Importance of long range – low energy radio technologies for Africa

in "IoT for sustainable development in Africa"

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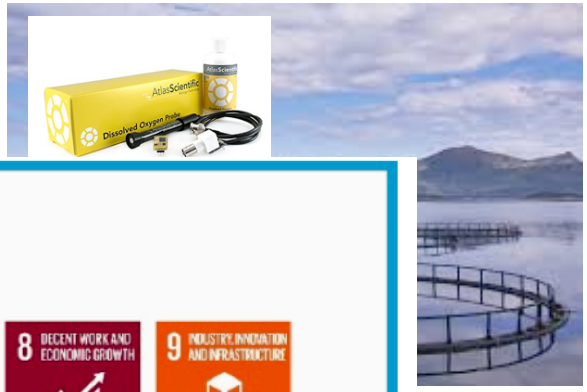
LIUPPA T2I team

IoT: development for rural areas

Irri



aculture

Storage & logistic

Agriculture

Environment

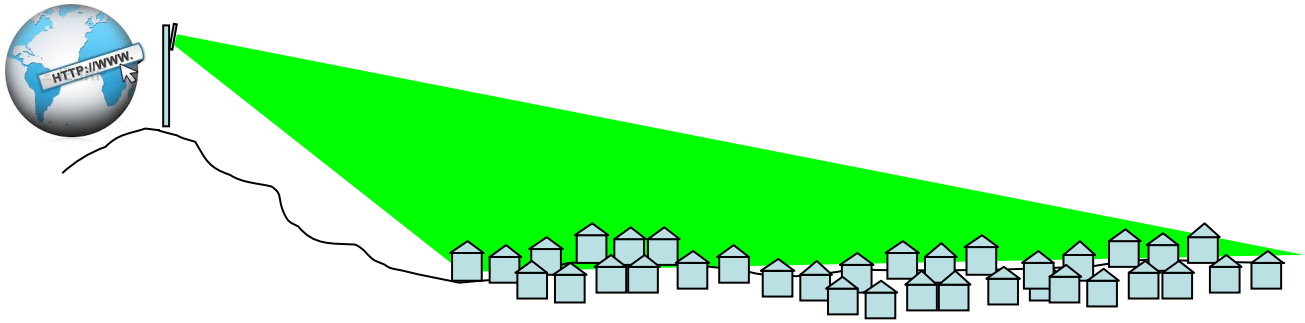
Long-range Sensing Applications

Moisture/
Temperature of
storage areas

10-15kms

GSM GPRS

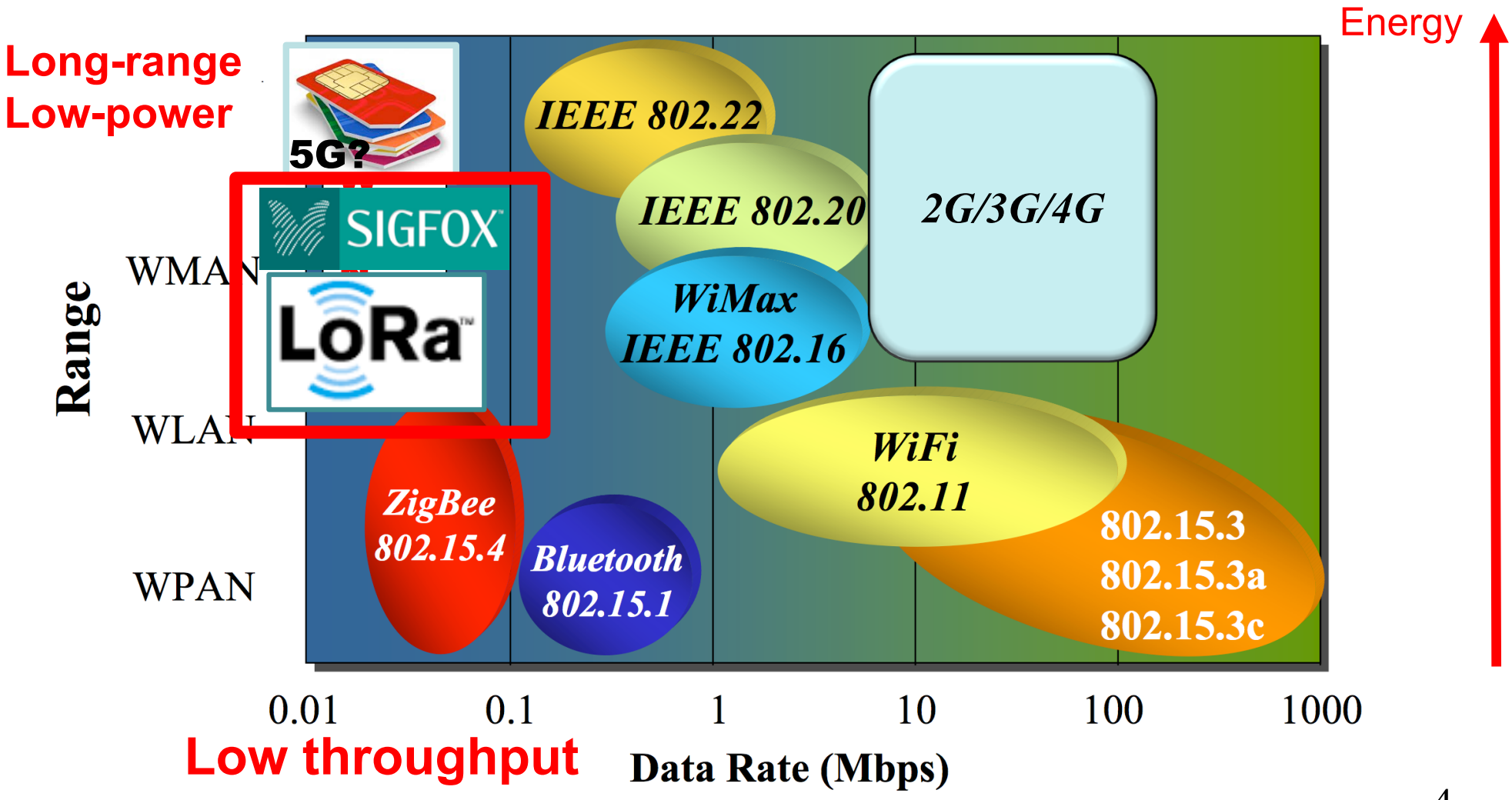
Pay subscription
Limitation of coverage
High energy consumption



