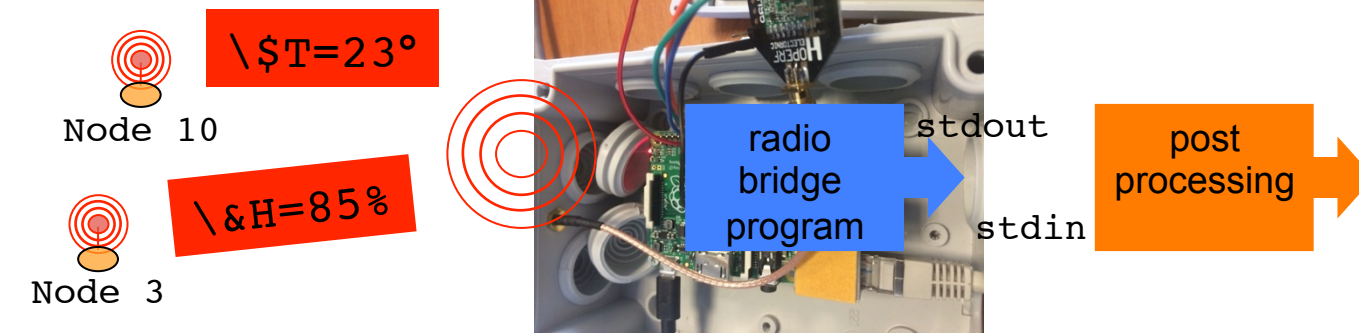




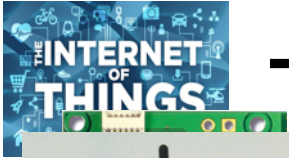
# LOG RECEIVED MESSAGES USING CLOUD SERVICES



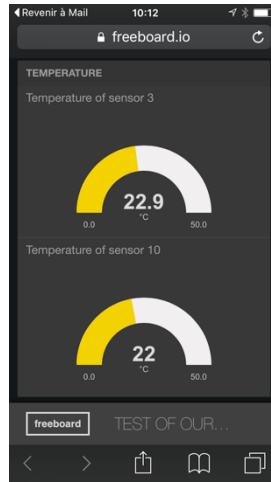
```
> sudo ./lora_gateway | python ./post_processing_gw.py
Power ON: state 0
LoRa mode: 4
Setting mode: state 0
Channel CH_10_868: state 0
Power M: state 0
Get Preamble Length: state 0
Preamble Length: 8
LoRa addr 1 : state 0
SX1272/76 configured as LR-BS. Waiting RF input for transparent RF-serial bridge

--- rxloras. dst=1 type=0x10 src=10 seq=0 len=5 SNR=9 RSSIpkt=-54
Rcv ctrl packet info 1,16,10,0,5,9,-54
(dst=1 type=0x10 src=10 seq=0 len=5 SNR=9 RSSI=-54)
rcv msg to log (\$) on dropbox : T=23°
--- rxloras. dst=1 type=0x10 src=3 seq=0 len=5 SNR=8 RSSIpkt=-54
Rcv ctrl packet info 1,16,3,0,5,8,-54
(dst=1 type=0x10 src=3 seq=0 len=5 SNR=8 RSSI=-54)
rcv msg to log (\&) on firebase : H=85%
```

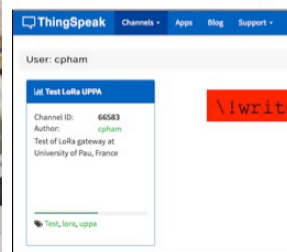
`\$` or `\&` before the data indicates that the data should be logged on a file or server. It is up to the end-device to decide which option



# TEMPLATES FOR VARIOUS CLOUDS

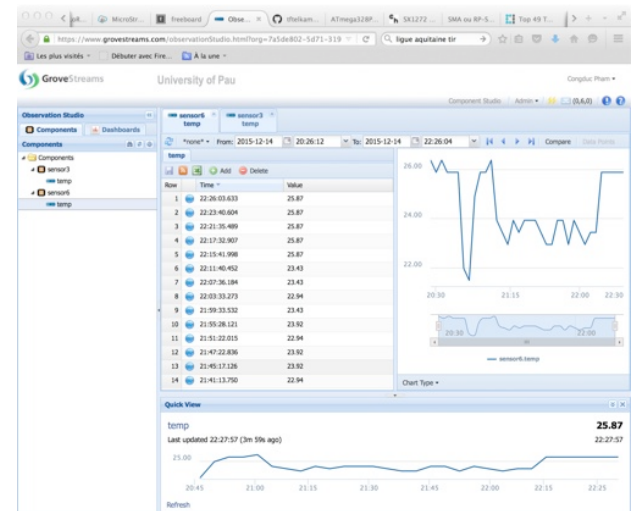
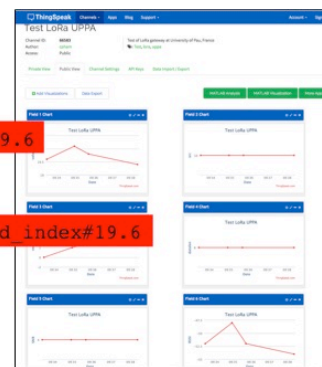


