IoT standards for Africa and Sustainable Development Goals (SDGs)

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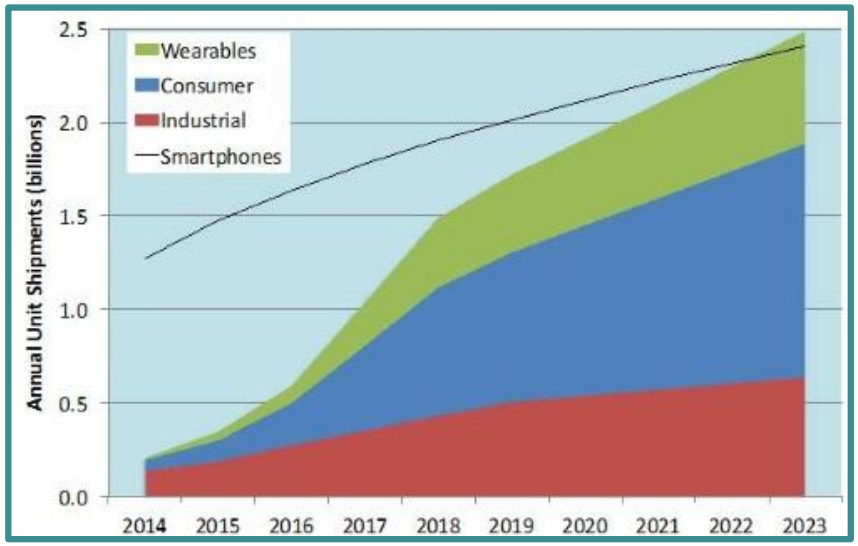
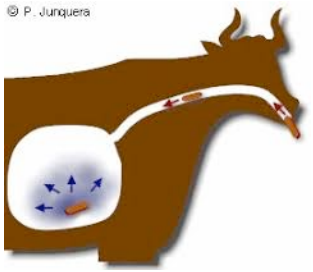
LIUPPA
T2I team
T2i

One of the most promising market is IoT!



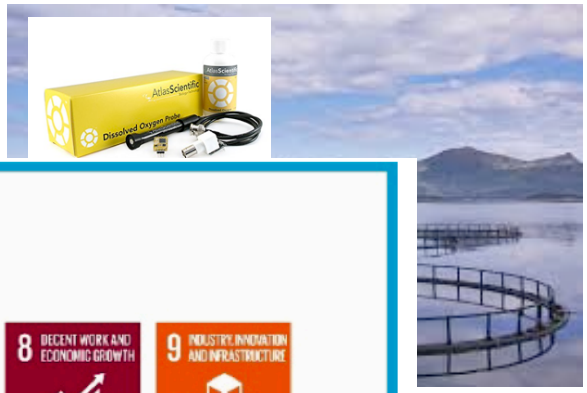


Needs, constraints, cost, design approach, control mechanism

Challenge: Bridging the digital divide

IoT4D: development for rural areas

Irri



aculture

Storage & logistic

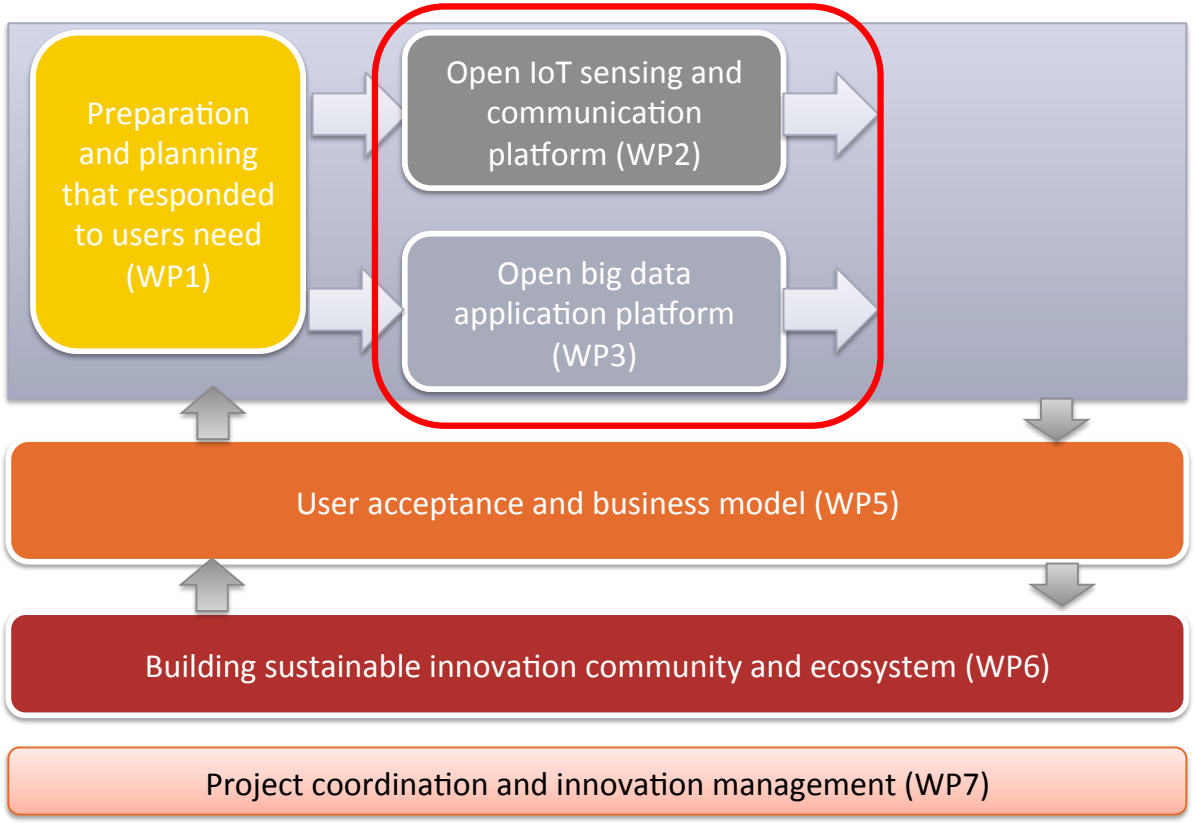
Agriculture

Environment

WAZIUP : low-cost IoT

IoT for rural applications in developping countries

- WAZIUP is an EU H2020 project (2016-2019)
- contributes to long-range networks for rural applications with WP2 and big data with WP3

