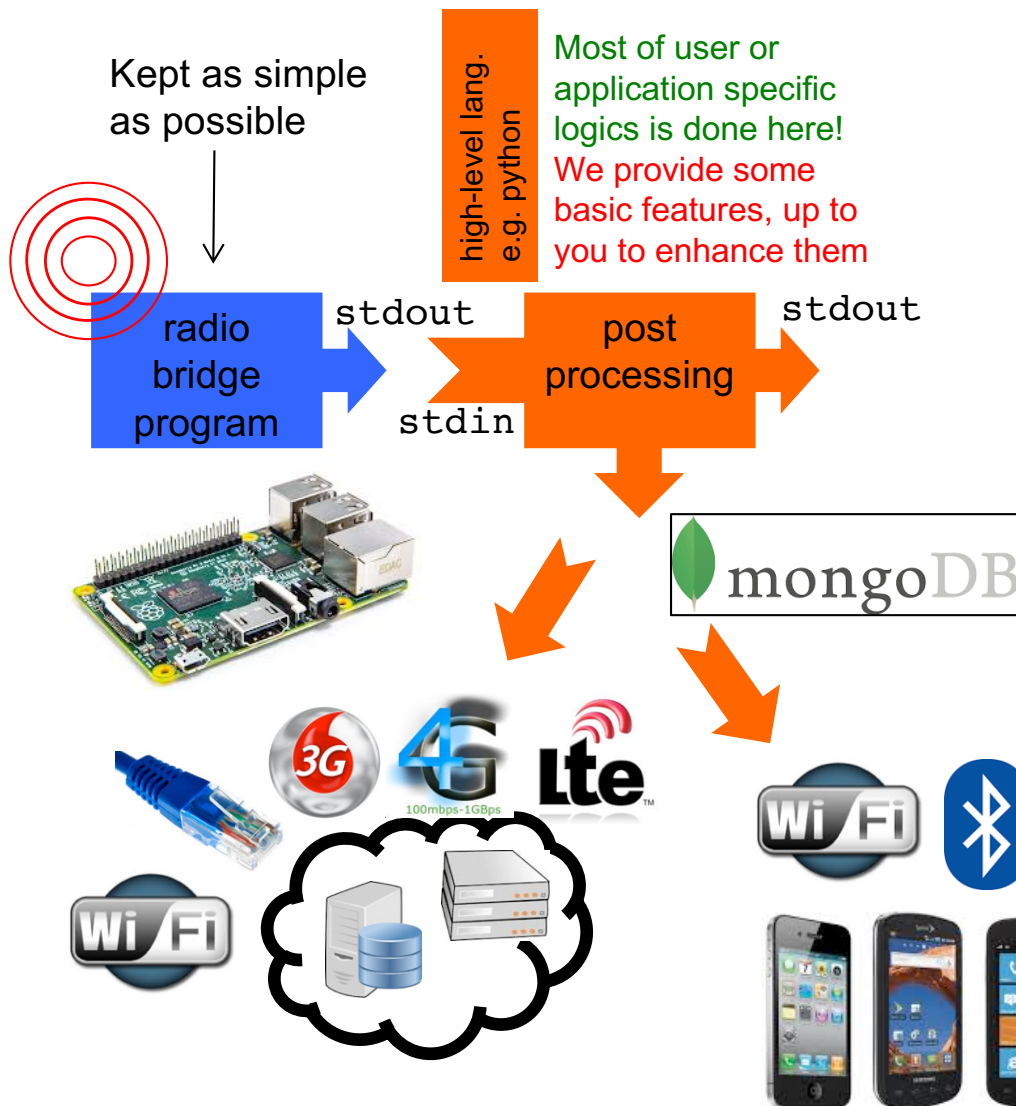
```
sendPacketTimeout("18.5");  
// sends to gateway  
// 18.5 : temperature message
```

**1 send function!**

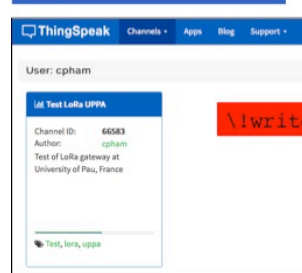
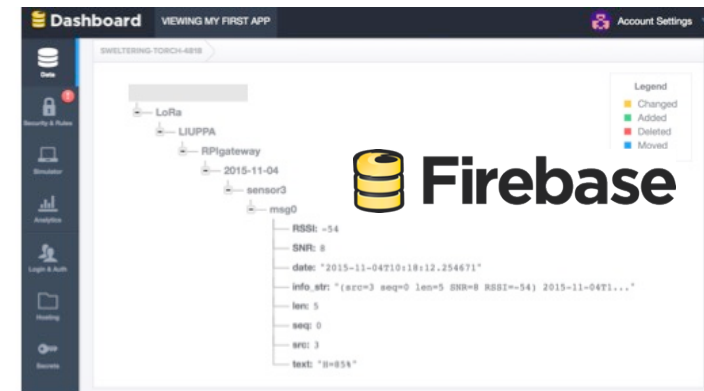
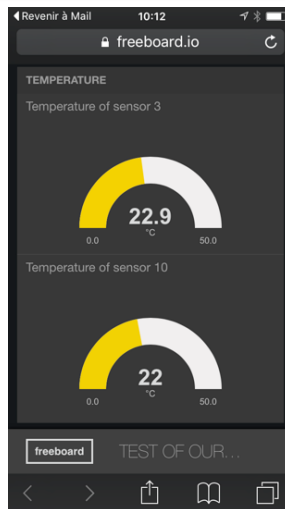
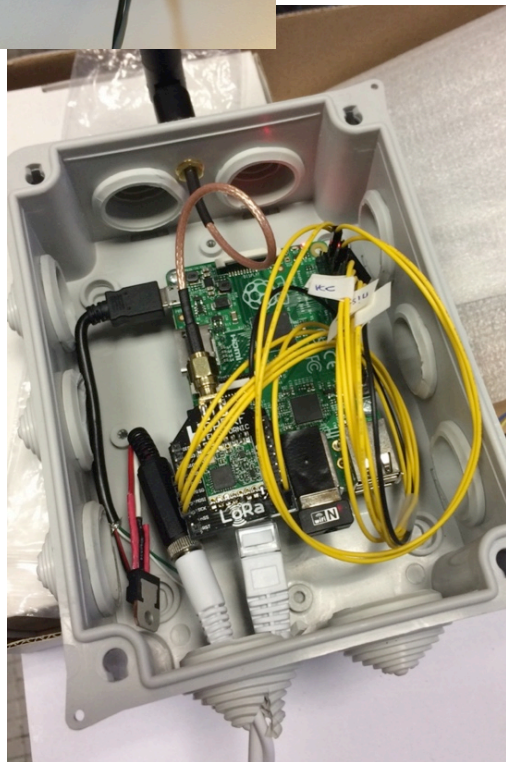




