

# MORE UNDERSTANDING OF THE IOT ECOSYSTEM

WAZIHUB IOT BOOTCAMP  
HIVECOLAB & WITU

KAMPALA, OUGANDA  
DEC 13TH

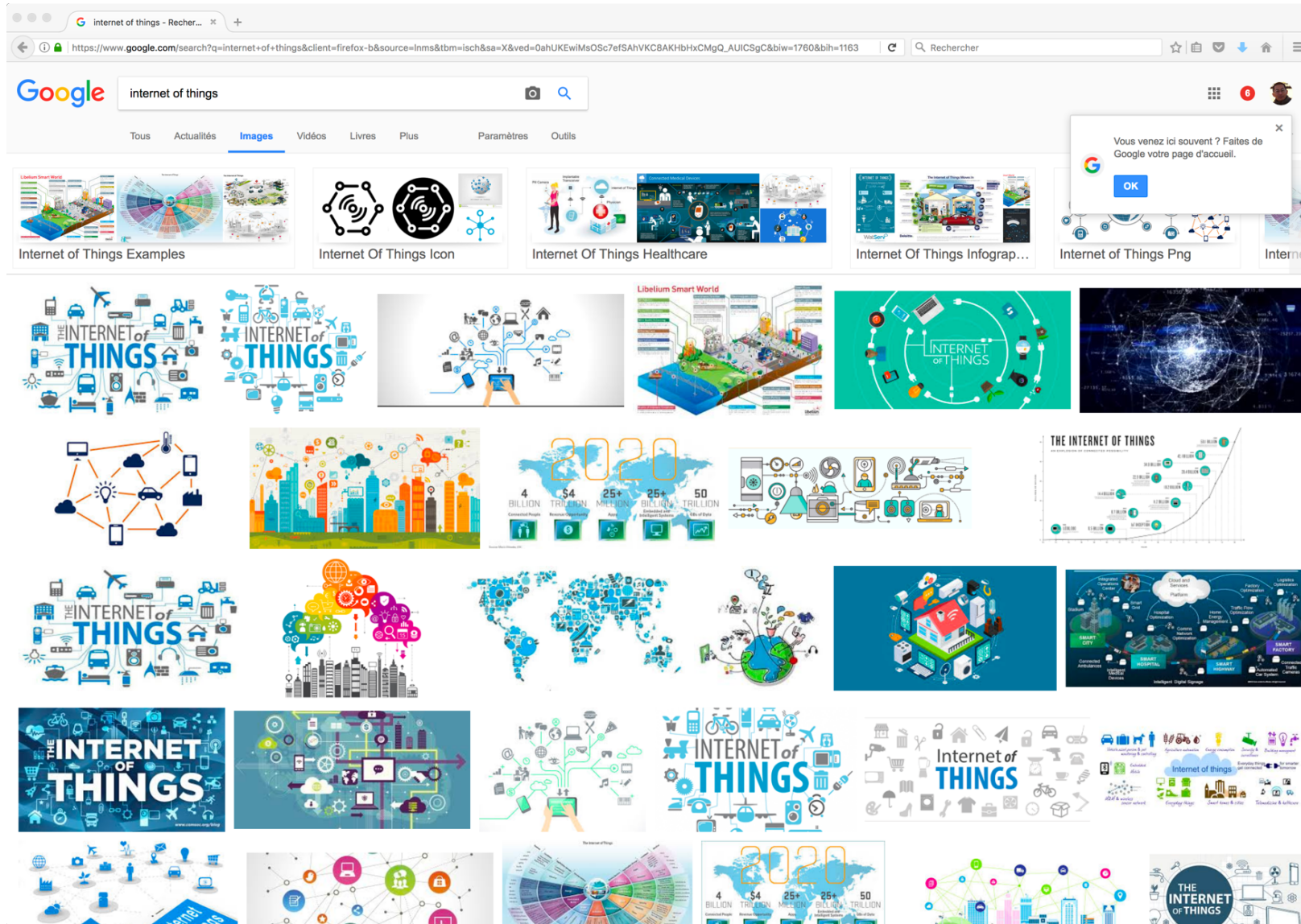
CONGDUC PHAM



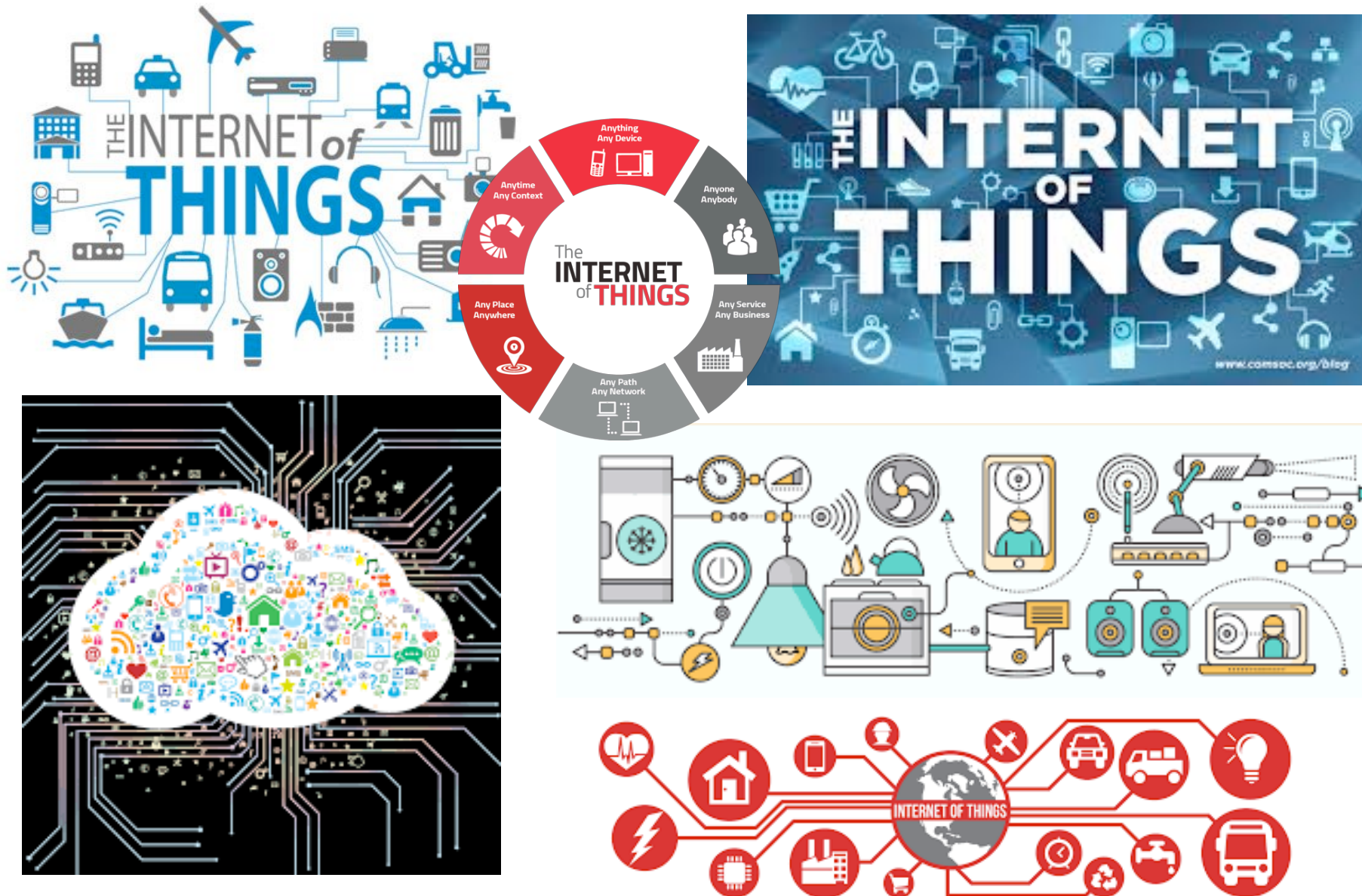
AUTHOR  
PROF. CONGDUC PHAM  
[HTTP://WWW.UNIV-PAU.FR/~CPHAM](http://www.univ-pau.fr/~cpham)