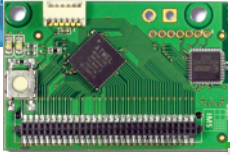
Dropbox



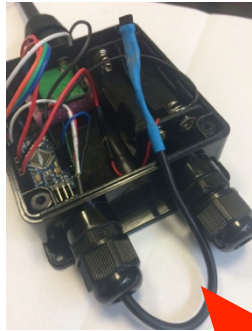
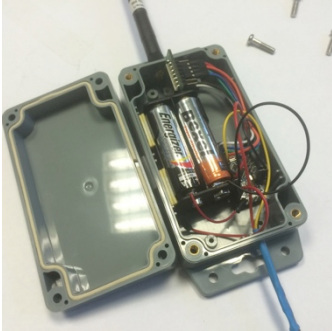
Node 10

`\!write_key#field_index#19.6`





# DO IT YOURSELF !

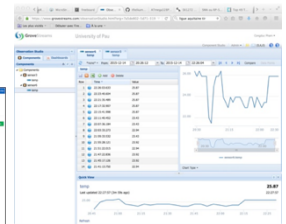
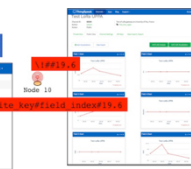


Step-by-step tutorial and source code available



Step-by-step tutorial and source code available