# OUR LOW-COST GATEWAY ARCHITECTURE

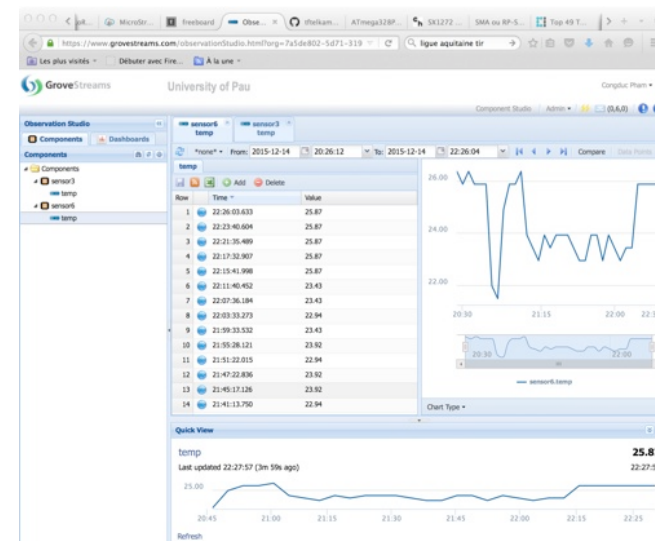
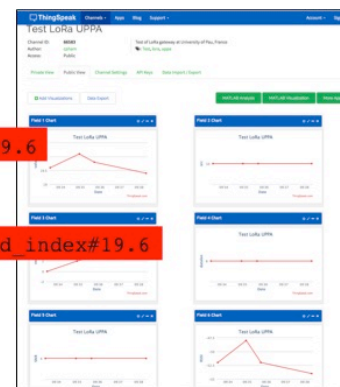


# TEMPLATES FOR VARIOUS CLOUDS



Node 10

\\#19.6  
\\write\_key#field\_index#19.6







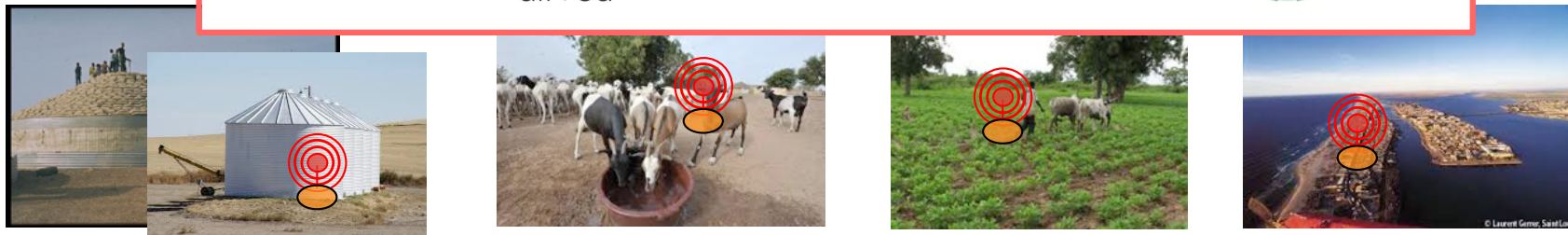
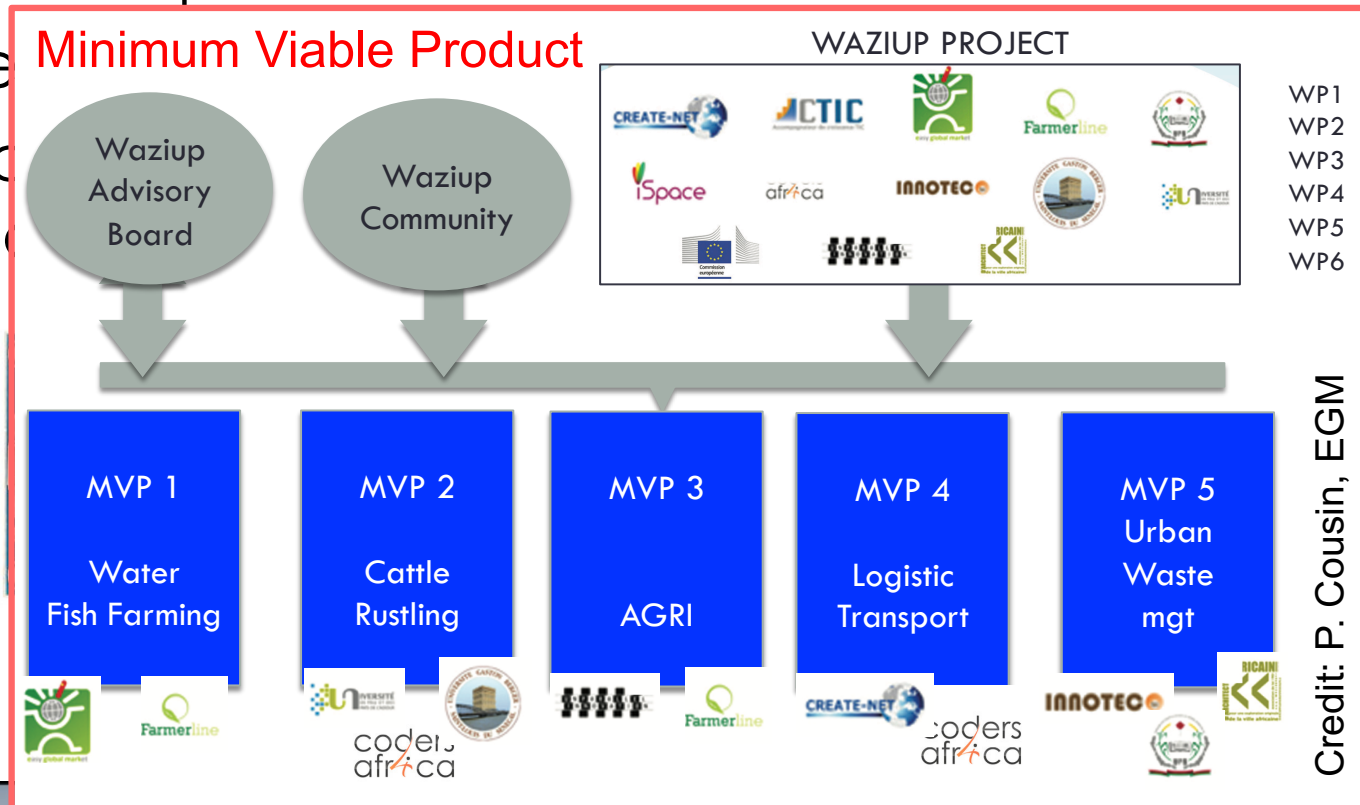