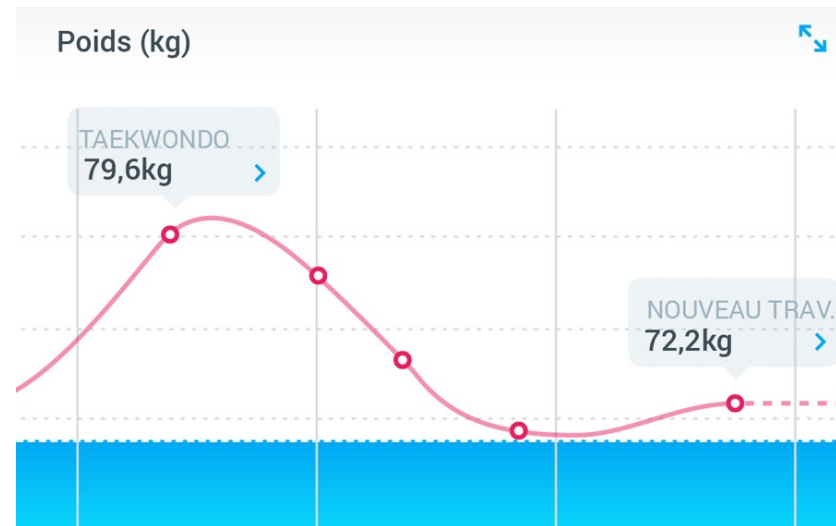
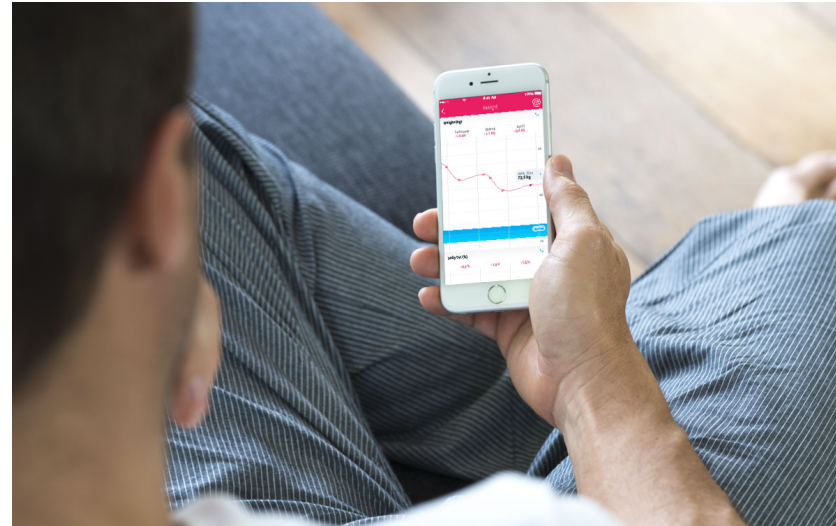
# GOOGLING FOR « INTERNET OF THINGS »...



# ... TYPICALLY SHOWS COMMUNICATING OBJECTS

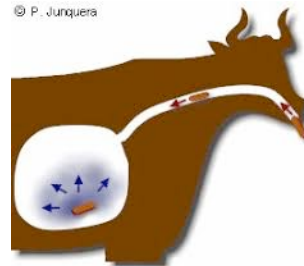
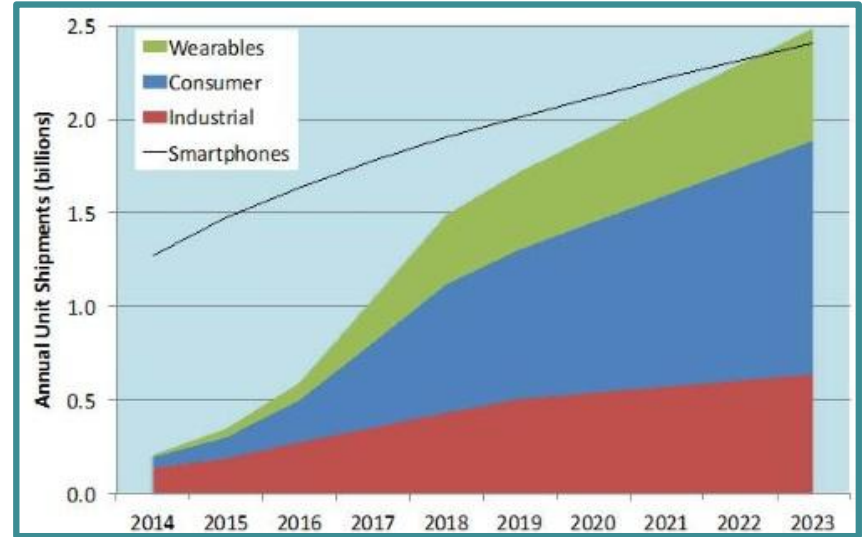


# HOME/CONSUMER IOT PRODUCTS



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

# ONE OF THE MOST PROMISING MARKET IS IOT!



© P. Junquera



# IOT FOR DEVELOPMENT

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Irrigation



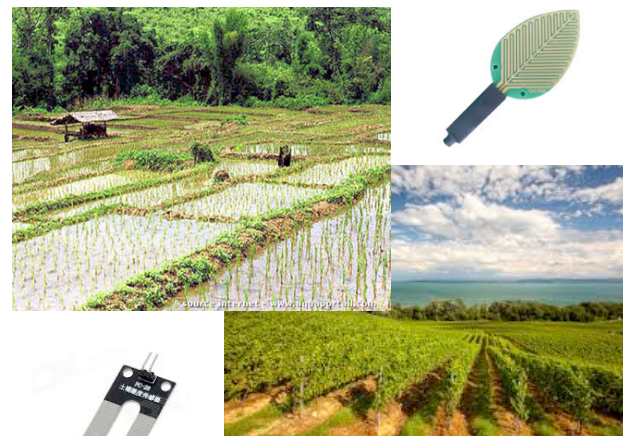
Livestock farming



Fish farming & aquaculture



Storage & logistic



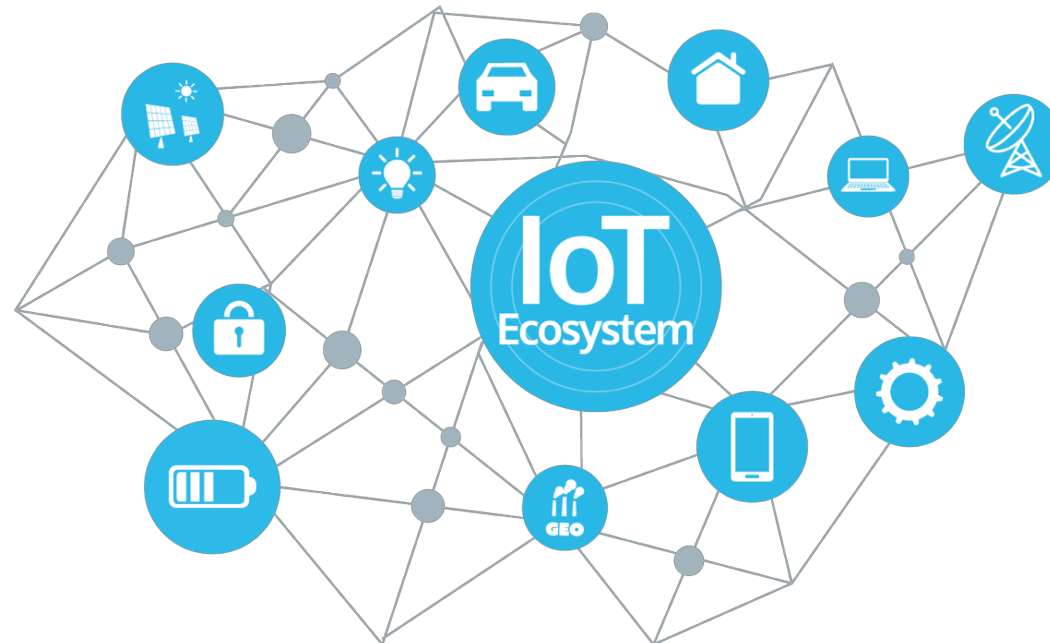
Agriculture



Fresh water



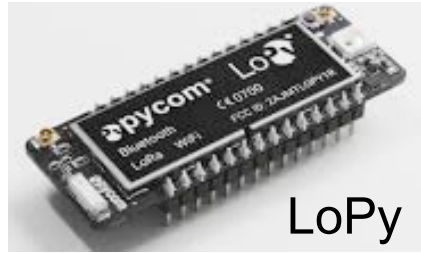
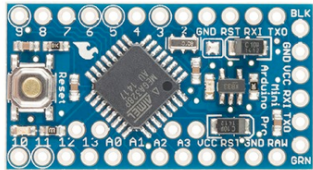
## THE IOT ECOSYSTEM