Python scripts available

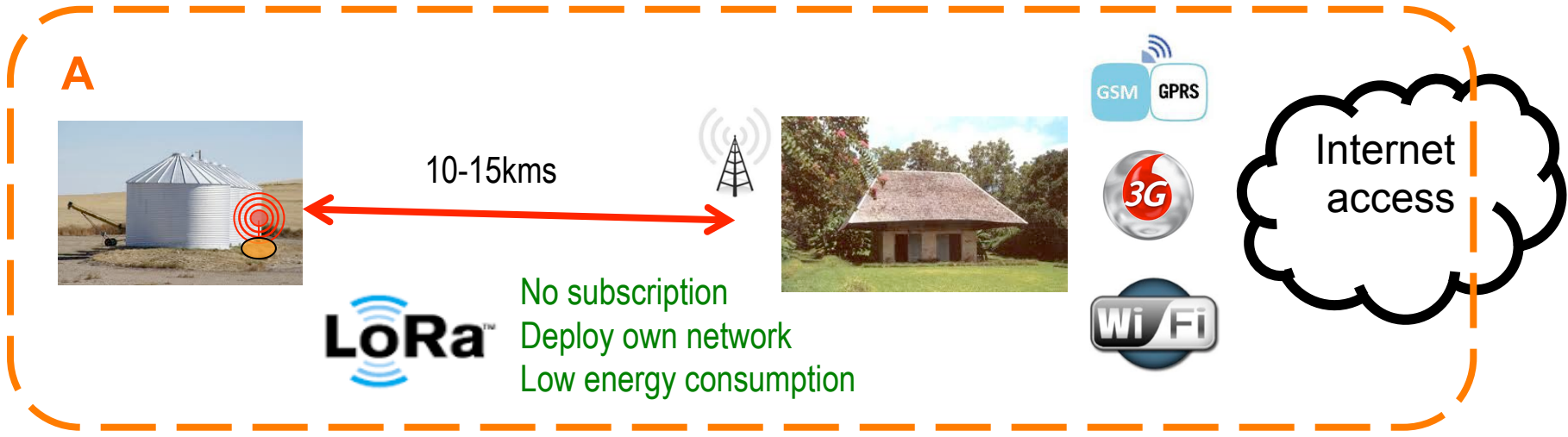


<https://github.com/CongducPham/LowCostLoRaGw>

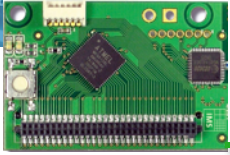




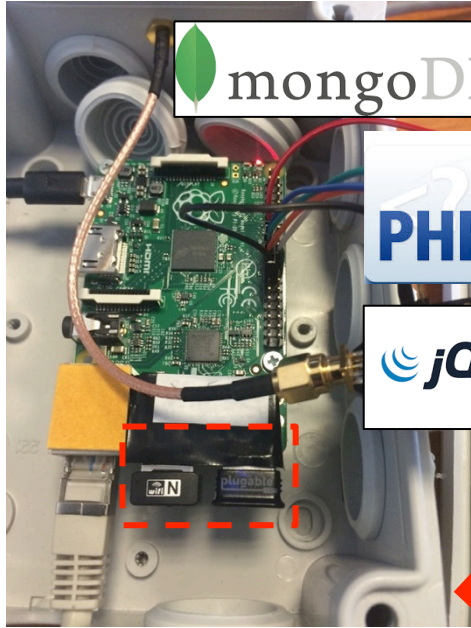
# WORKING WITHOUT INTERNET ACCESS







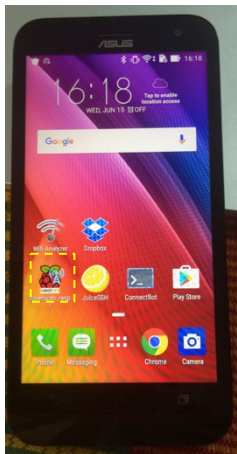
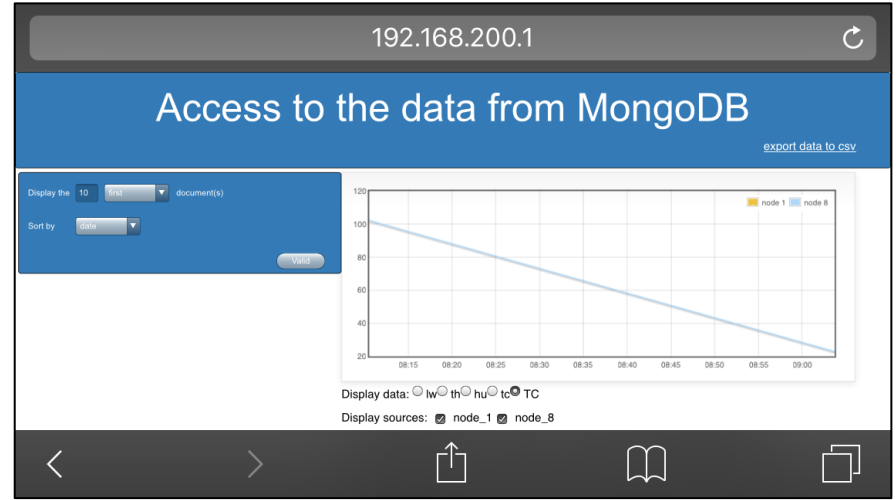
# STANDALONE GATEWAY