# GENERIC SENSING IOT DEVICE



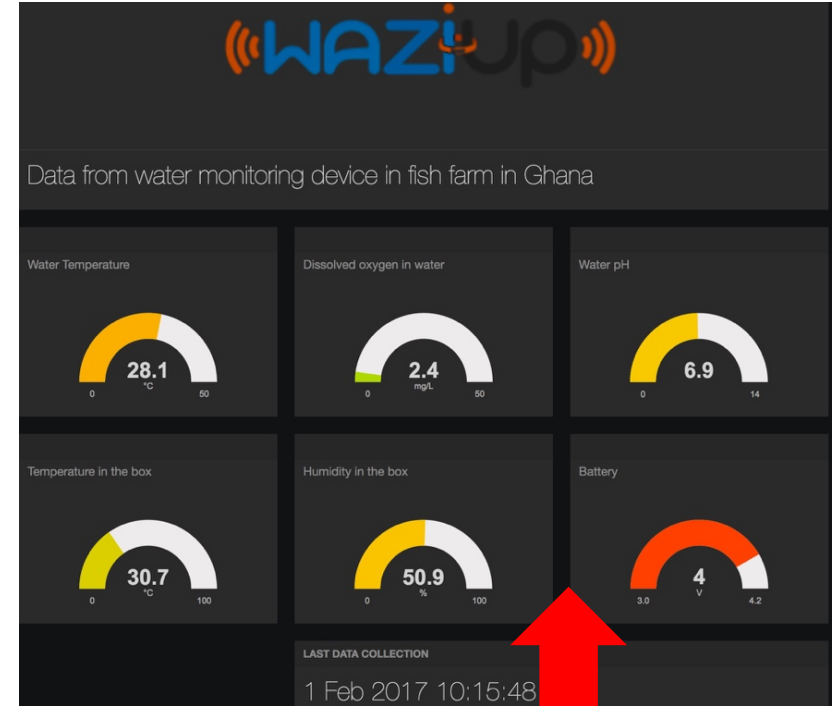
- Build low-cost, low-power, Long-range enabled generic platform

- Me
- Tec
- ec





# LOW-COST BUOY FOR FISH FARMING MVP



WAZIup  
Physical sensor reading



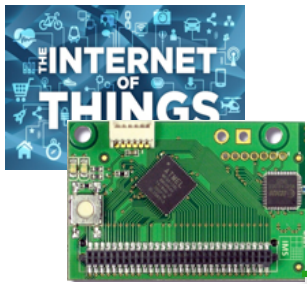
Credit: EGM



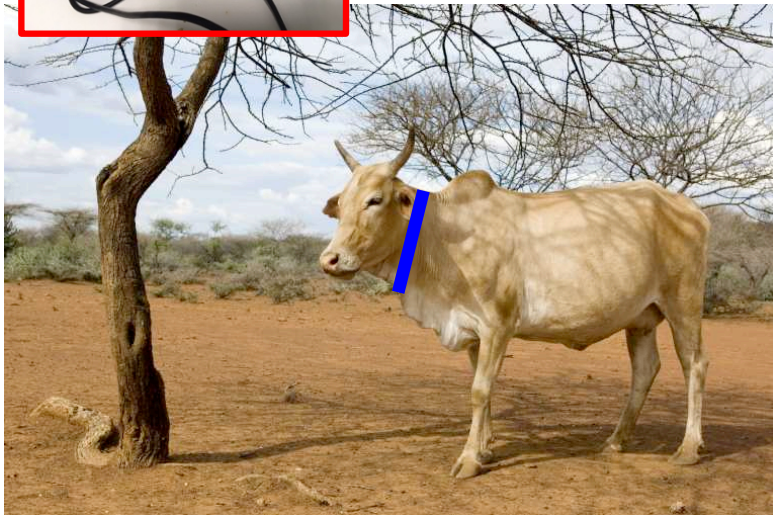
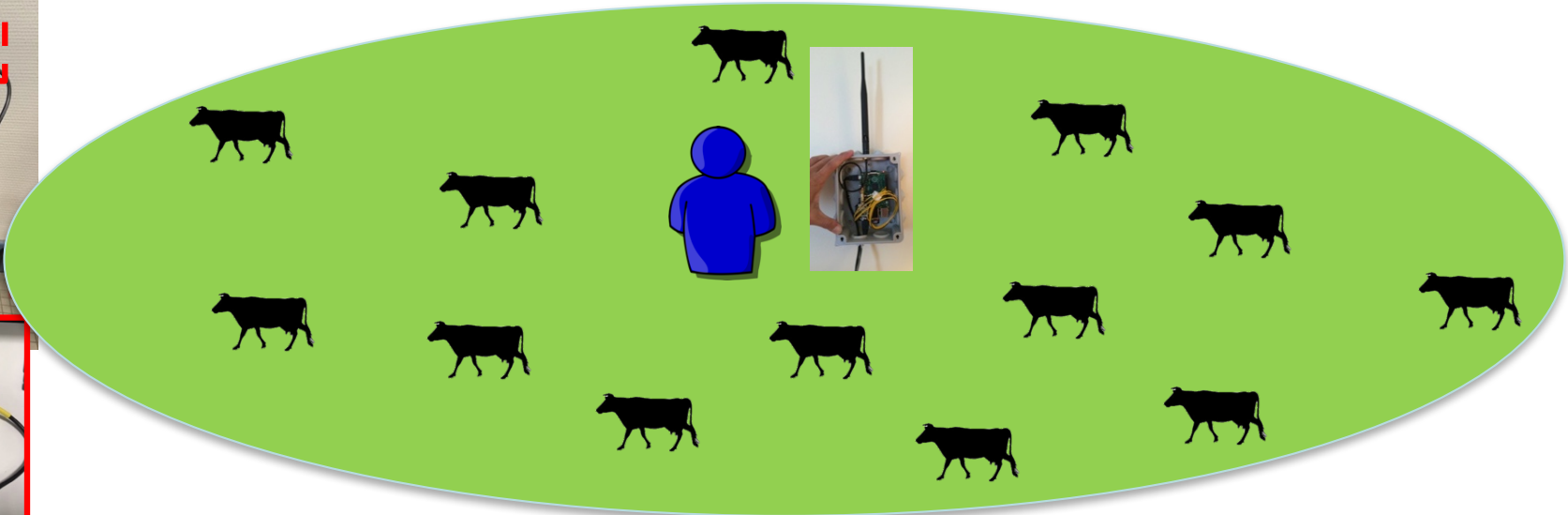
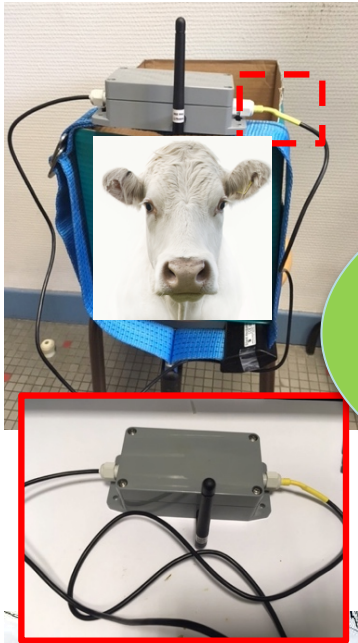
- Physical sensor management
- Activity duty-cycle, low power
- Security
- Long-range transmission
- Logical sensor management







# COLLAR FOR CATTLE RUSTLING MVP



### Access to the data from MongoDB

export data to csv

Display the 10 last document(s)

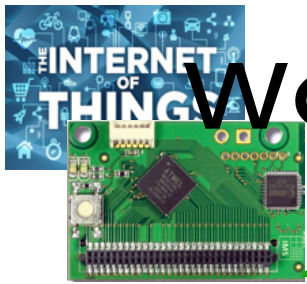
Sort by date

2016-12-15 16:47:59
2016-12-15 16:41:29
2016-12-15 15:38:24
2016-12-15 15:28:32
2016-12-15 16:24:30
2016-12-15 16:15:28
2016-12-15 16:03:38
2016-12-15 16:01:52
2016-12-15 14:56:37
2016-12-15 14:51:40