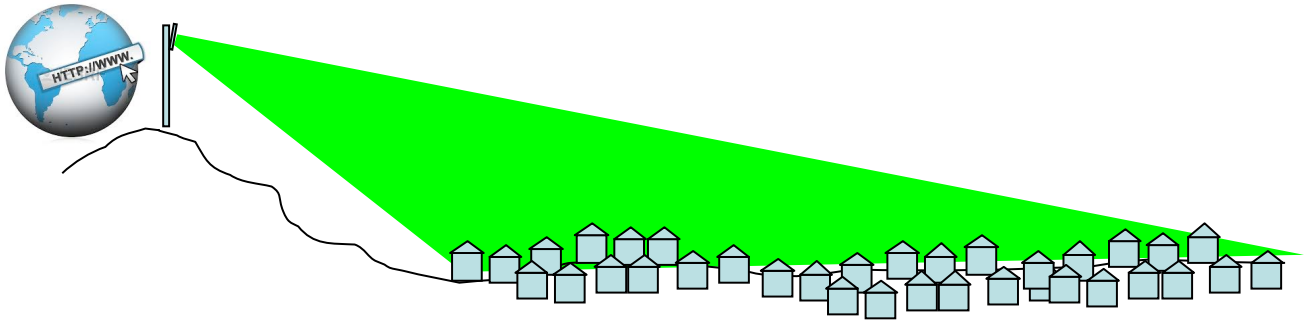


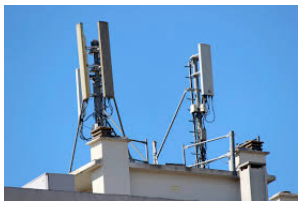
Telemetry and Transmission cost

Moisture/
Temperature of
storage areas

10-15kms

GSM GPRS

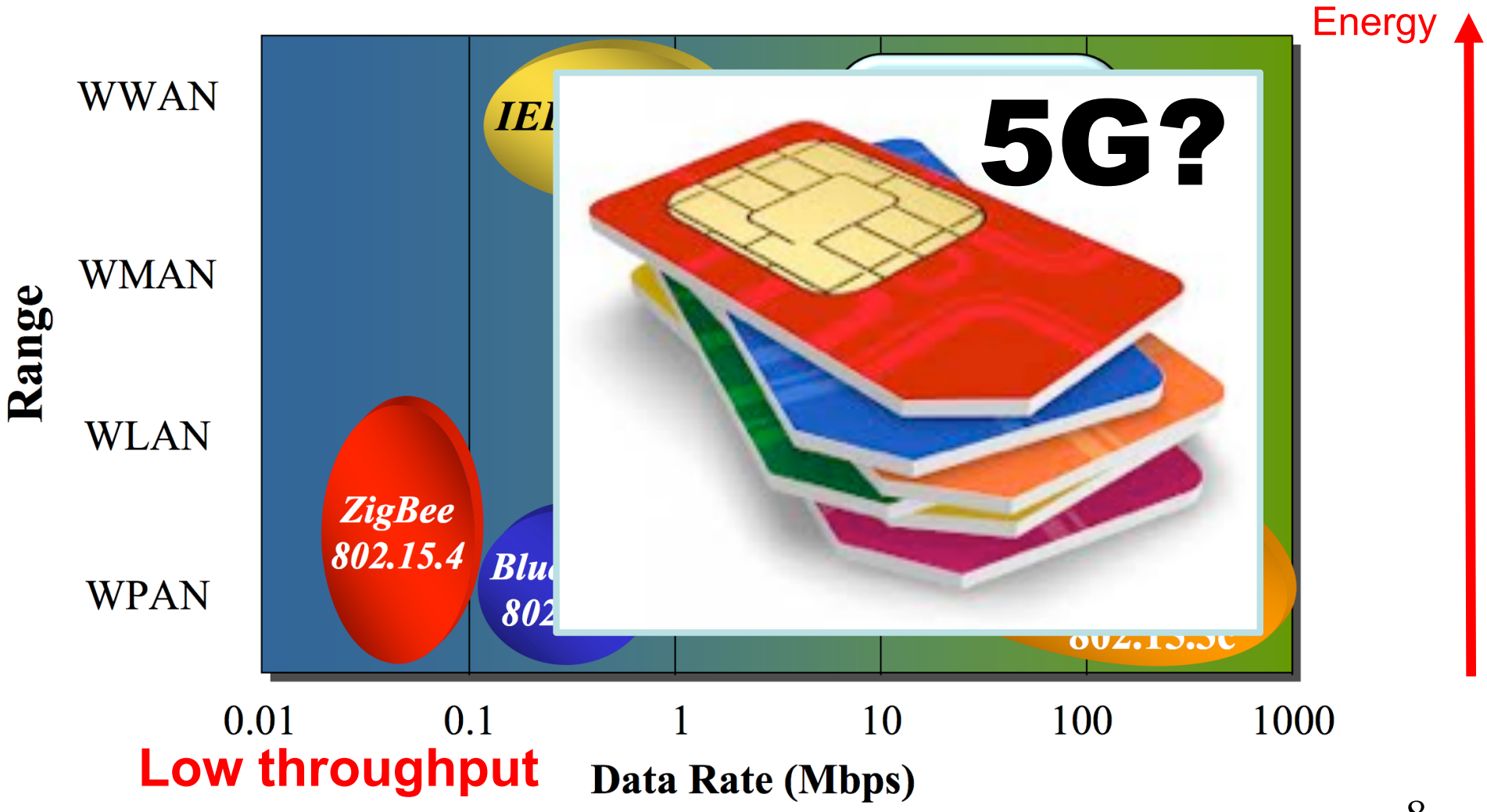




Technology	2G	3G	LAN
Range (I=Indoor, O=Outdoor)	N/A	N/A	O: 300m I: 30m
Tx current consumption	200-500mA	500-1000mA	100-300mA
Standby current	2.3mA	3.5mA	NC