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

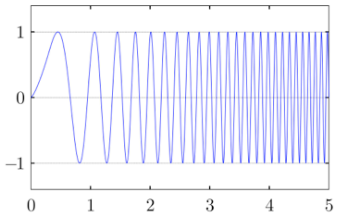
Low-power & long-range radio technologies (LPWAN)

Energy-Range dilemma

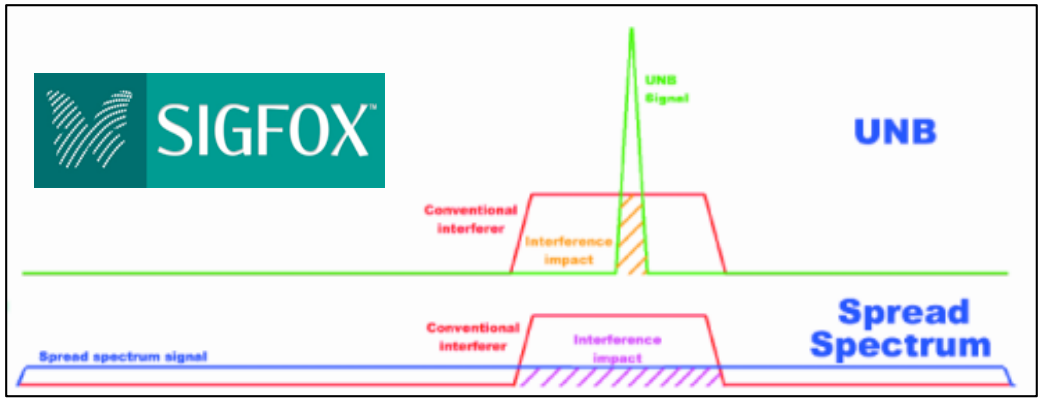


Increasing range?

- Generally, robustness and sensitivity can be increased when transmitting much slower
- A Sigfox message is sent relatively slowly in an ultra narrow band of spectrum. Max throughput=~100bps
- LoRa also increases time-on-air when maximum range is needed. But LoRa uses spread spectrum approach. Throughput=~300bps-37500bps