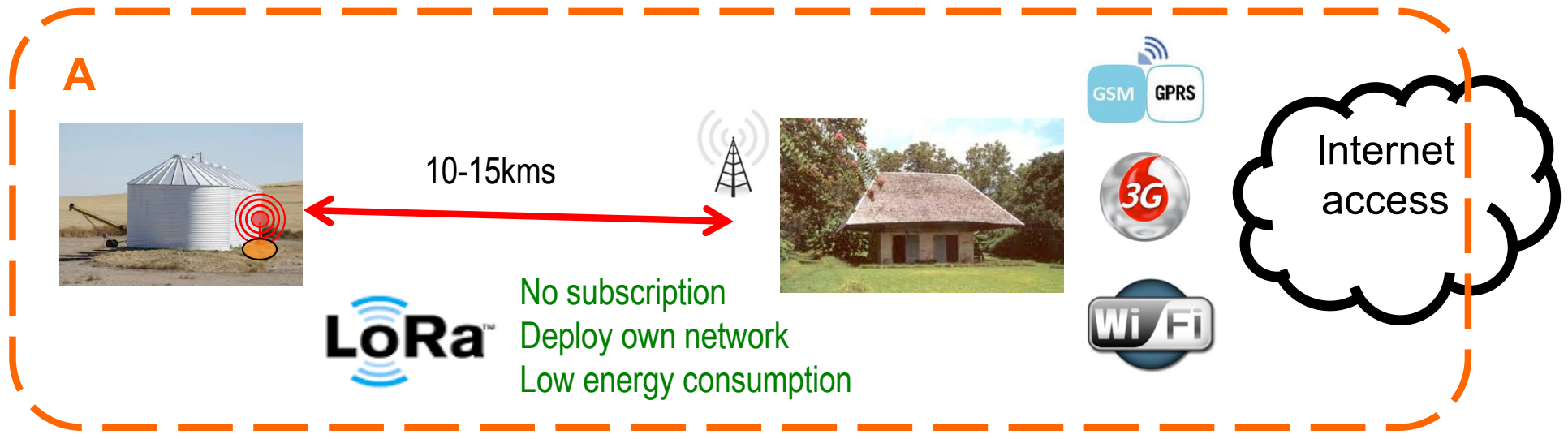
Display data: RSSI TC DEF

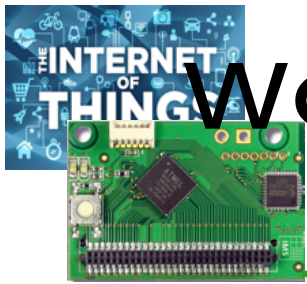
Display sources: node\_3 node\_6 node\_10

Zoom to: Whole period Last month Current month Last seven days Current day

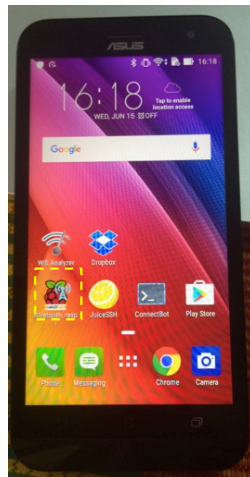
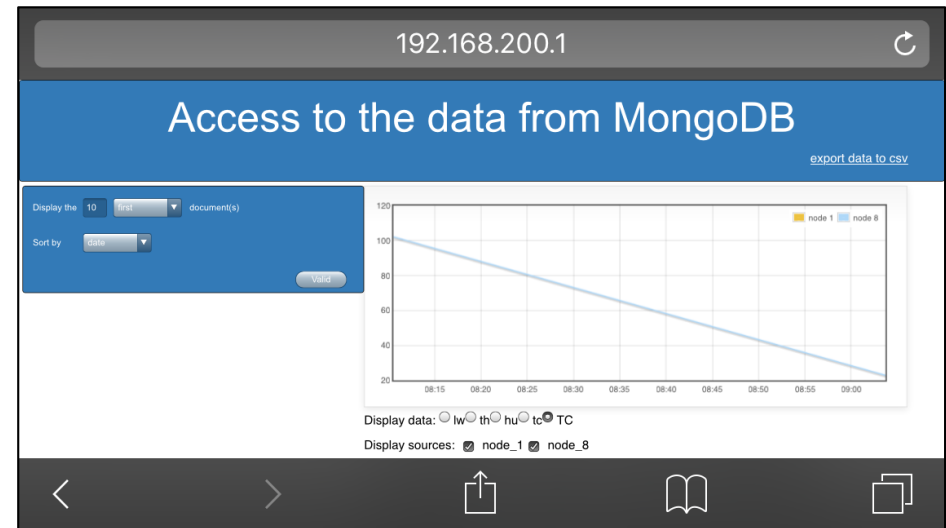
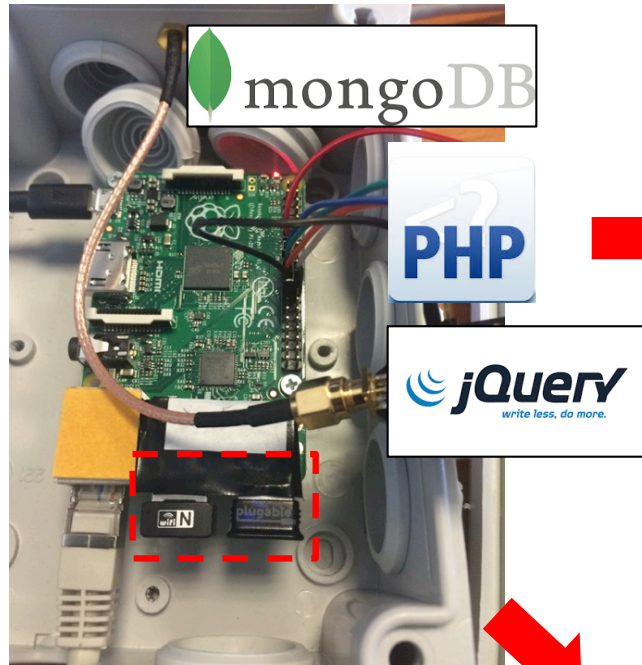