# LOW-COST HARDWARE



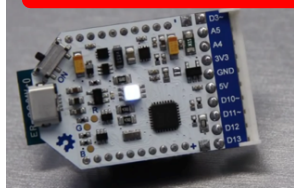
Arduino Pro Mini



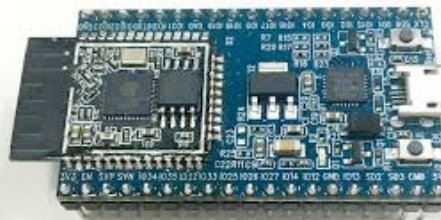
LoPy

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

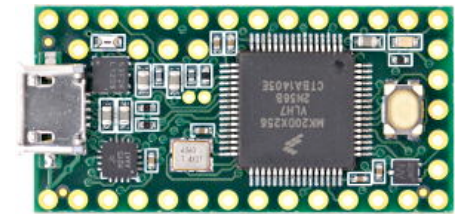
<http://blog.atmel.com/2015/04/09/25-dev-boards-to-help-you-get-started-on-your-next-iot-project/>



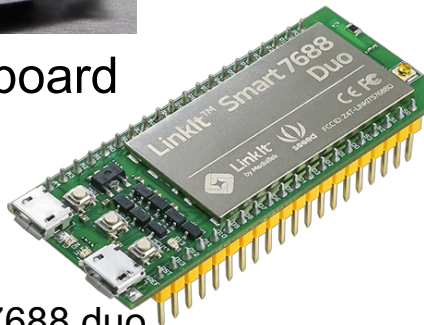
Theairboard



Expressif ESP32

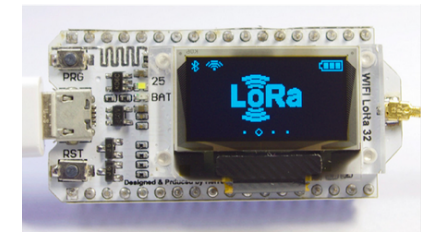
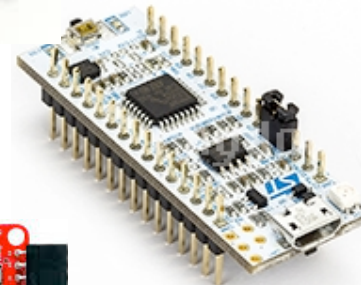