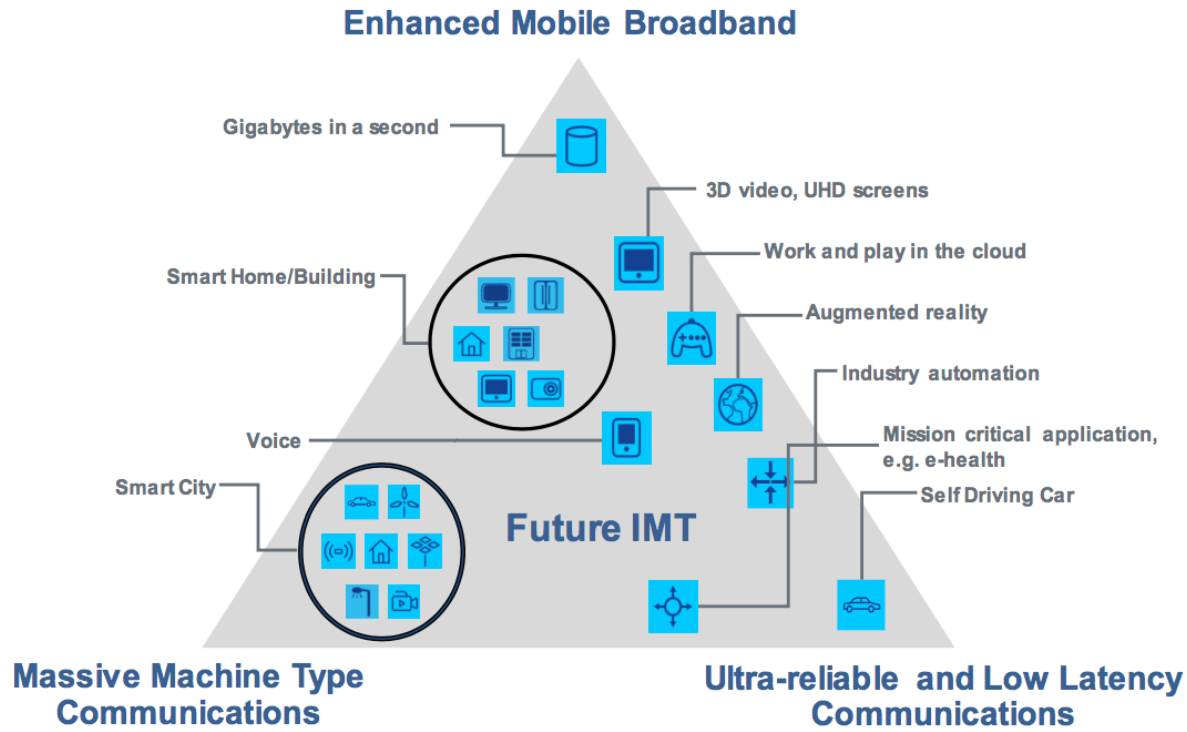
Wireless radio technologies

Energy-Range dilemma



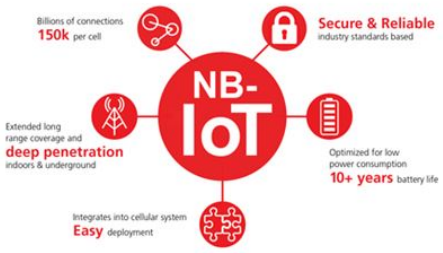
5G objectives

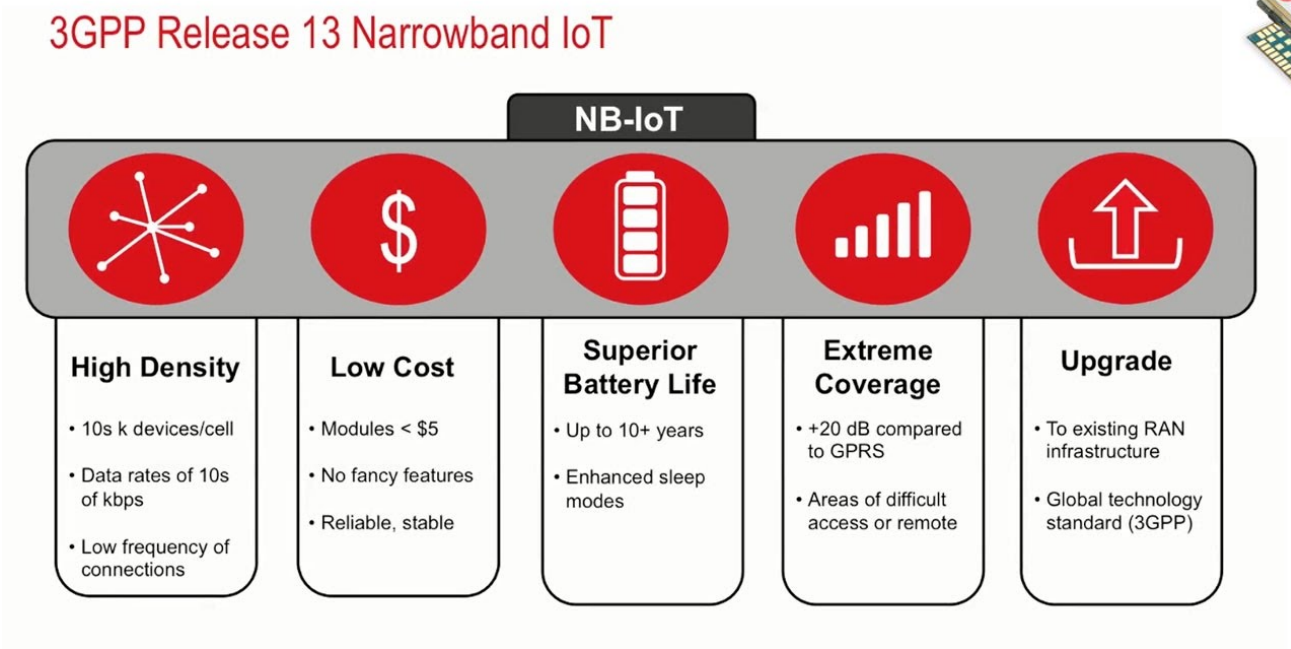
- 5G is a set of objectives
- Can be implemented by combining various technologies
- 5G wants to propose an adapted approach for IoT