# WORKING WITHOUT INTERNET ACCESS





# WORKING WITHOUT INTERNET ACCESS



Orange F

Bluetooth\_raspi

```

NODE: 1 DATE: 2016-05-09 08:04:59.807000 DATA: {"lw": 3.29, "th": 22.6, "hu": 50.7}
NODE: 1 DATE: 2016-05-09 08:28:52.993000 DATA: {"lw": 3.29, "th": 22.89, "hu": 50.29}
NODE: 1 DATE: 2016-05-09 08:53:04.317000 DATA: {"lw": 3.29, "th": 23.2, "hu": 50.79}
NODE: 1 DATE: 2016-05-09 09:05:00.997000 DATA: {"lw": 3.29, "th": 23.29, "hu": 51.29}
NODE: 1 DATE: 2016-05-09 09:17:24.482000 DATA: {"lw": 3.29, "th": 23.39, "hu": 51.7}
NODE: 1 DATE: 2016-05-09 09:41:27.437000 DATA: {"lw": 3.29, "th": 23.6, "hu": 52.0}
NODE: 1 DATE: 2016-05-09 10:05:39.032000 DATA: {"lw": 3.29, "th": 23.79, "hu": 51.5}
NODE: 1 DATE: 2016-05-09 10:17:45.186000 DATA: {"lw": 3.29, "th": 23.79, "hu": 50.79}
NODE: 1 DATE: 2016-05-09 10:29:24.285000 DATA: {"lw": 3.29, "th": 23.79, "hu": 50.79}
NODE: 1 DATE: 2016-05-09 10:53:09.347000 DATA: {"lw": 3.29, "th": 23.79, "hu": 51.9}
NODE: 1 DATE: 2016-05-09 11:17:02.953000 DATA: {"lw": 3.29, "th": 23.5, "hu": 50.79}
NODE: 1 DATE: 2016-05-09 11:52:53.334000 DATA: {"lw": 3.29, "th": 23.29, "hu": 50.7}
NODE: 1 DATE: 2016-05-09 12:04:32.437000 DATA: {"lw": 3.29, "th": 23.5, "hu": 50.29}
NODE: 1 DATE: 2016-05-09 12:16:56.116000 DATA: {"lw": 3.29, "th": 23.6, "hu": 50.29}
    
```

Display data      Retrieve data in a csv file

Orange F

Bluetooth\_raspi

**NODES PREFERENCES**

1 check to retrieve its data

8 check to retrieve its data

**DATES PREFERENCES**

Pick a begin date  
Retrieve data since 09-05-2016

Pick an end date  
Retrieve data until 17-05-2016

Display data      Retrieve data in a csv file

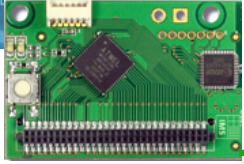
Orange F

Bluetooth\_raspi

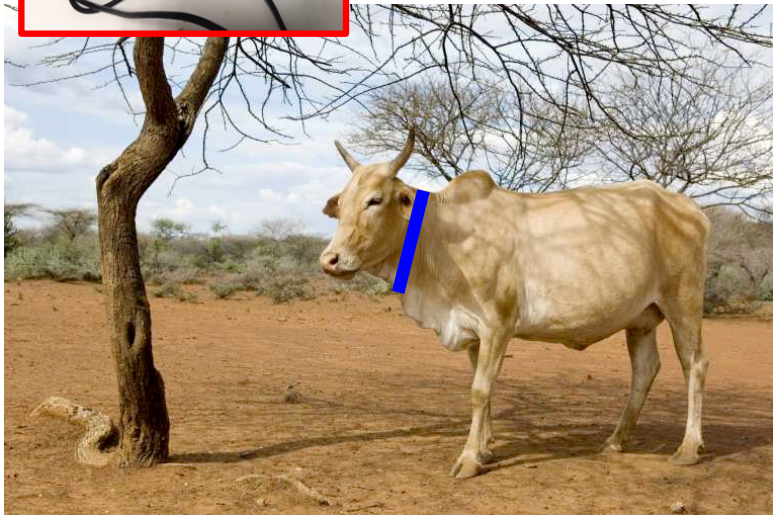
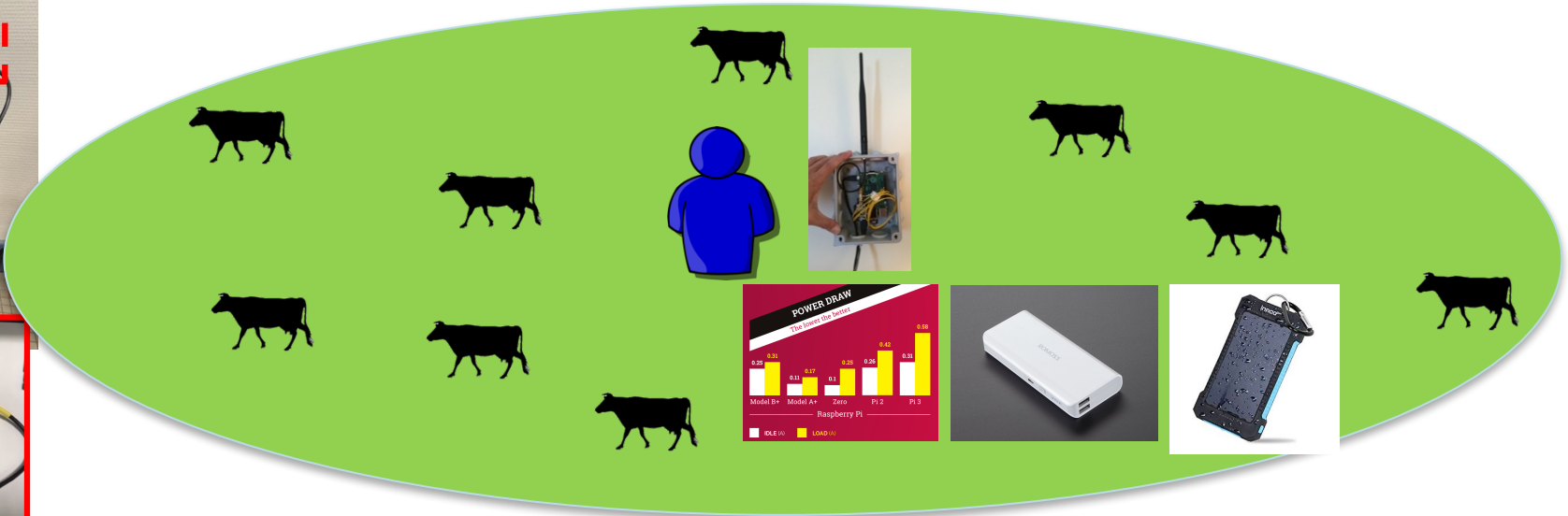
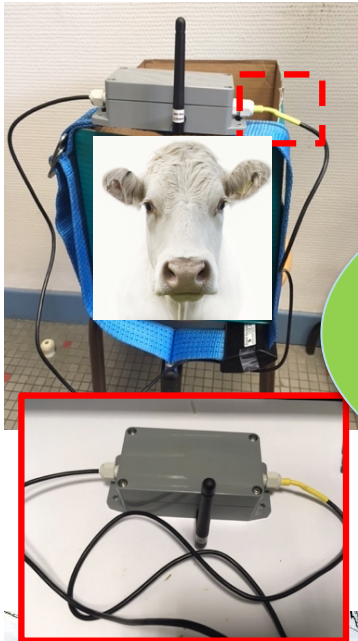
Creating .csv file with the data received...  
File 17-05-2016\_10h39m36s.csv created and saved in the folder /storage/emulated/0/Raspberry\_local\_data

Display data      Retrieve data in a csv file





# GATEWAY FOR « ON-THE-GO » APPLICATIONS



## Access to the data from MongoDB

export data to csv

Display the 10 last document(s)