Teensy 3.2



LinkIt Smart7688 duo

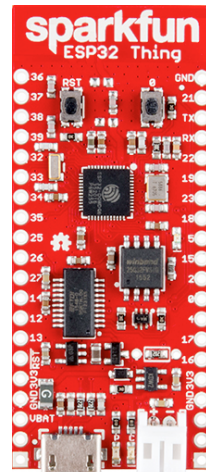
STM32 Nucleo-32



Heltec ESP32 + OLED



Adafruit Feather



Sparkfun ESP32 Thing



Tessel

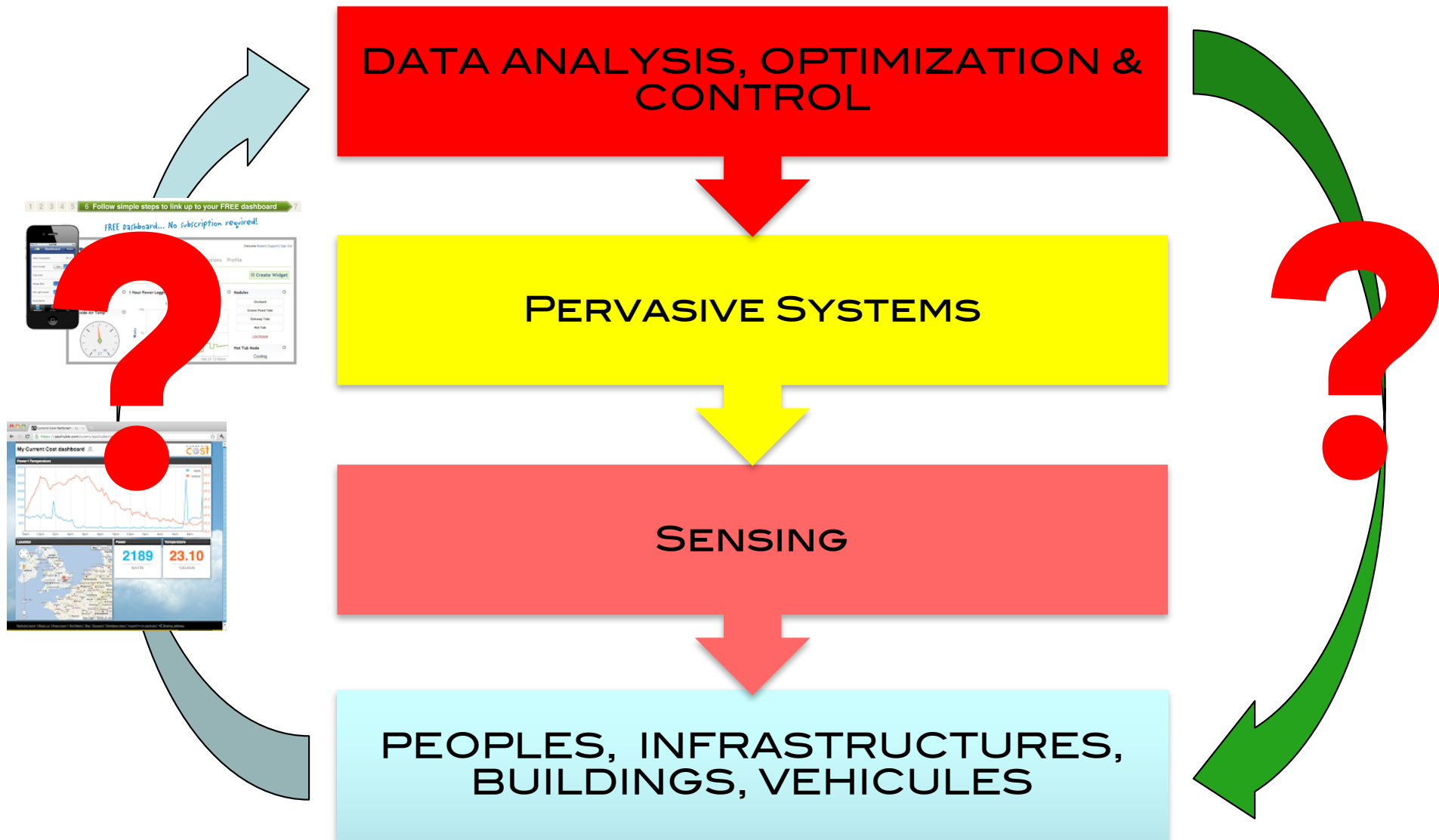
SodaqOnev2



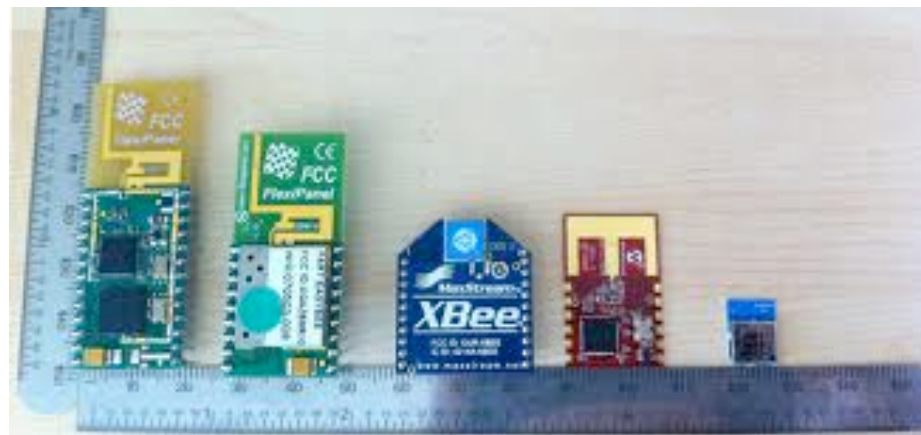
Tinyduino



# COLLECT DATA

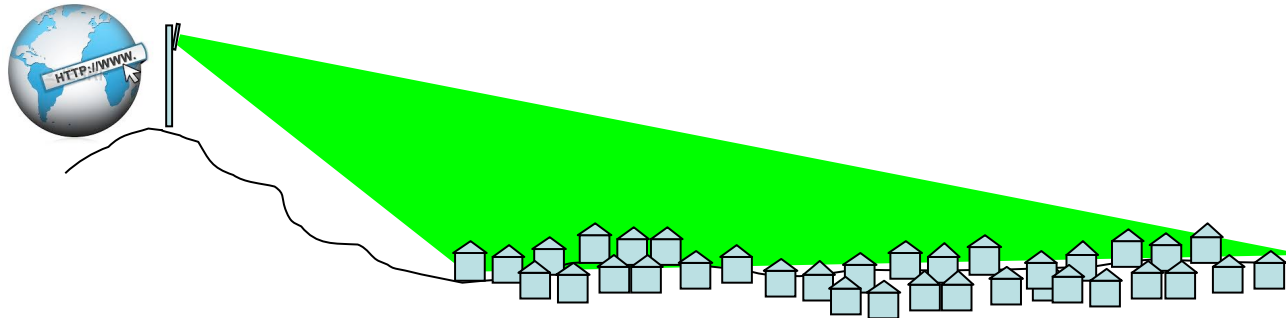


# WIRELESS COMMUNICATION MADE EASY



# TELEMETRY AND TRANSMISSION COST

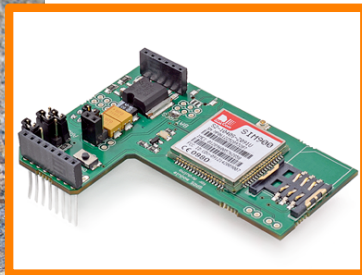
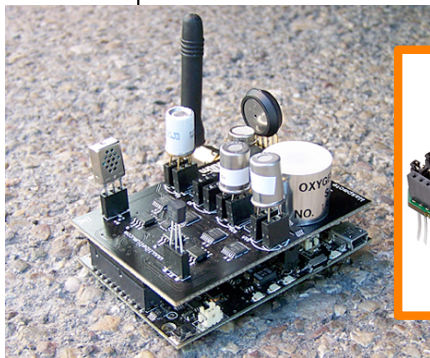
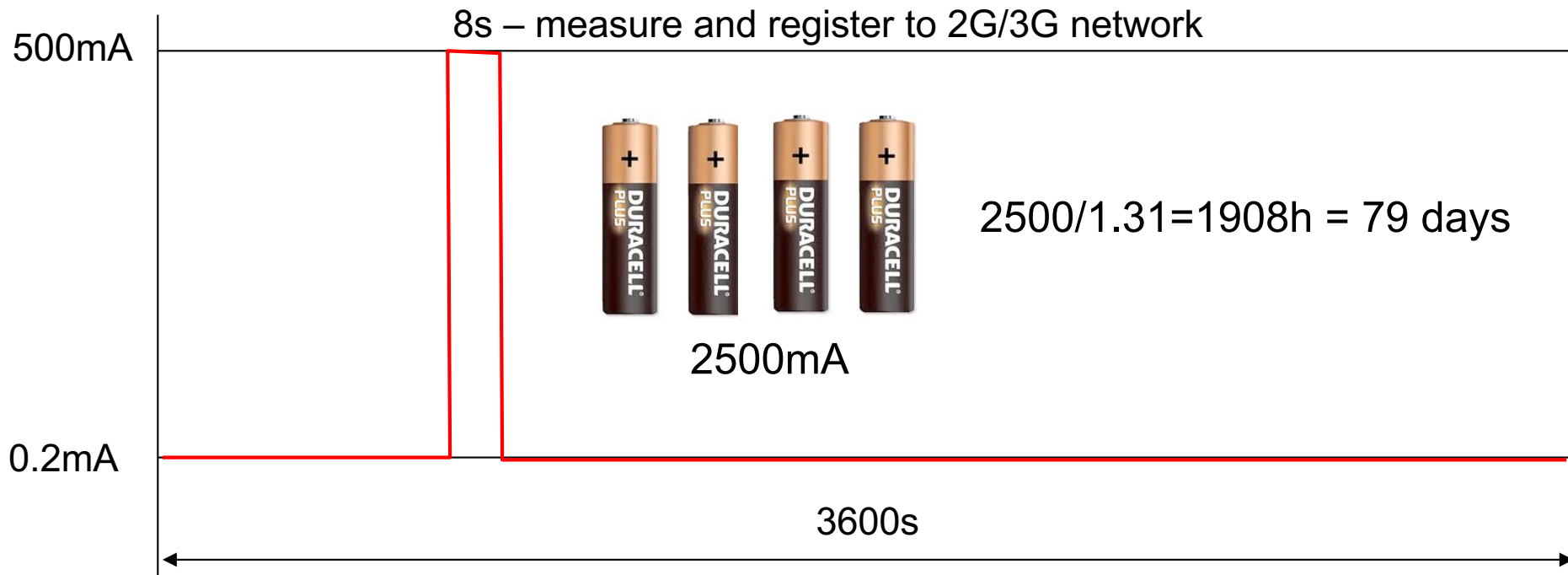
Moisture/  
Temperature of  
storage areas



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

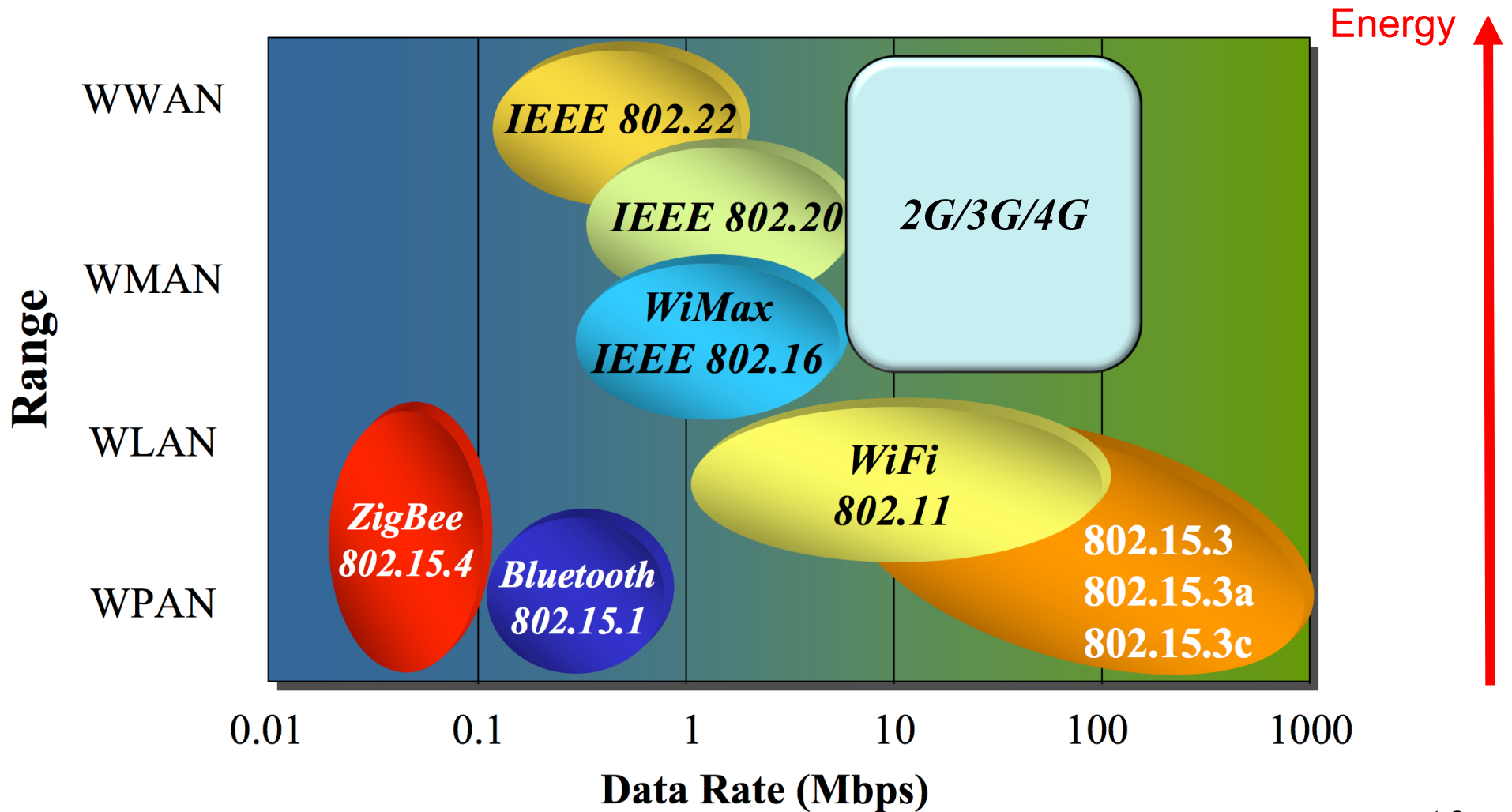
TX power: 500mA. Mean consumption:  $(8 \times 500 + 3592 \times 0.2) / 3600 = 1.31 \text{mA}$