NB-IoT: IoT cellular technology

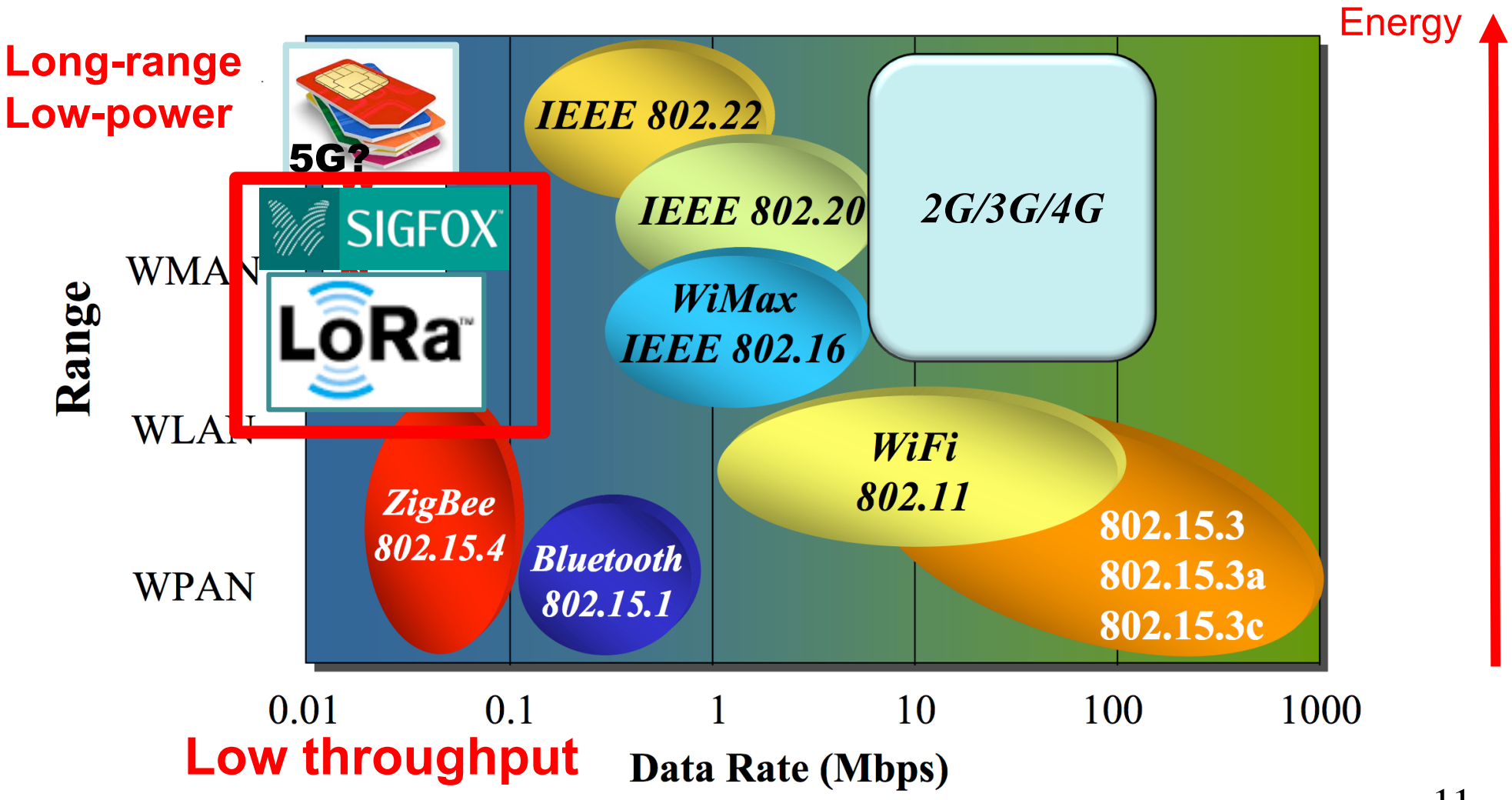
- Narrow-Band-IoT radio technology can be deployed without changing the hardware already in place in operator's base station
- Can reuse GSM frequency bands
- uBlox has announced NB-IoT module





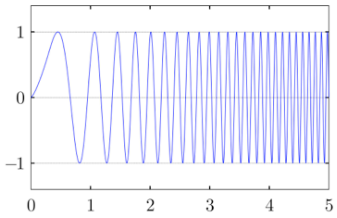
Low-power & long-range radio technologies (LPWAN)

Energy-Range dilemma

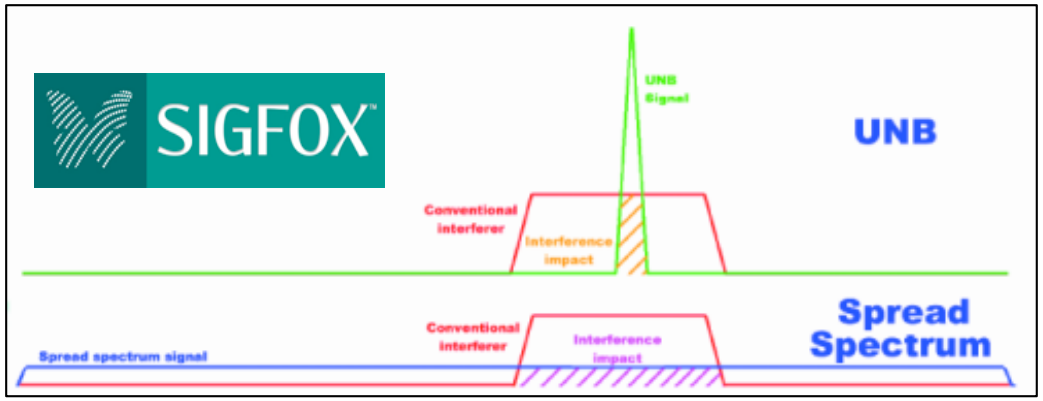


Increasing range?

- 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 (hence ultra-narrow-band) using Gaussian Frequency-Shift Keying modulation]. Max throughput=~100bps
- LoRa also increases time-on-air when maximum range is needed. But LoRa uses spread spectrum instead of UNB. 300bps-37.5kbps



LoRa™



LoRa™ Alliance

Wide Area Networks for IoT

HORIZON 2020

WAZIUP

Sponsor members

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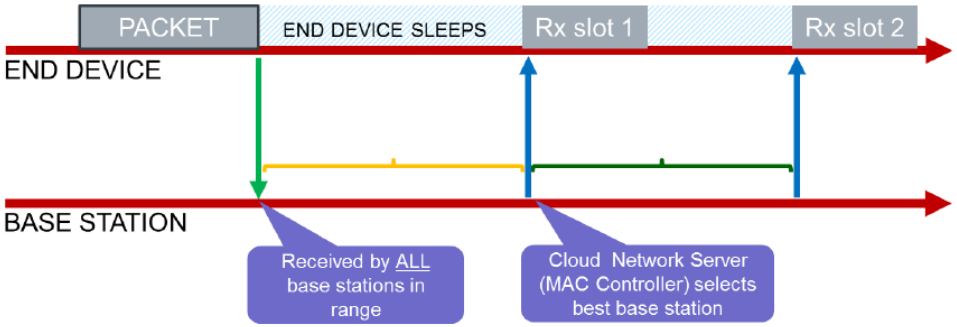
What is LoRaWAN?