Sort by date

Valid

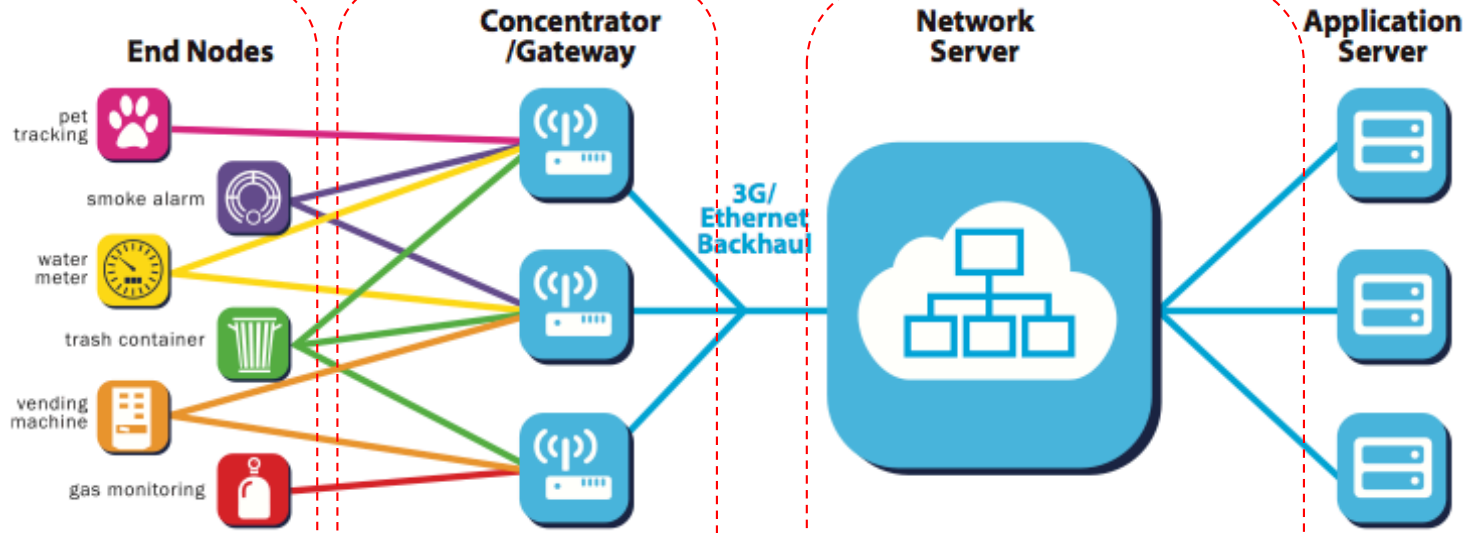
2016-12-15 16:47:59
2016-12-15 16:41:29
2016-12-15 16:38:24
2016-12-15 16:28:32
2016-12-15 16:24:30
2016-12-15 16:18:28
2016-12-15 16:03:38
2016-12-15 16:01:52
2016-12-15 14:56:37
2016-12-15 14:51:40

Display data: RSSI TC DEF

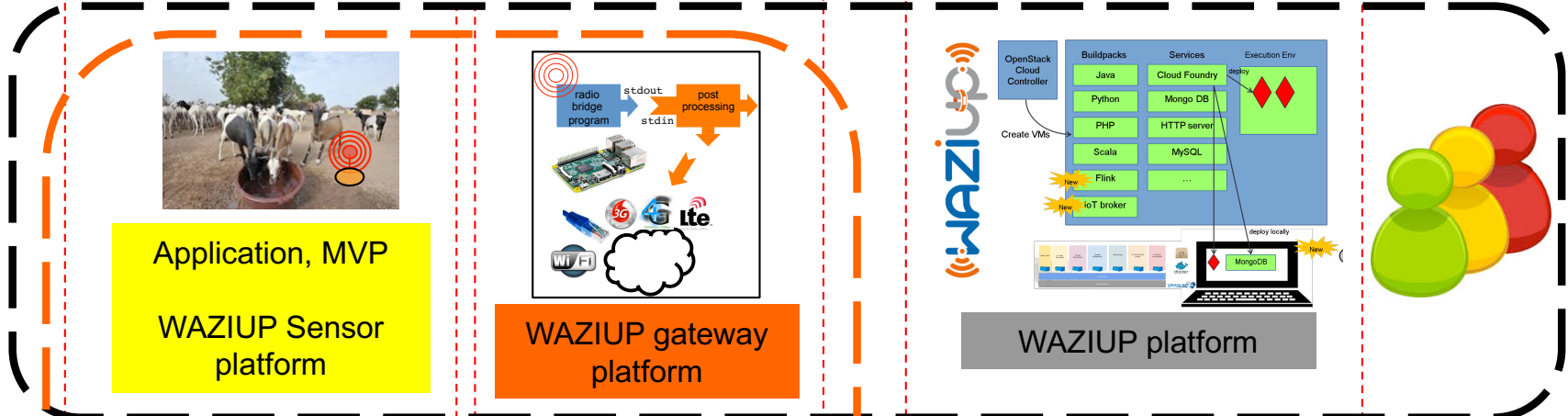
Display sources: node\_3 node\_6 node\_10