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

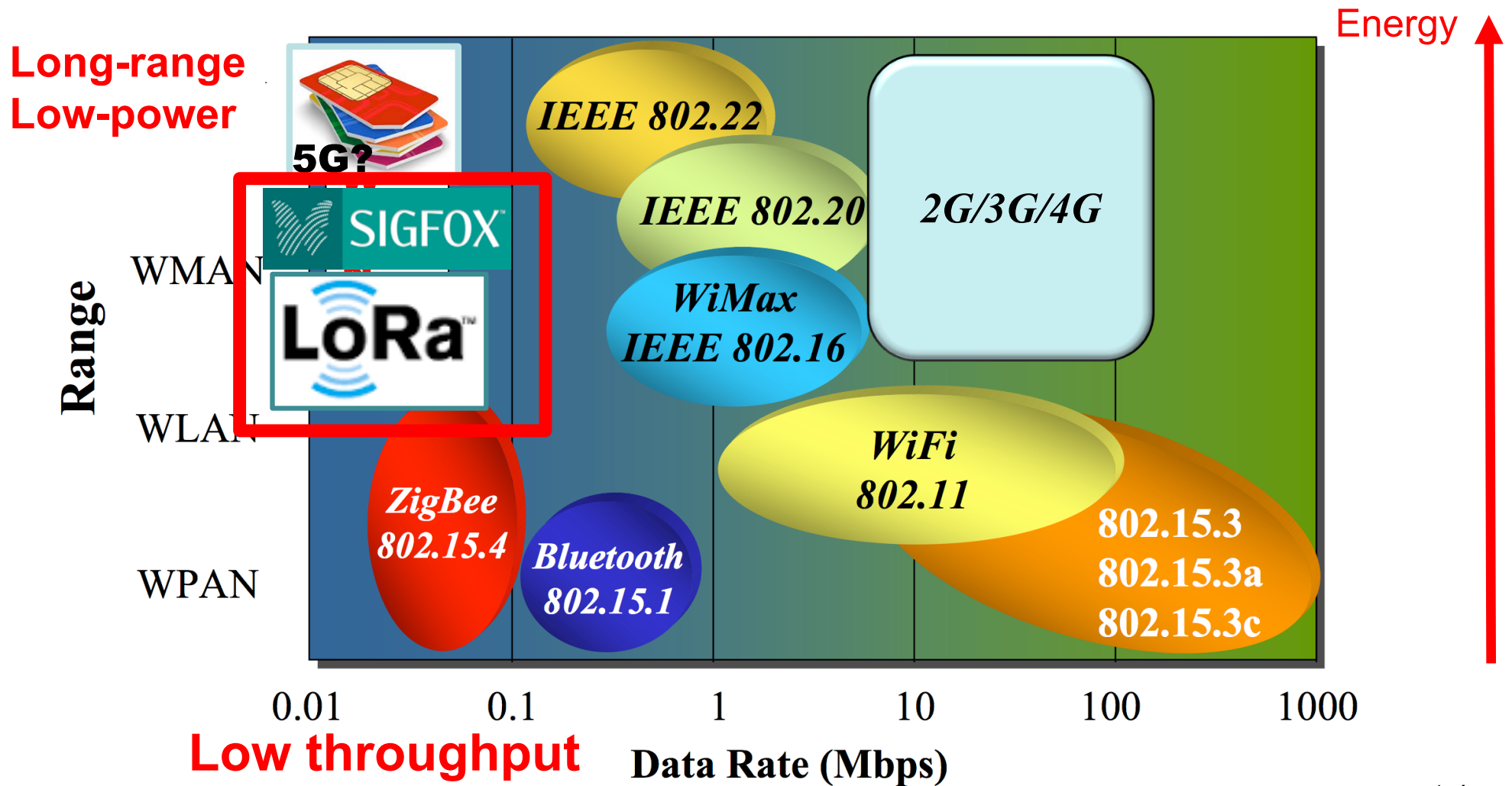
# THE WIRELESS SPACE

## Energy-Range dilemma



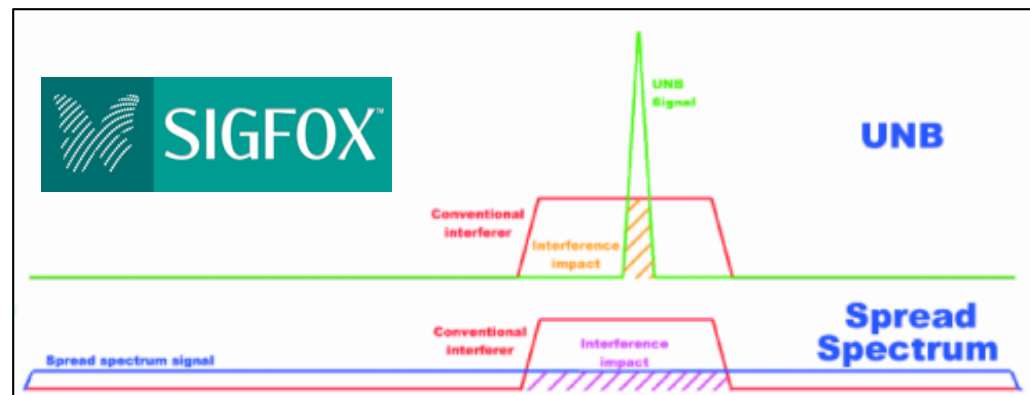
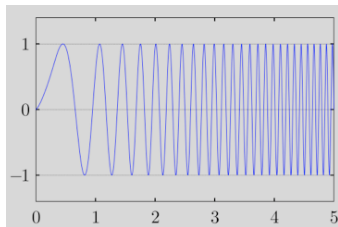
# LOW-POWER & LONG-RANGE RADIO TECHNOLOGIES

## Energy-Range dilemma

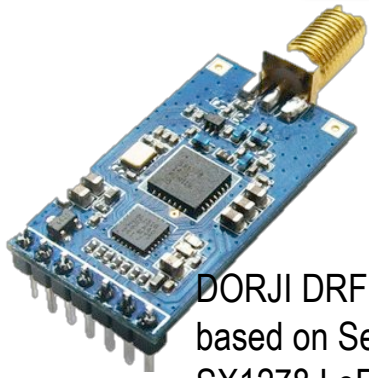


# INCREASING RANGE?

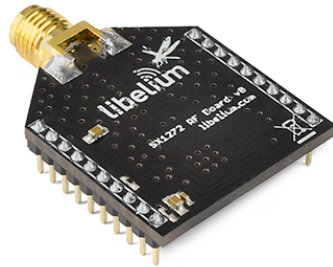
- Generally, robustness and sensitivity can be increased when **transmitting much slower**
- A Sigfox message is sent relatively slowly in a very narrow band of spectrum. **Max throughput= $\sim 100$ bps (bit/second !)**
- LoRa also increases time-on-air when maximum range is needed. But LoRa uses spread spectrum instead of UNB. **throughput= $\sim 300$ bps- $37.5$ kbps**



# LoRa Modules from Semtech's SX127x Chips



DORJI DRF1278DM is based on Semtech SX1278 LoRa 433MHz



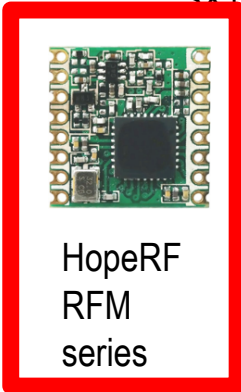
Libelium LoRa is based on Semtech SX1272 LoRa 863-870 MHz for Europe



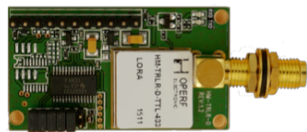
inAir9 based on SX1276



Energy Factory LoRa module (Arduino)