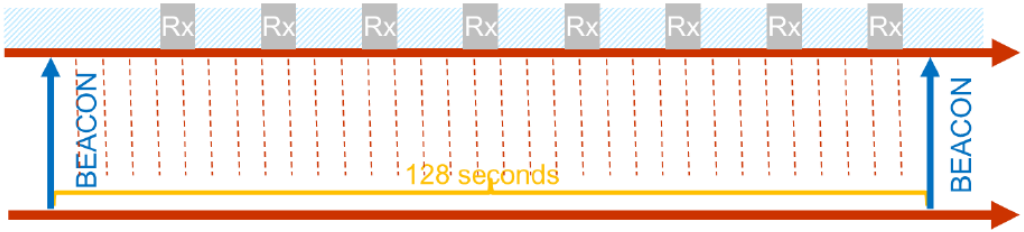
Class A: Receiver Initiated Transmission strategy (RIT)



Class B: Coordinated Sampled Listening (CSL)

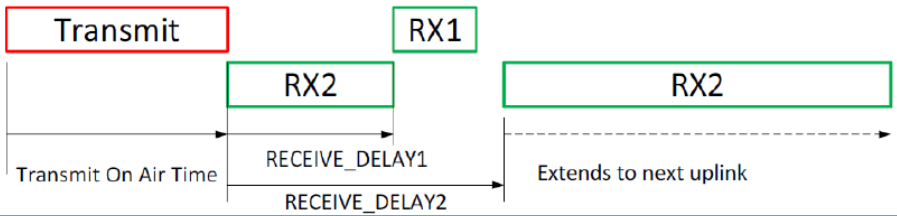
Network may send downlink packet to node at any Rx slot

END DEVICE



BASE STATION

Class C: Continuous Listening



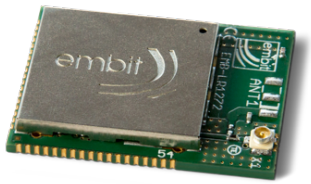
Latency constrained applications

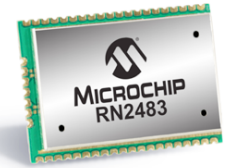
Power Efficiency

LoRa Alliance

Wide Area Networks for IoT

Application				
LoRa® MAC				
MAC options				
Class A (Baseline)	Class B (Baseline)	Class C (Continuous)		
LoRa® Modulation				
Regional ISM band				
EU 868	EU 433	US 915	AS 430	—





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

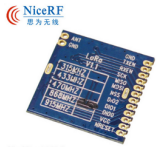
Build your own private LoRa net

Add LoRa radio module to your preferred dev platform


HopeRF RFM92W/95W


Libelium LoRa


Modtronix inAir9/9B


NiceRF LoRa1276

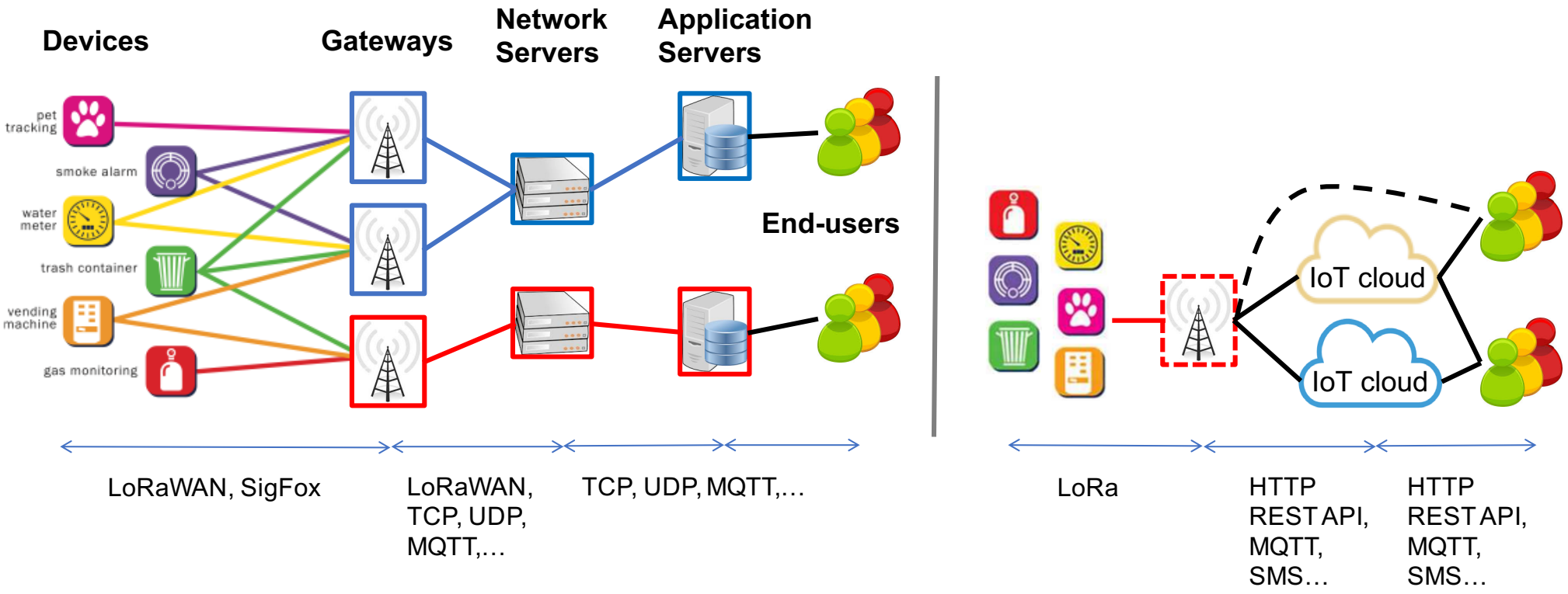
Install a LoRa gateway and start collecting data