Zoom to: Whole period Last month Current month Last seven days Current day

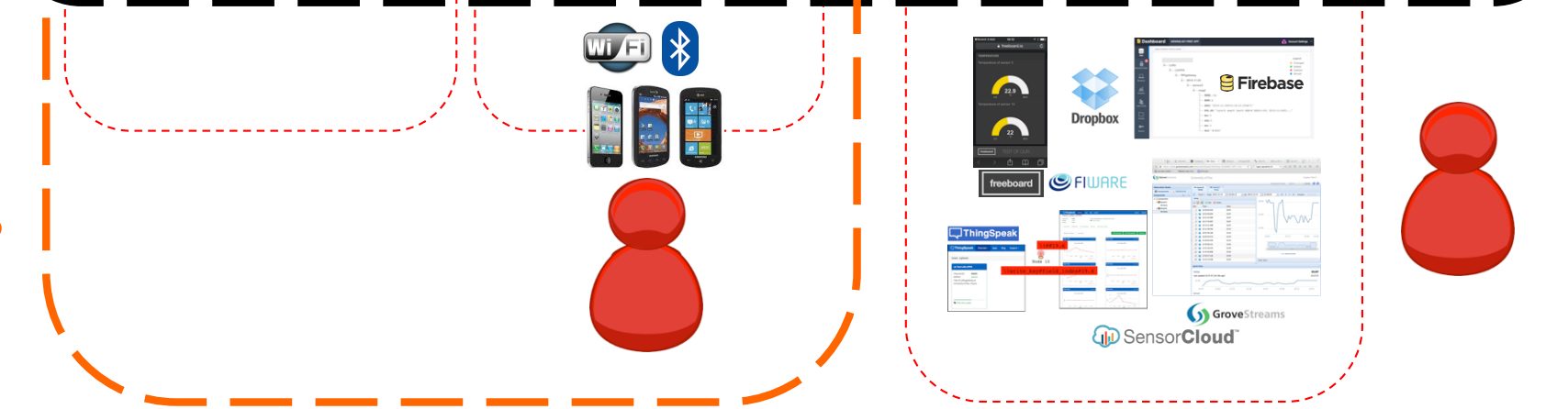
Figure from Semtech

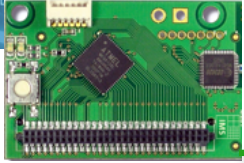


A

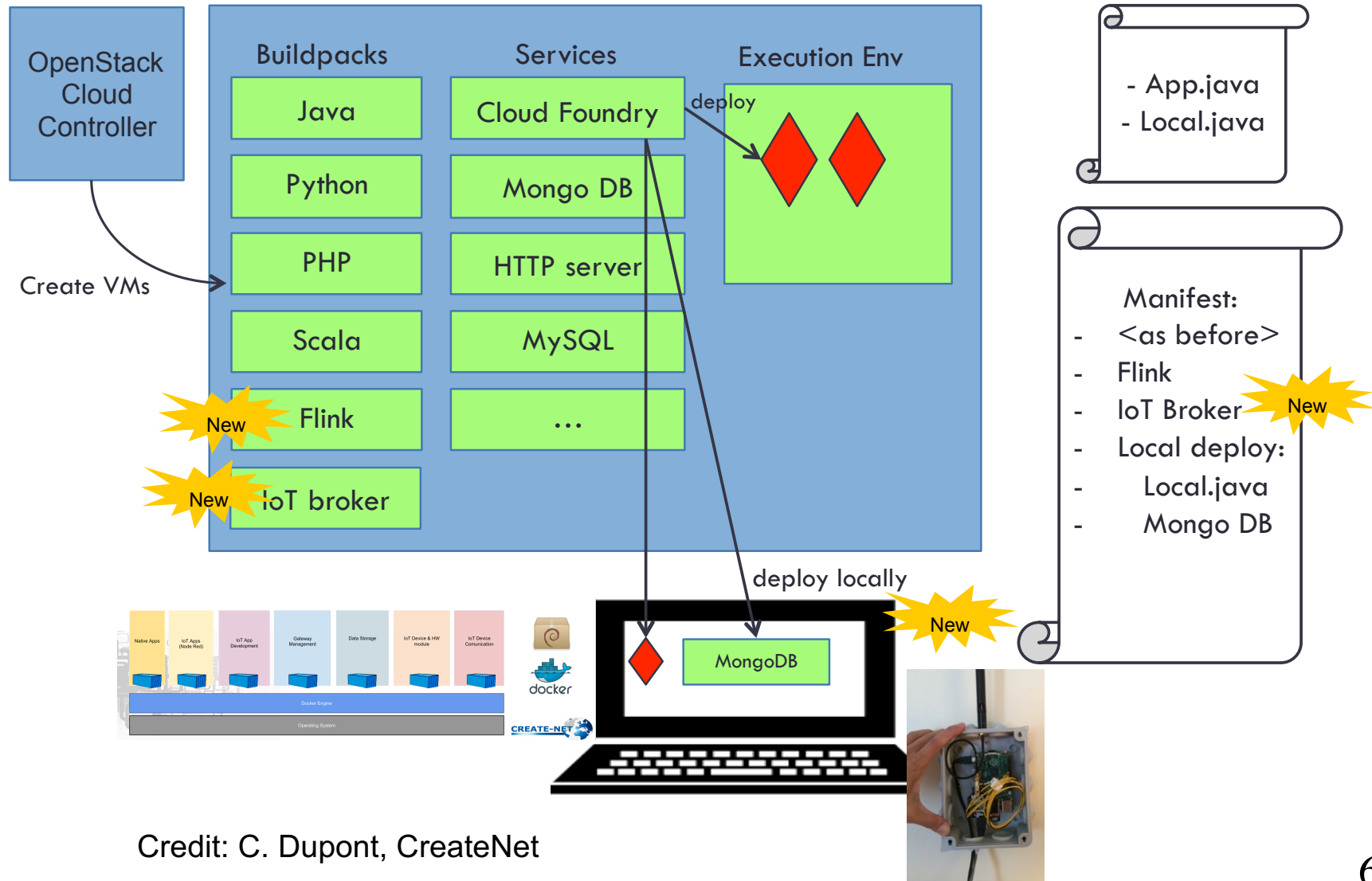


B





# LOCAL DATA ANALYTICS

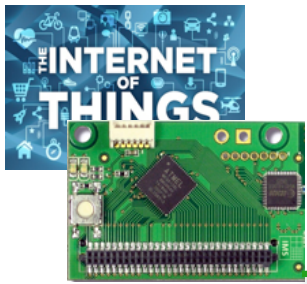


Credit: C. Dupont, CreateNet





**ADDED-VALUE**



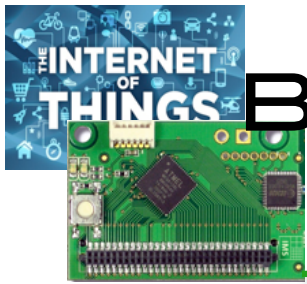
# INVOLVING INNOVATION HUBS/STAKEHOLDERS



- **Close to dev & entrepreneurs** communities
- Have their **own community and com channels** (community builders & catalysts)
- Used to organizing disruptive events
- **On the field** (know the targets personally & the market)
- **Used to empowering startups & businesses** (coaching, business dev, incubation, acceleration...)
- Affiliated to **international networks** that could be involved in dissemination or Business dev (Afrilabs)







# BUILDING WAZIUP COMMUNITY AND ECOSYSTEM



**International Events**  
+ 20 organized & attended

**Workshop at the European Conference on Networks & Communications (Greece, CNET)**



**Launch event (Ghana, iSpace)**



**IoTWeek2016 (Belgrade, EGM)**



**IoTBigData2016 (Italy, EGM)**

**Launch event (Senegal, CTIC Dakar)**



**IoT Care Conference (Budapest, CNET)**

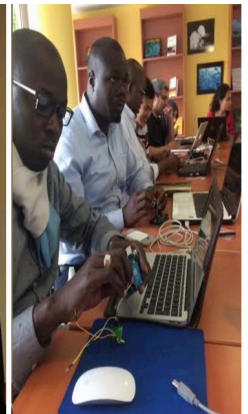
**WAZIUP Workshop on IoT (Togo, L'Africaine d'Architecture)**



**Credit: C. Vavasseur, CTIC Dakar**

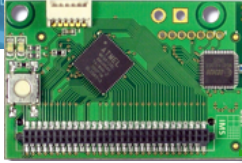


**RESSACS 2016**



**Workshop at the RESSACS 2016 (France, UPPA)**





# TUTORIALS/RESOURCES



**WAZIUP**  
 101 822020 grant agreement number 8876167

**Low-cost LoRa IoT devices and gateway FAQ**

1) **What is Internet-of-Thing (IoT)?**  
 From IERC (European Research Cluster on the Internet of Thing)  
 The IERC definition states that IoT is "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."  
 From <http://www.gartner.com/it-glossary/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."  
 From <http://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT>  
 "The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction."

2) **What is WAZIUP?**  
 The EU H2020 WAZIUP project, namely the Open Innovation Platform for IoT-Big Data in Sub-Saharan Africa is a collaborative research project using cutting edge technology applying IoT and Big Data to improve the working conditions in the rural ecosystem of Sub-Saharan Africa. First, WAZIUP operates by involving farmers and breeders in order to define the platform specifications in focused validation cases. Second, while tackling challenges which are specific to the rural ecosystem, it also engages the flourishing ICT ecosystem in those countries by fostering new tools and good practices, entrepreneurship and start-ups. Aimed at boosting the ICT sector, WAZIUP proposes solutions aiming at long term sustainability.  
 WAZIUP will deliver a communication and big data application platform and generate locally the know how by training by use case and examples. The use of standards will help to create an interoperable platform, fully open source, oriented to radically new paradigms for innovative applications/services delivery. WAZIUP is driven by the following visions:  
 1. Empower the African Rural Economy. Develop new technological enablers to empower the African rural economy now threatened by the concurrent action of rapid urbanization and of climate change. WAZIUP technologies can support the necessary services and infrastructures to launch agriculture and breeding on a new scale.