mongoDB

PHP

jQuery  
*write less, do more.*



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": 50.90)

```

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

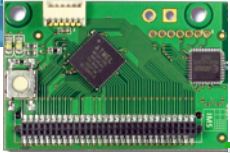
Display data    Retrieve data in a csv file

Orange F

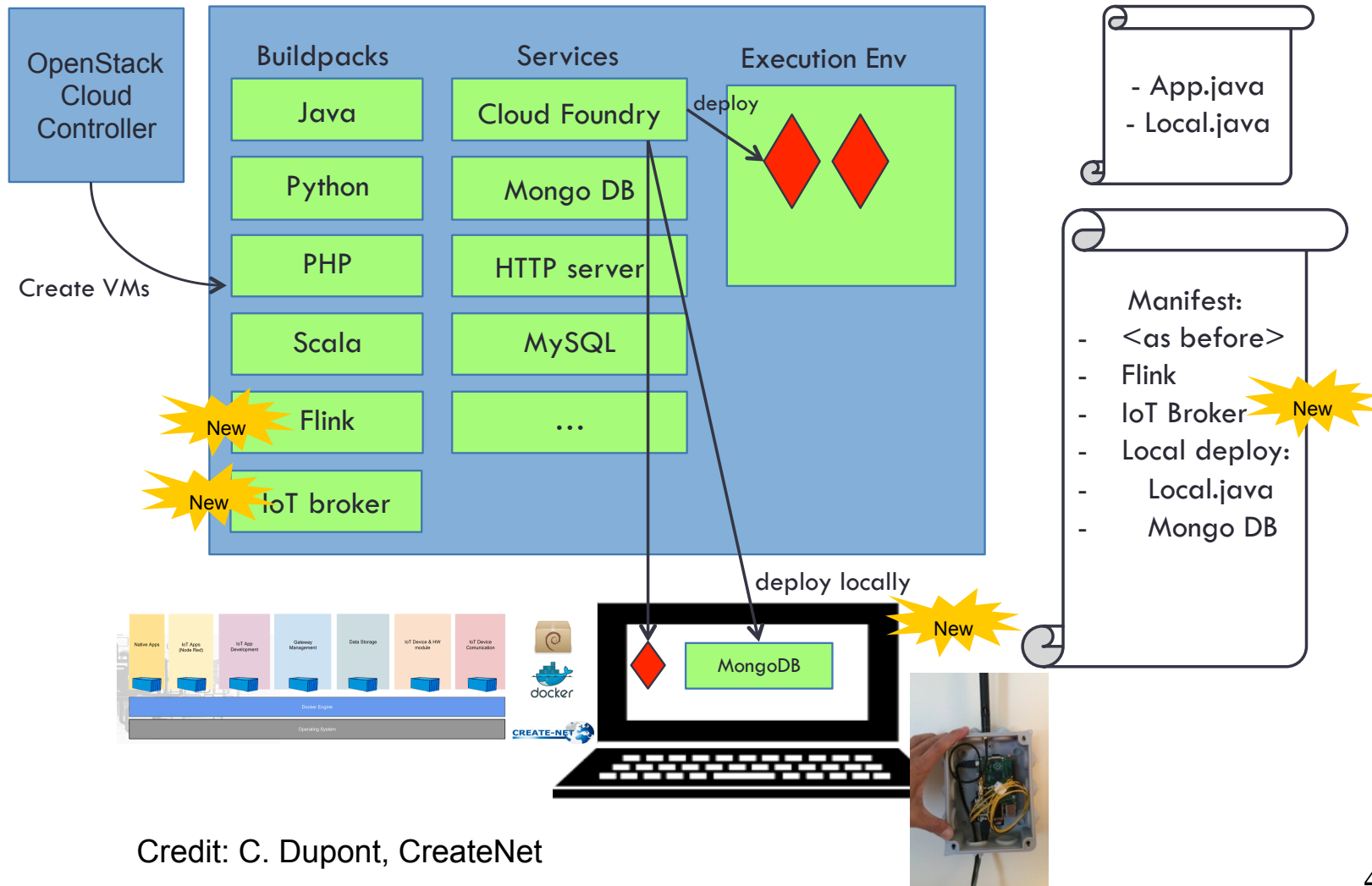
Bluetooth\_raspi

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

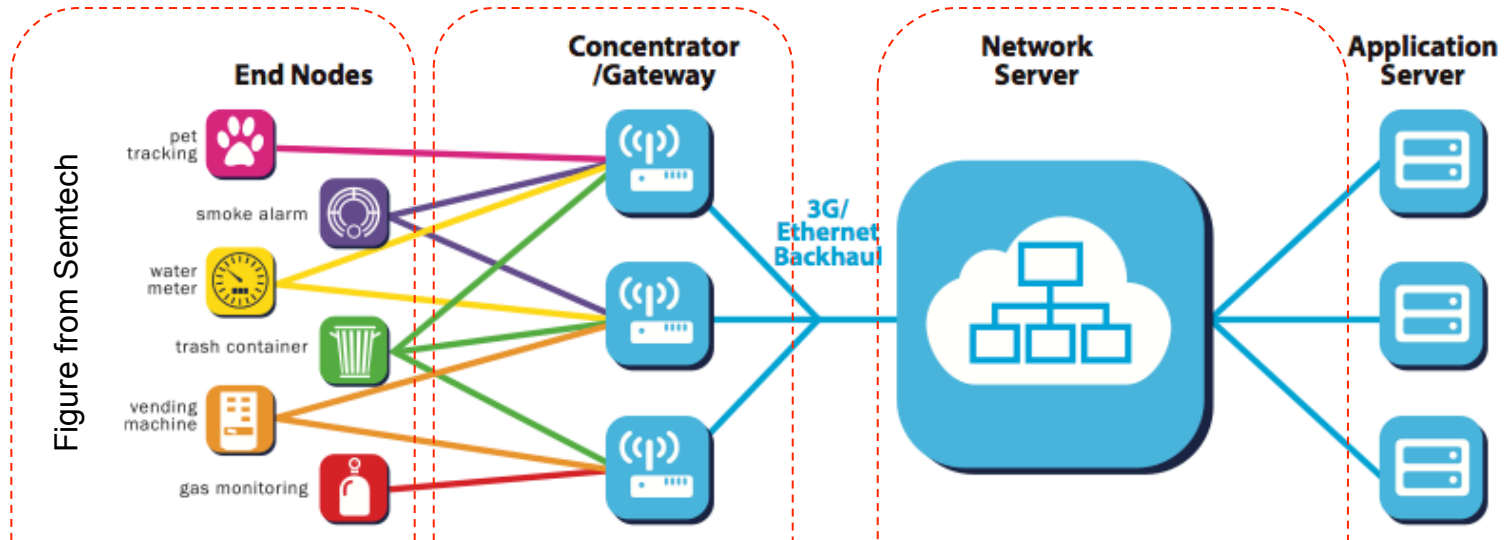


# LOCAL DATA ANALYTICS

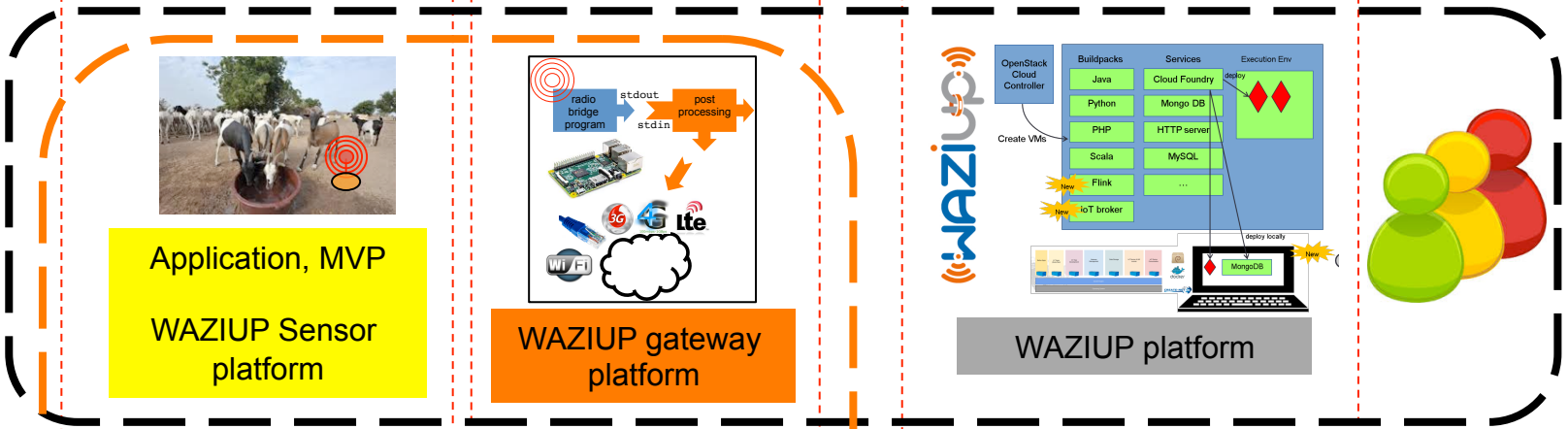


Credit: C. Dupont, CreateNet

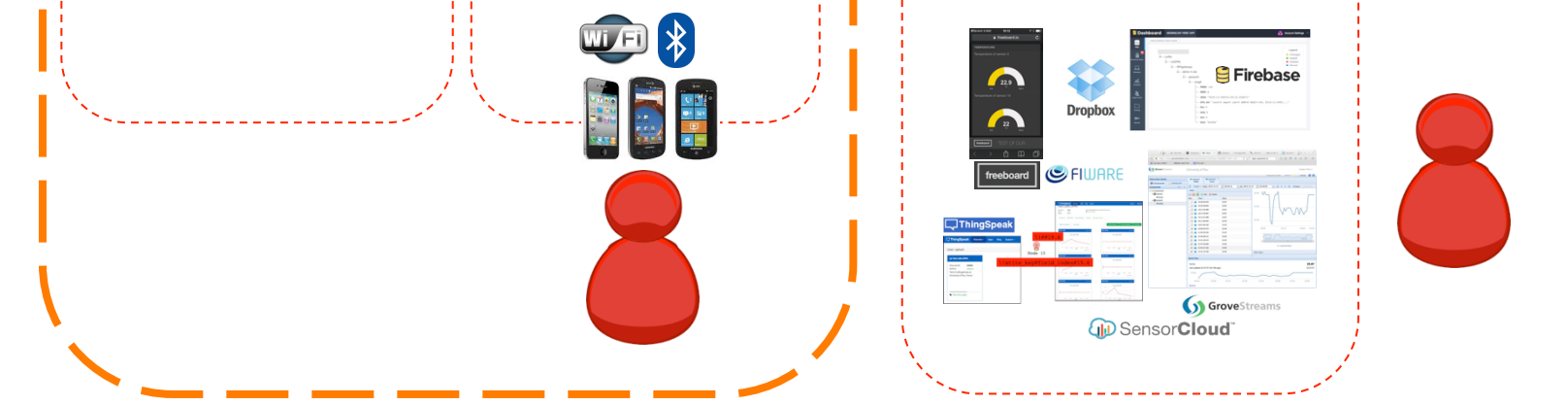
Figure from Semtech



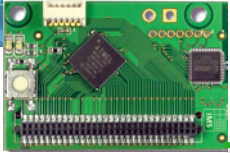
A



B







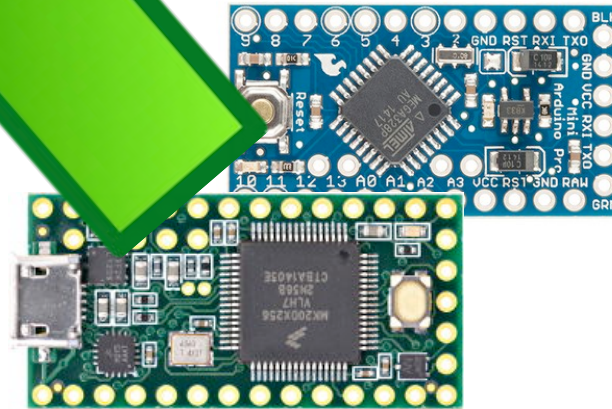
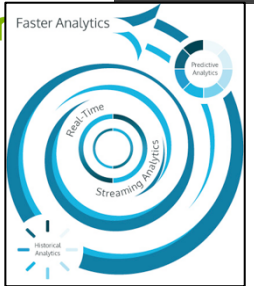
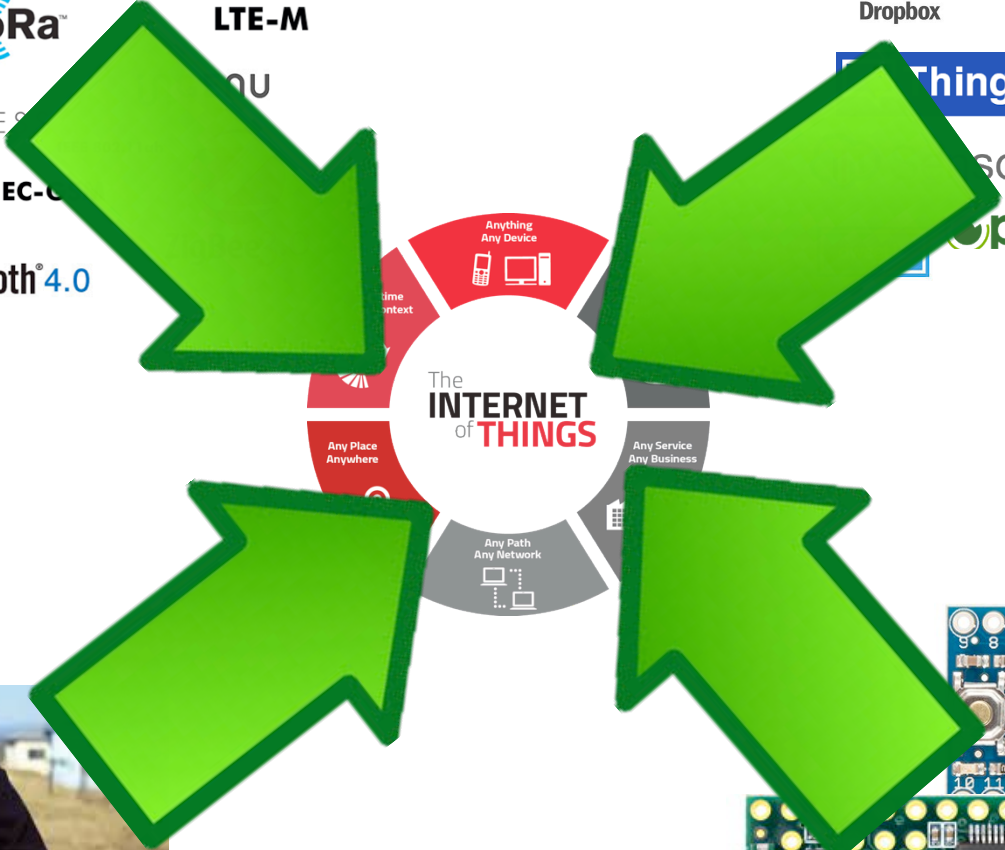
NOW,

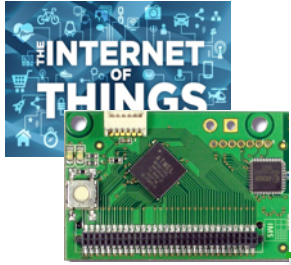
IOT BECOMES REALITY!



Logos for various IoT technologies and services:

- SIGFOX: One network A billion dreams
- NB-LTE
- LoRa™
- nwave
- LTE-M
- Dropbox
- Firebase
- FIWARE
- Axeda
- ioBridge: Connect things.
- ThingSpeak
- GroveStreams
- SensorCloud™
- OpenRe
- DASH7 ALLIANCE
- Bluetooth® 4.0