Soil moisture
Leaf wetness

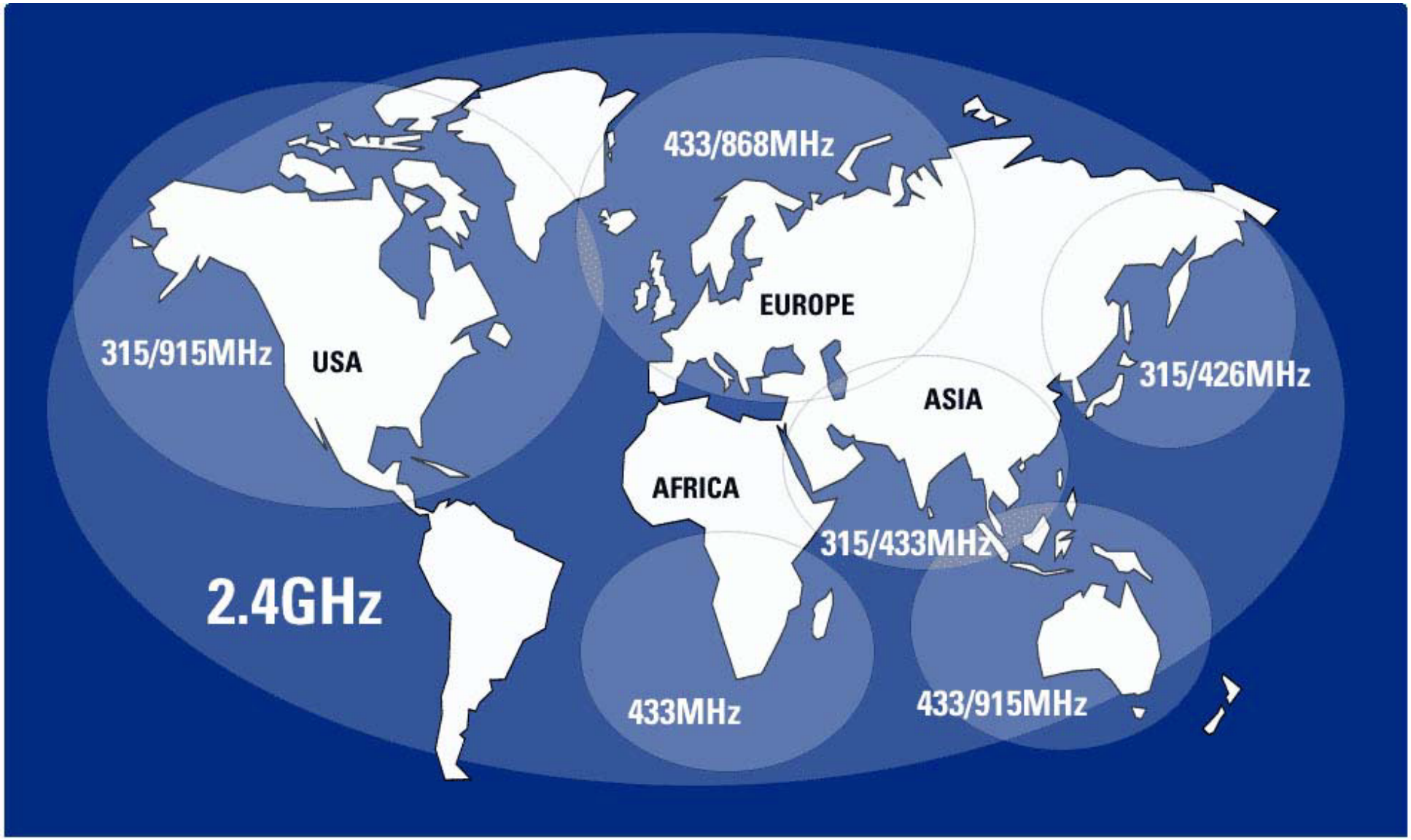
10-15kms

No subscription
Deploy own network
Low energy consumption

LoRaWAN/LoRa architecture



The ISM/SRD unlicensed bands



Some unlicensed band constraints

- Shared medium so long-range transmission in dense environments can create lots of interference!
- Activity time is constrained from 0.1%, 1% 10% duty-cycle depending on frequency: 3.6s, 36s/hour to 360s/hour

Band	Edge Frequencies		Field / Power	Spectrum Access	Band Width
	Fe-	Fe+			
g(Note 7)	865 MHz	868 MHz	+6.2 dBm /100 kHz	1 % or LBT AFA	3 MHz
g(Note 7)	865 MHz	870 MHz	-0.8 dBm / 100 kHz	0.1% or LBT AFA	5 MHz
g1	868 MHz	868.6	14 dBm	1 % or LBT AFA	600 kHz
g2	868.7 MHz	869.2 MHz	14 dBm	0.1% or LBT AFA	500 kHz
g3	869.4 MHz	869.65 MHz	27 dBm	10 % or LBT AFA	250 kHz
g4	869.7 MHz	870 MHz	7 dBm	No requirement	300 kHz
g4	869.7 MHz	870 MHz	14 dBm	1 % or LBT AFA	300 kHz

For SigFox, the operator typically limits the number of messages per day (140) with penalty for over usage. e.g. new messages/day = 140 – (2 * « #msg_overuse») applied during «#msg_overuse» days

Tell us about your country!