HopeRF RFM series



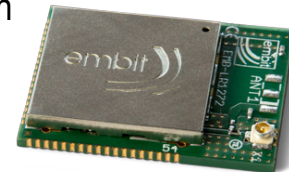
HopeRF HM-TRLR-D



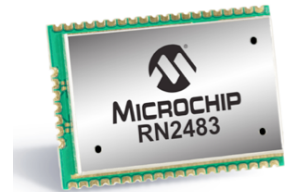
LinkLabs Symphony module



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



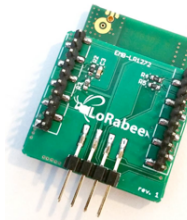
Multi-Tech MultiConnect mDot



AMIHO AM093



ARM-Nano N8 LoRa module from ATIM



SODAQ LoRaBee Embit



SODAQ LoRaBee RN2483



# 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)

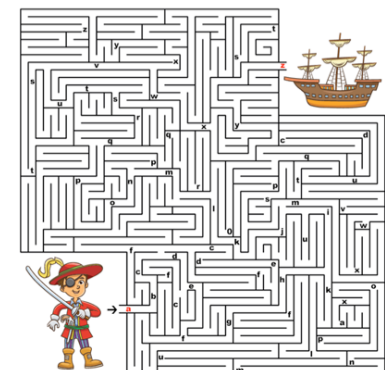
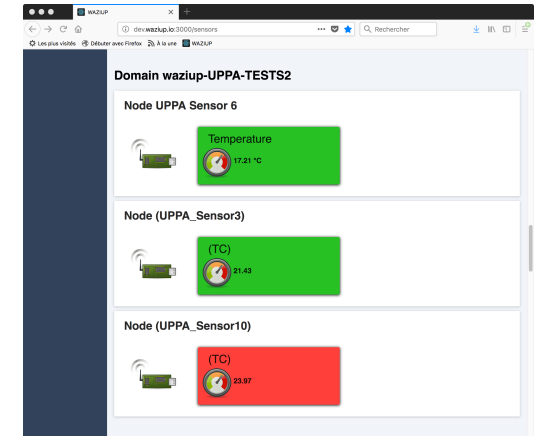
TX power: 30mA. Mean consumption:  $(2 \times 30 + 3598 \times 0.2) / 3600 = 0.216\text{mA}$

$2500 / 0.216 = 11574\text{h} = 482 \text{ days} = 16 \text{ months}$

# FINDING THE INFORMATION YOU NEED

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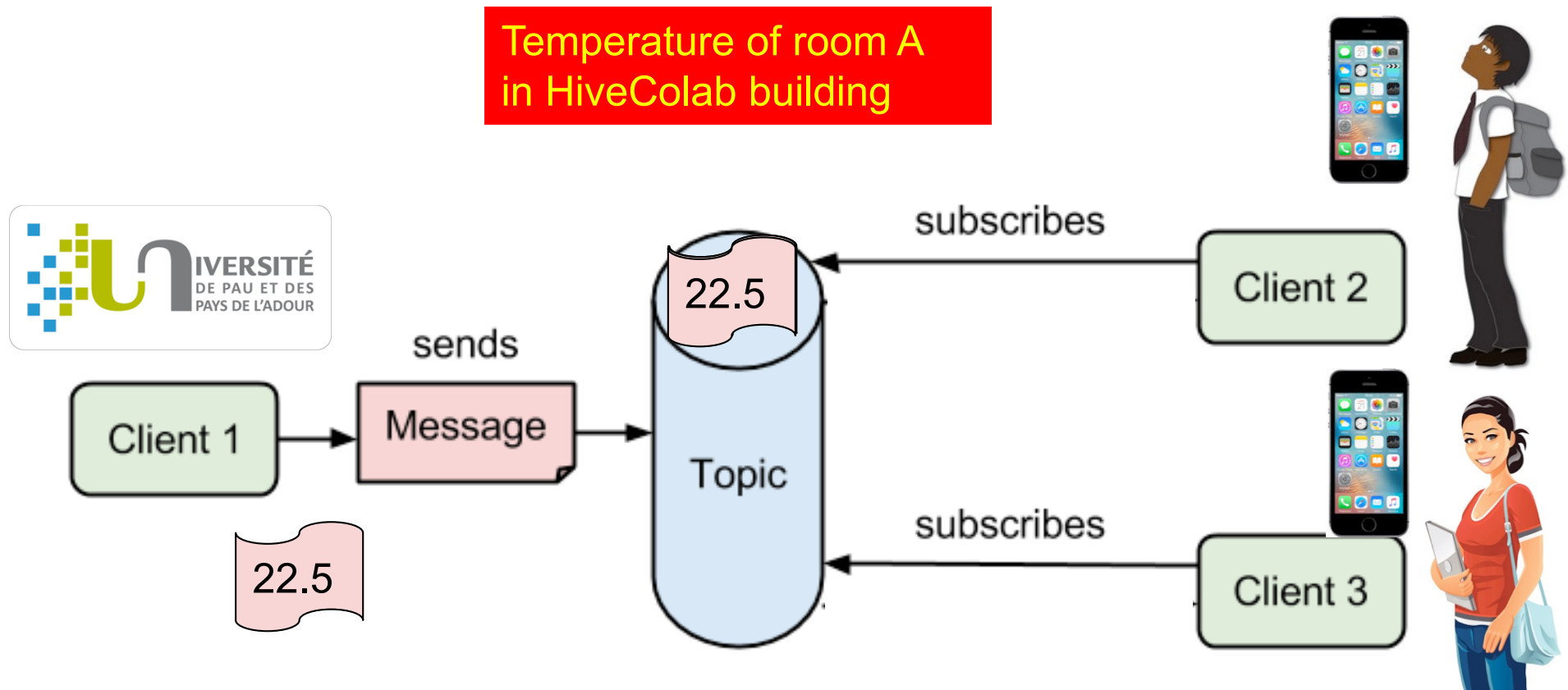
- ❑ Searching for information is a tough issue
  - ❑ Web search engine: Google,...
- ❑ Many IoT clouds uses HTTP request (GET, POST, PUT, ...) to push/store data to web platforms/servers
- ❑ If you need an information, for instance **the temperature in BuniHub**, then you have to go to the right web page
- ❑ When there can be millions of IoT nodes providing large variety of data, it is difficult to find your way!



# FROM "SEARCH FOR INFO" TO "GET THE INFO"

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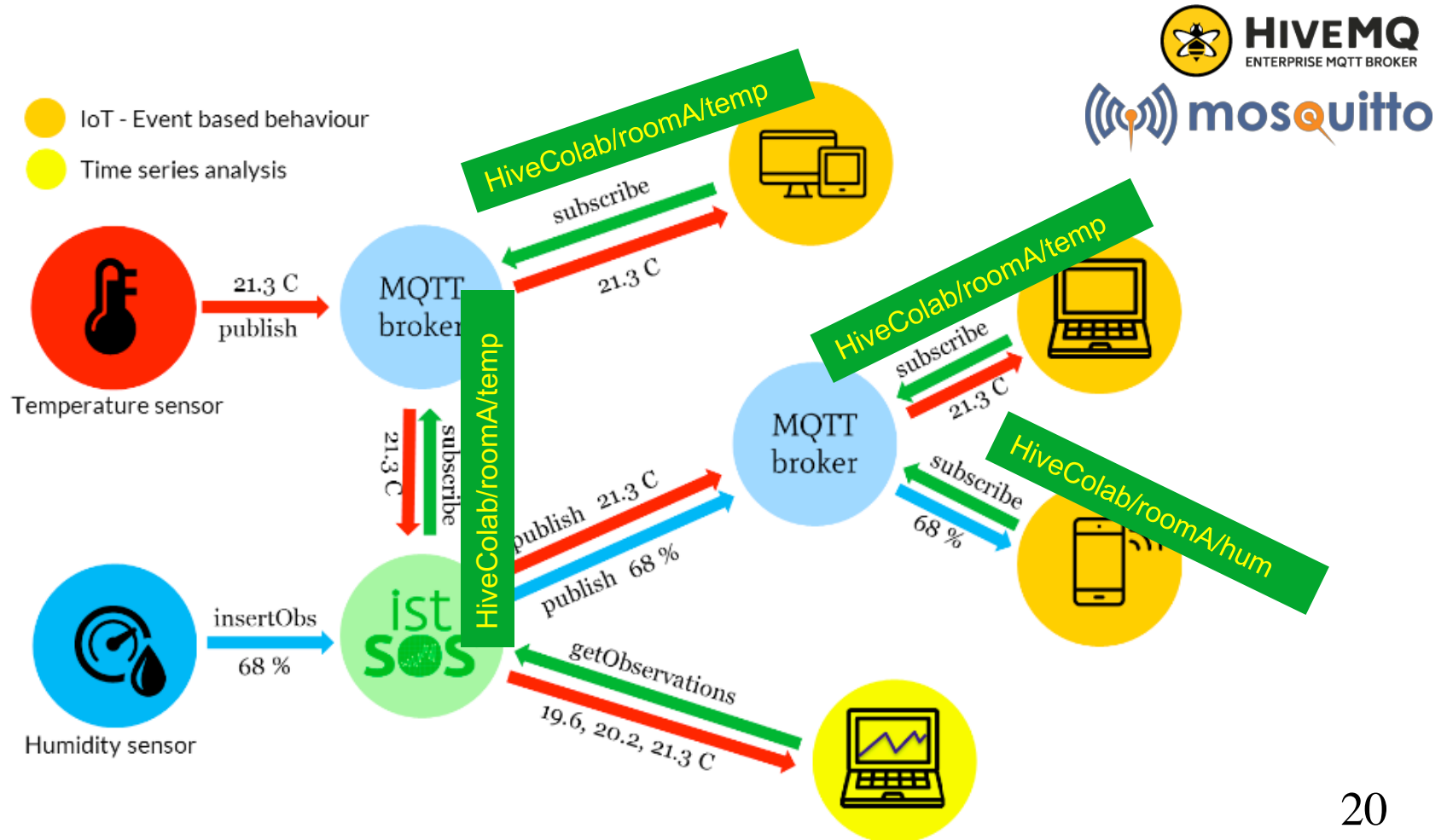
- Use the PUBLISH/SUBSCRIBE model