- freeboard





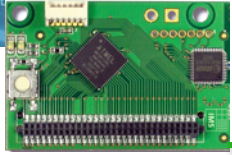
# USE CASE: FISH POND MONITORING



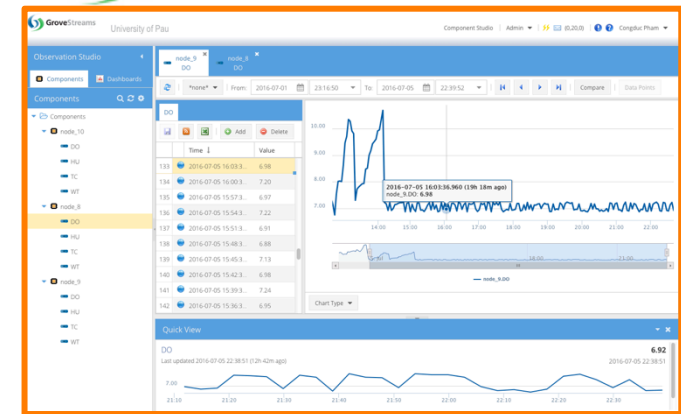
- ❑ Farmerline in Ghana
- ❑ Water temperature and dissolved oxygen for monitoring fish ponds



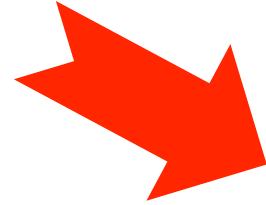




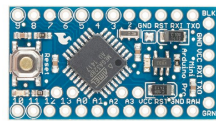
# OUT-OF-THE-BOX !



Physical sensor reading



Physical sensor management

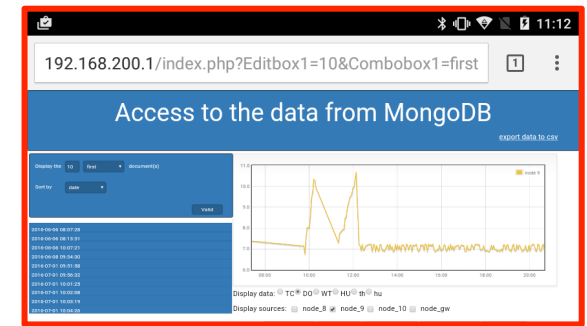


Activity duty-cycle, low power

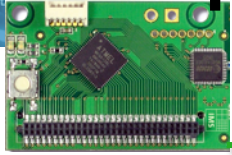
Security

Long-range transmission

Logical sensor management







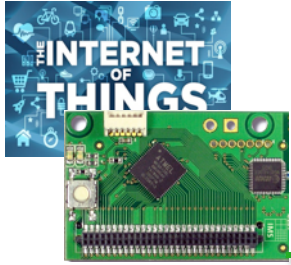
# THINGS WE ARE DOING FOR RESEARCH



- ❑ To leverage the « single » connection gateway approach
  - ❑ Smarter radio channel access mechanism
- ❑ Image sensor
  - ❑ Transfer low-resolution images for context-awareness applications
- ❑ To handle larger amount of data (image)
  - ❑ Quality of Service mechanism
  - ❑ Activity sharing mechanism
- ❑ The proposed framework can be used to set-up your own LoRa test-bed for implementing advanced mechanisms