- It is difficult to get frequency usage/constraint/regulation is Africa
- **Please help us with the questionnaire !**

EU H2020 grant agreement number 687607

Questionnaire on unlicensed frequency band in your country

Your country:

The unlicensed frequency band you are aware of:
Example: 865-868MHz

Any regulatory issues you are aware of:
Example: maximum transmit power is 14dBm

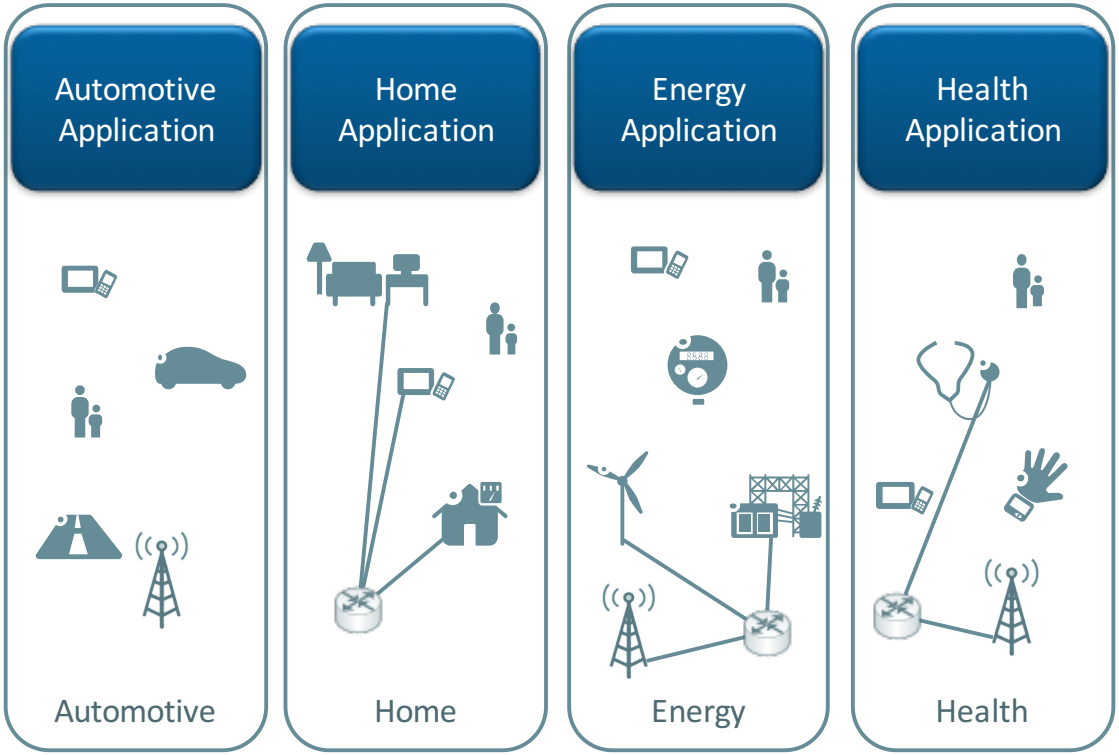
Source of info:
Example: ETSI document

Other comment:

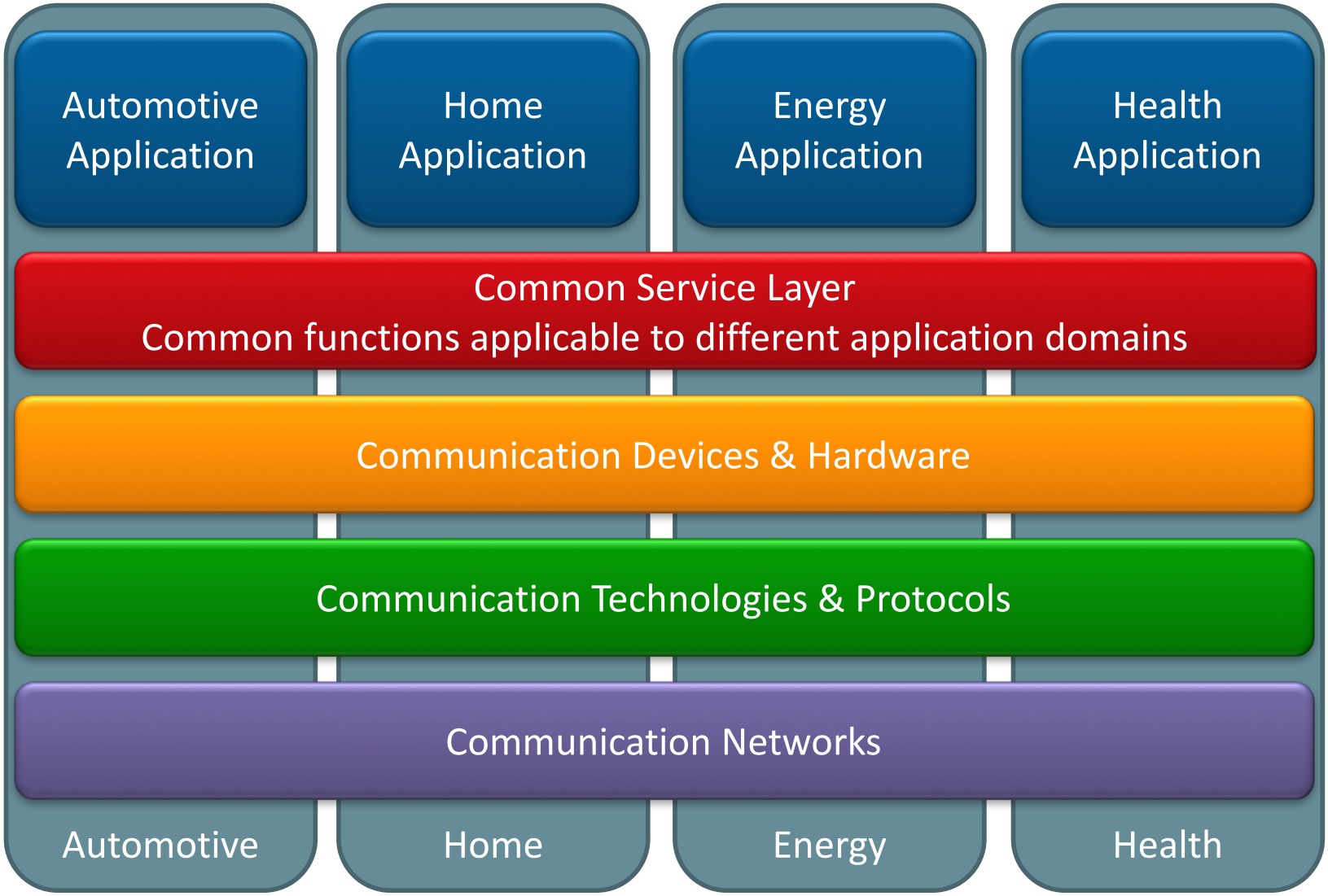
Email for answers: Congduc.Pham@univ-pau.fr

IoT is not only radio technologies!