Author : Congduc Pham, University of Pau, France  
 page 1  
 Last update : 07.09.2016

**TUTORIAL ON HARDWARE & SOFTWARE FOR LOW-COST LONG-RANGE IOT**

**WAZIUP**

**LIUPPA**  
T21 team

**PROF. CONGDUC PHAM**  
[HTTP://WWW.UNIV-PAU.FR/~CPHAM](http://www.univ-pau.fr/~cpham)  
 UNIVERSITÉ DE PAU, FRANCE

**UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR**

**LOW-COST LORA IOT DEVICE: A STEP-BY-STEP TUTORIAL**

**WAZIUP**

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T21 team

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**BUILDING AN IOT DEVICE FOR OUTDOOR USAGE: A STEP-BY-STEP TUTORIAL**

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**LOW-COST LORA IOT DEVICE: SUPPORTED PHYSICAL SENSORS**

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**LOW-COST LORA GATEWAY: A STEP-BY-STEP TUTORIAL**

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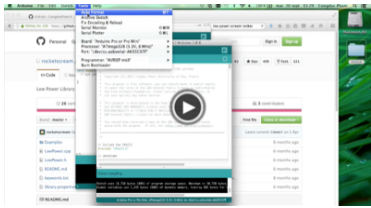
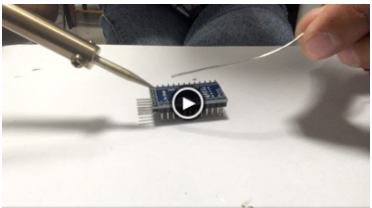
**LOW-COST LORA IOT: USING THE WAZIUP DEMO KIT**

**WAZIUP**

**LIUPPA**  
T21 team

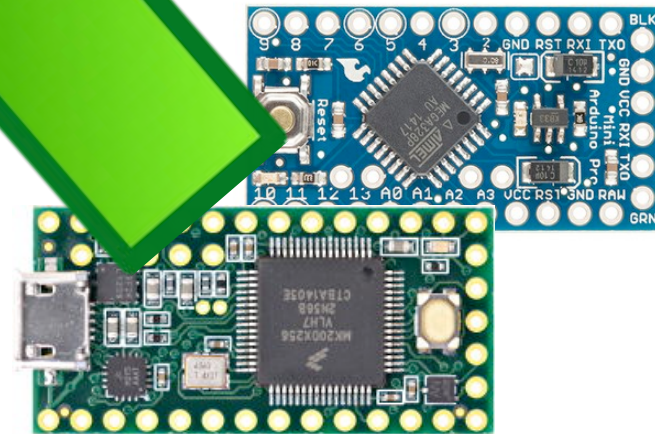
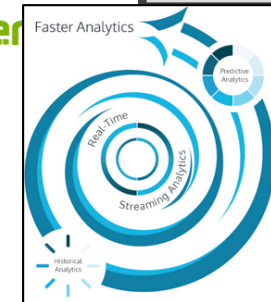
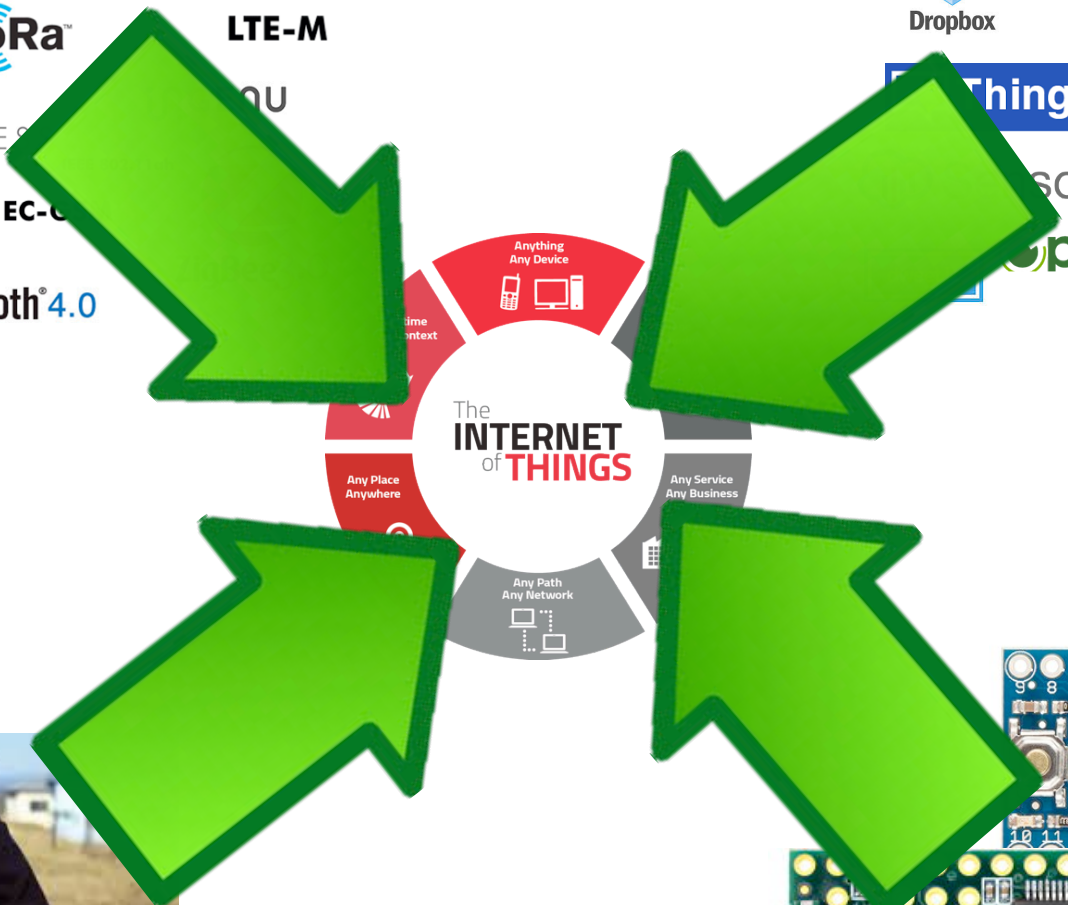
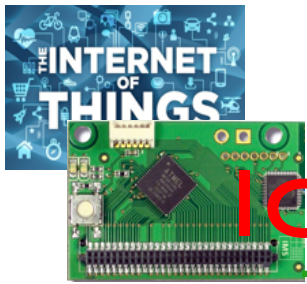
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**UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR**



# Now,

# IOT CAN BECOMES REALITY!







Thanks.  
**Let's keep in touch**



**Carine VAVASSEUR**

*Communication & Event Manager*

Carine.vavasseur@cticdakar.com

www.cticdakar.com  
contact@cticdakar.com



facebook.com/waziupIoT



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github.com/waziup