**ADDED-VALUE**



# INVOLVING INNOVATION HUBS/STAKEHOLDERS

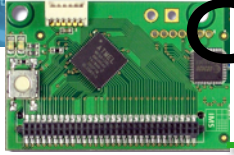


- **Close to dev & entrepreneurs** communities
- Have their **own community and com channels** (community builders & catalysts)
- Used to organizing disruptive events
- **On the field** (know the targets personally & the market)
- **Used to empowering startups & businesses** (coaching, business dev,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



Credit: C. Vavasseur, CTIC Dakar



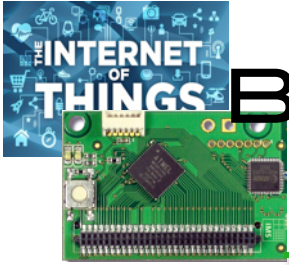


# COMMUNITY ENGAGEMENT



	Hackathons	Innovation Lab Weeks	Startup weekends	Webinars	Conferences	Workshop	Participation to international events	Presentation events	Publications
Scientific researchers	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Developers	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Entrepreneurs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
End-users	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Standardisation and policy makers					<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Application industries					<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Investors					<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Credit: C. Vavasseur, CTIC Dakar



# 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)**

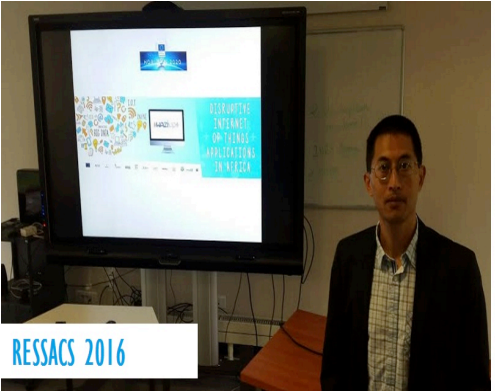


**Launch event (Senegal, CTIC Dakar)**

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



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

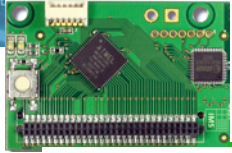


**RESSACS 2016**

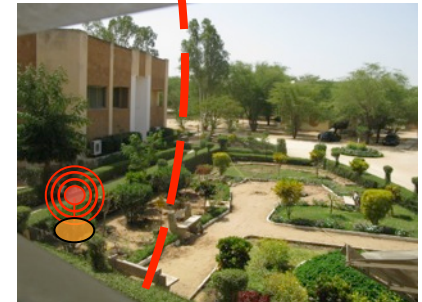


Credit: C. Vavasseur, CTIC Dakar **Workshop at the RESSACS 2016 (France, UPPA)** 59

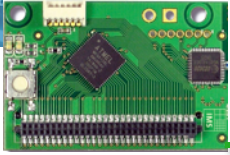




# OPEN LONG-RANGE TEST-BED & BENCHMARK







# TUTORIALS/RESOURCES



**WAZIUP**  
EU H2020 grant agreement number 1010167

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

1) **What is Internet-of-Thing (IoT)?**

From IERC (European Research Cluster on the Internet of Things)

"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 vision:

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  
Last update : 01/09/2016  
page 1

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



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



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



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



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



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



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



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



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



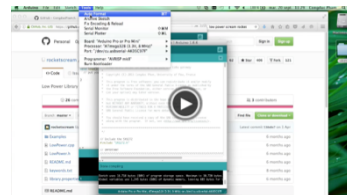
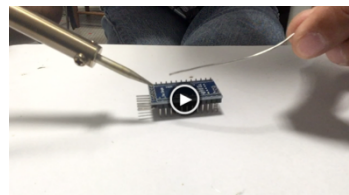
PROF. CONGDUC PHAM  
[HTTP://WWW.UNIV-PAU.FR/~CPHAM](http://www.univ-pau.fr/~cpham)  
UNIVERSITÉ DE PAU, FRANCE



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



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





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



Accompagnateur de croissance TIC

**Carine VAVASSEUR**

*Communication & Event Manager*

Carine.vavasseur@cticdakar.com

www.cticdakar.com  
contact@cticdakar.com



facebook.com/waziupIoT



twitter.com/waziupIoT



linkedin.com/groups/8156933



github.com/waziup