- IoT provides data, services,…, for various application silos
- **IoT+Services=Innovation**
- Should also address high-level concerns: interoperability, high-level service, semantic,…
- Need for a Common Service Layer for IoT



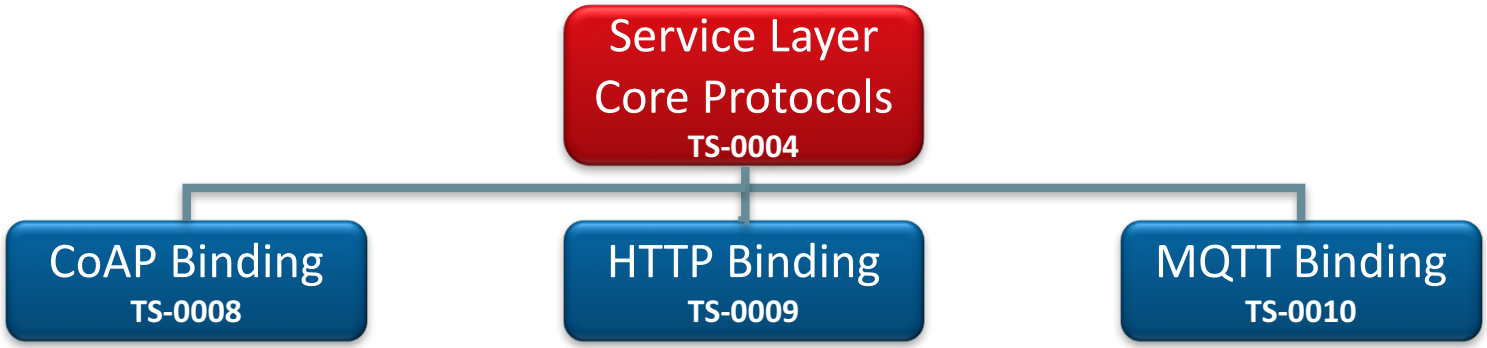
The Common Service Layer



Common Service Functions

Ex: Communication Protocols

Reuse IP-based existing protocols



XML or JSON Content serialization

HTTP Example

REQUEST

```
GET http://provider.net/home/temperature HTTP/1.1
Host: provider.net
From: //provider.net/CSE-1234/WeatherApp42
X-M2M-RI: 56398096
Accept: application/onem2m-resource+json
```

RESPONSE

```
HTTP/1.1 200 OK
X-M2M-RI: 56398096
Content-Type: application/onem2m-resource+json
Content-Length: 107
{"typeOfContent":"application/json",
"encoding":1,
"content": "{'timestamp':1413405177000,'value':25.32}"
}
```

Ex: Security

Reuse existing mechanisms

Security Solutions
TS-0003

Enrolment

Provisioning/Configuration of the M2M System (Devices, Applications…)

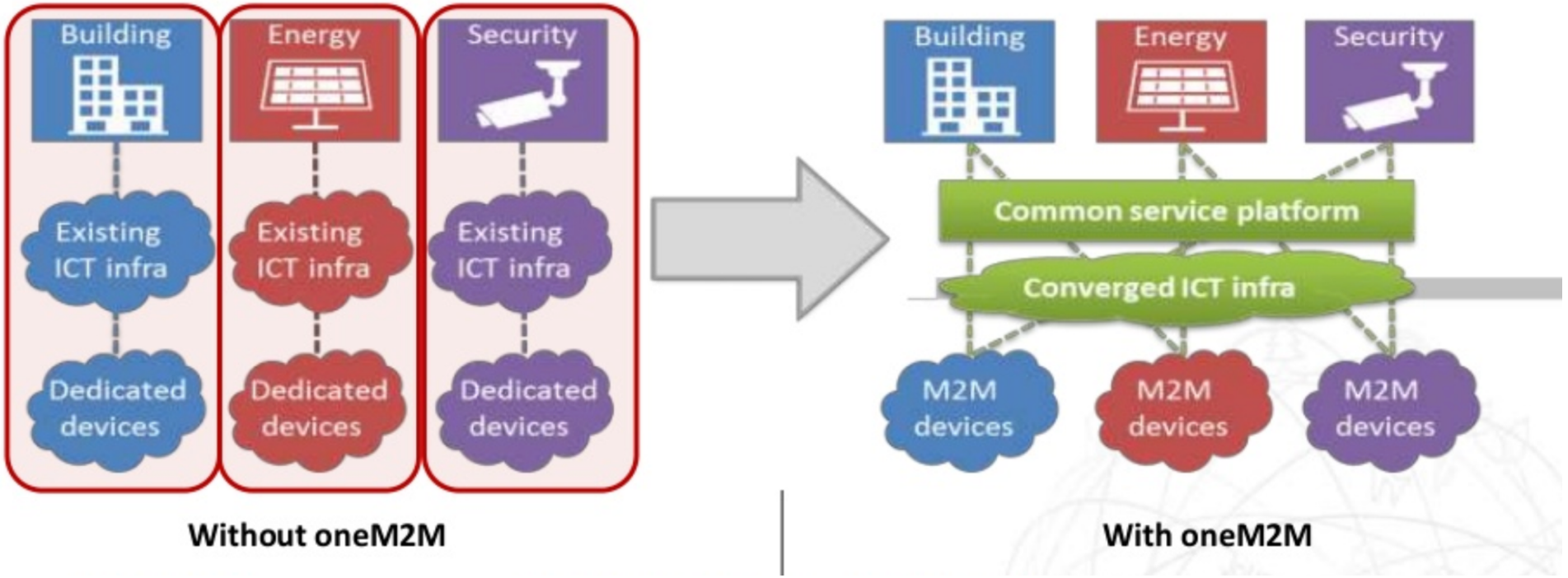
Secure communications

Protocols (TLS/DTLS), credentials and authentication (PSK/PKI/MAF)

Access Control

Defined in accessControlPolicy resources
Which SUBJECT can perform which ACTIONS
on which OBJECT under which CIRCUMSTANCES

Don't reinvent the wheel!



Conclusions

- IoT is growing fast, with new cutting-edge radio technologies and frameworks
- NB-IoT is pushed hard by most of operators but they are also rolling out large-scale SigFox and LoRa networks (just-in-case ☺)
- There will be room for all these technologies, depending on the application profiles
- There are emerging standards for IoT service layers/middleware and it is expected that OneM2M will play an important role
- More information in the paper

Demo of WAZIUP IoT solutions

- Stay with us until the end of the session
- Demo of WAZIUP's DIY, low-cost, long-range IoT solutions