# MQTT

## MESSAGE QUEUE TELEMETRY TRANSPORT

- Use broker nodes to manage topics
  - HiveColab/roomA/temp, HiveColab/roomA/hum

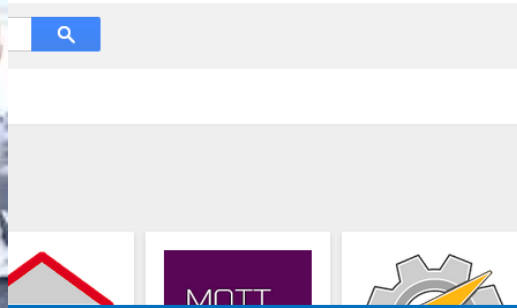


# MQTT+SMARTPHONE=



Editors' Choice

MQTT



Maxime Carrier

InstantSolutions

Thao



## MQTT Dash (IoT, Smart Home)

Routix software Communication

★★★★★ 1,584

PEGI 3

This app is compatible with all of your devices.

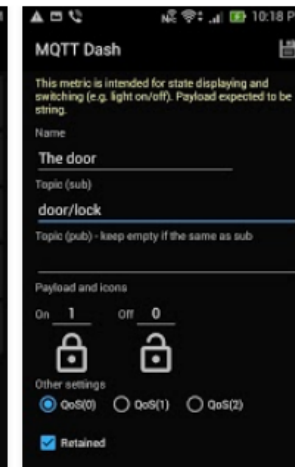
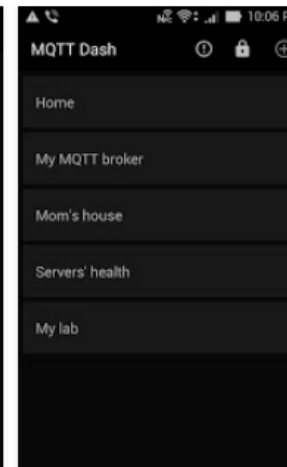
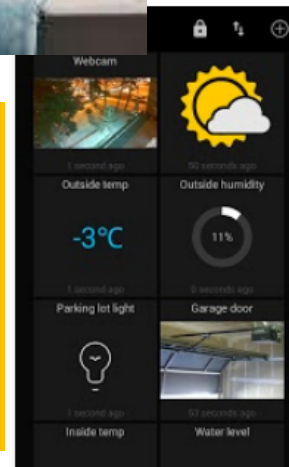
Installed

☐ Towards open data

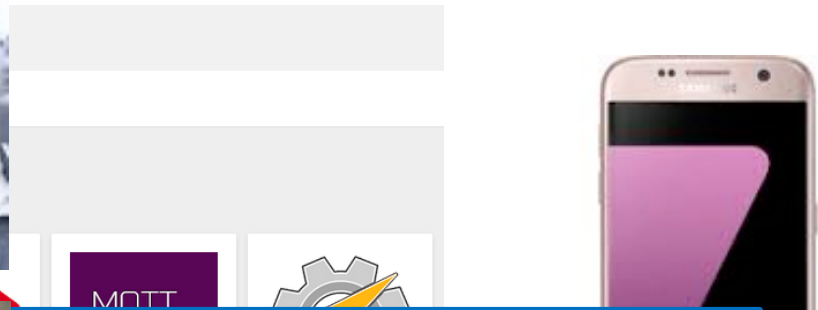
☐ HiveColab/roomA/#

☐ KPL/CITY/WEATHER/#

☐ KPL/CONGRESS/#

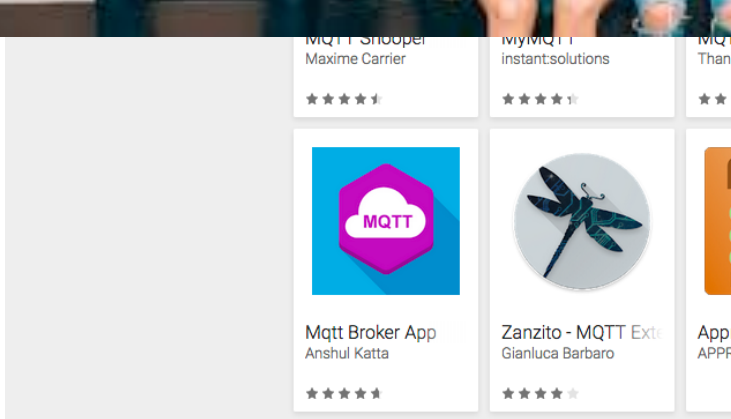


# MQTT+SMARTPHONE=



**MQTT Dash (IoT, Smart Home)**  
Routix software Communication ★★★★★ 1,584  
PEGI 3  
This app is compatible with all of your devices.

**Installed**



MQTT Dash

- Home
- My MQTT broker
- Mom's house
- Servers' health
- My lab

MQTT Dash

This metric is intended for state displaying and switching (e.g. light on/off). Payload expected to be string.

Name

**The door**

Topic (sub)

**door/lock**

Topic (pub) - keep empty if the same as sub

Payload and icons

On 1 OR 0

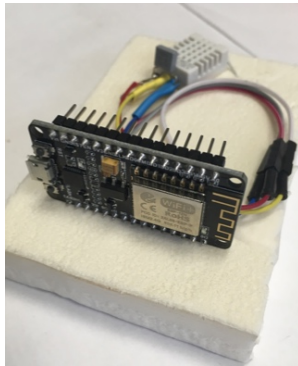
Other settings

QoS(0)  QoS(1)  QoS(2)

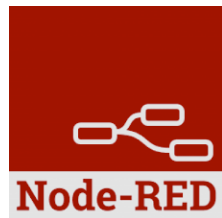
Retained

# MAKE IT SIMPLER?

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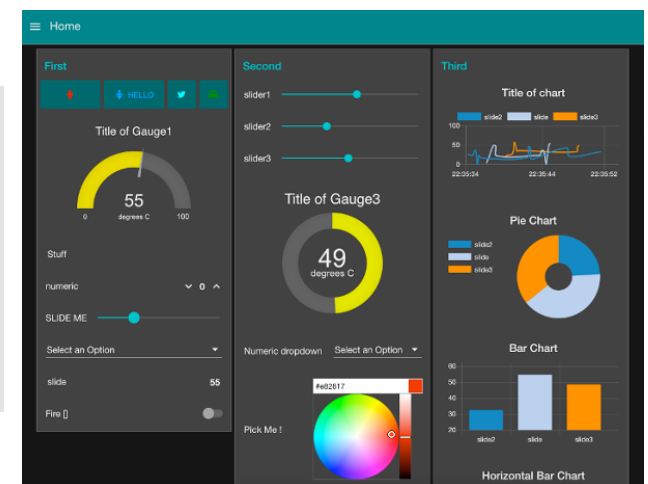
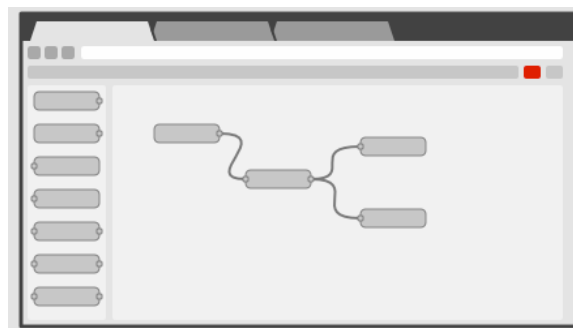


- ❑ End-users are not necessarily computer science experts nor high-skilled programmers
- ❑ Use graphical tools to build data processing flows, allowing intuitive connection from data producers to data consumers



# NODE-RED

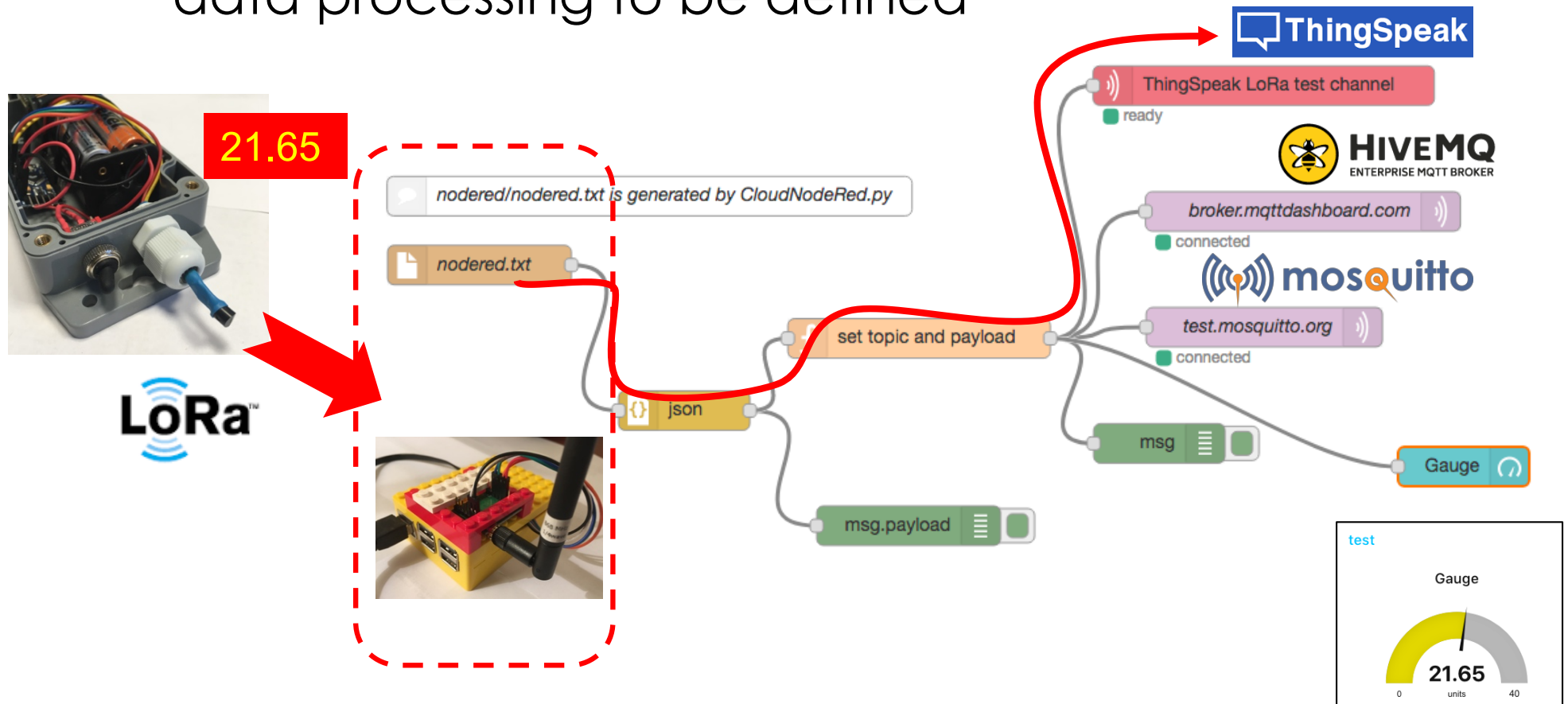
- Node-RED is a programming tool for wiring together hardware devices, APIs and online services, e.g. clouds of various types
- provides a browser-based flow editor to wire together flows with a wide range of nodes



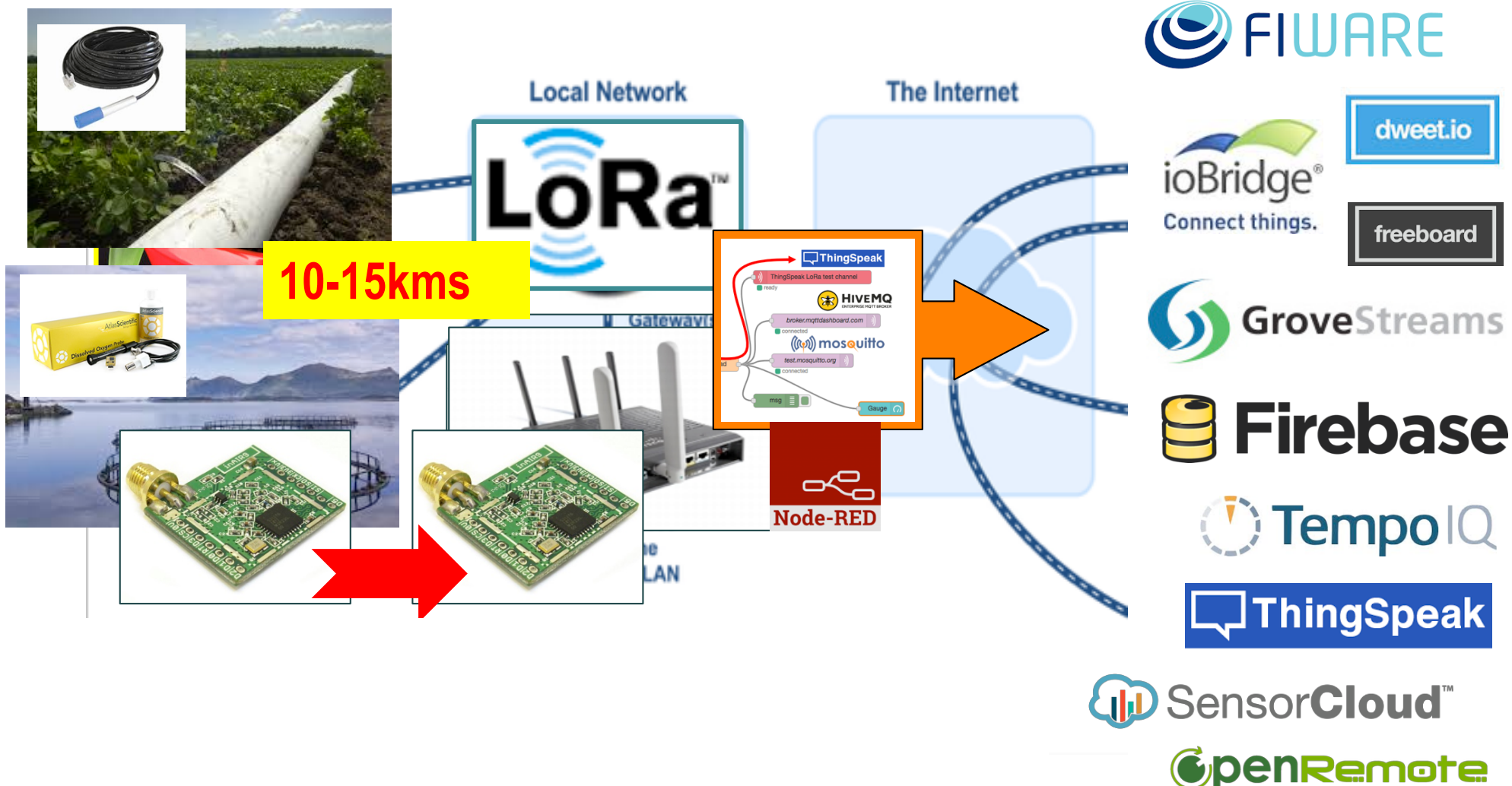


# NODE-RED ENABLED IOT GATEWAY

- Messages received on the IoT gateway can be injected into a Node-Red flow, allowing complex data processing to be defined



# GLOBAL PICTURE OF LONG-RANGE IOT ECOSYSTEM



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DEMO TIME

WAZIhub

WAZIup