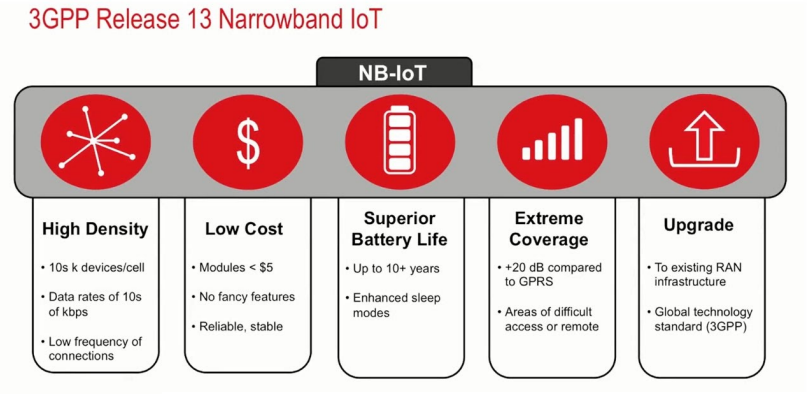
LoRa™

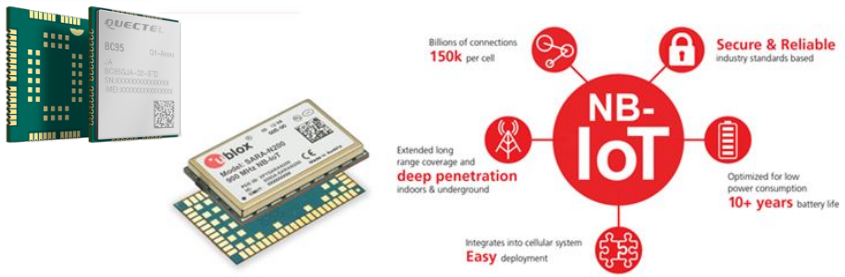


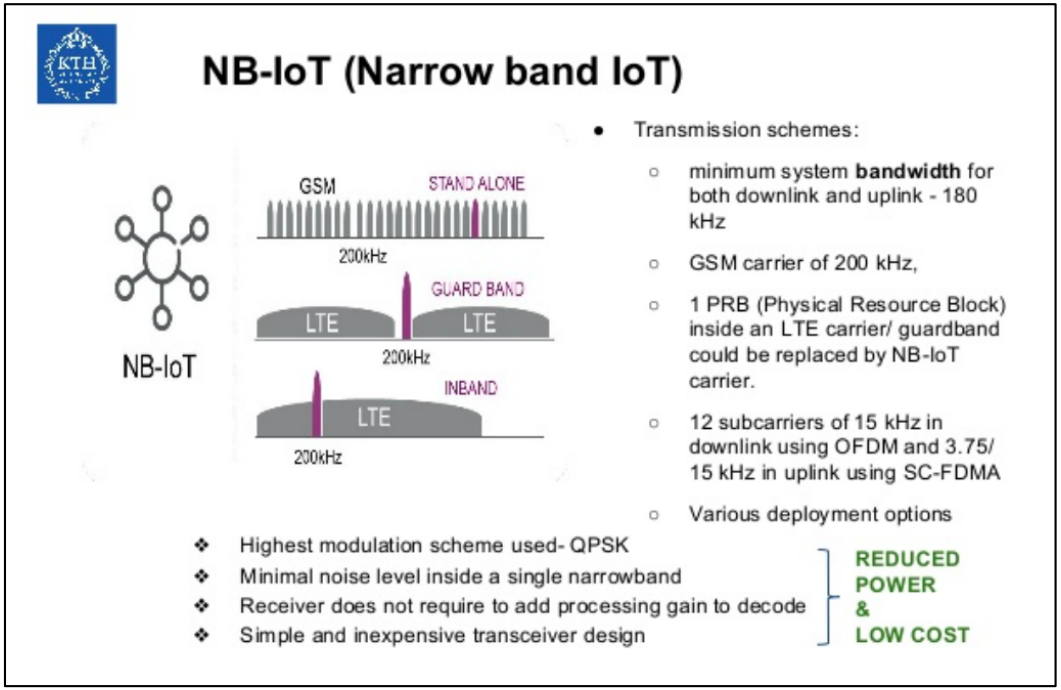
Other "long-range" technologies

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, Quectel,…







From G. Gupta, D. Patil, "LoRa and NB-IoT"

LoRa vs NB-IoT

LoRa and NB-IoT overview

Feature	LoRa	NB-IoT
Licensed/Unlicensed Spectrum	Unlicensed Band	Licensed Band
Reuse of Cellular Network	No	Yes
Development Status	Existing	Yet to develop
Modulation	SS chirp	QPSK
Bandwidth	500 Hz - 125 KHz	180 KHz
Data Rate	290 bps- 50 kbps	250 kbps max
Device cost/ complexity	1-5 $ (Ref- LPWA survey)	< 5$ per module (Ref-IETF)
Latency and Battery Lifetime	> 10 years	<10 seconds, >10 years battery (Ref-IETF)
Type of Standard	Proprietary	open

From G. Gupta, D. Patil, "LoRa and NB-IoT"

Needs, constraints, cost, design approach, control mechanism

Challenge: Bridging the digital divide

IoT in Africa usually means…

- … deploying IoT in very isolated areas!

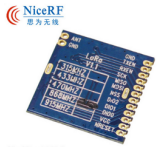
Private, ad-hoc LR network

Add LoRa radio module to your preferred dev platform

HopeRF RFM92W/95W

Libelium LoRa

Modtronix inAir9/9B



NiceRF LoRa1276

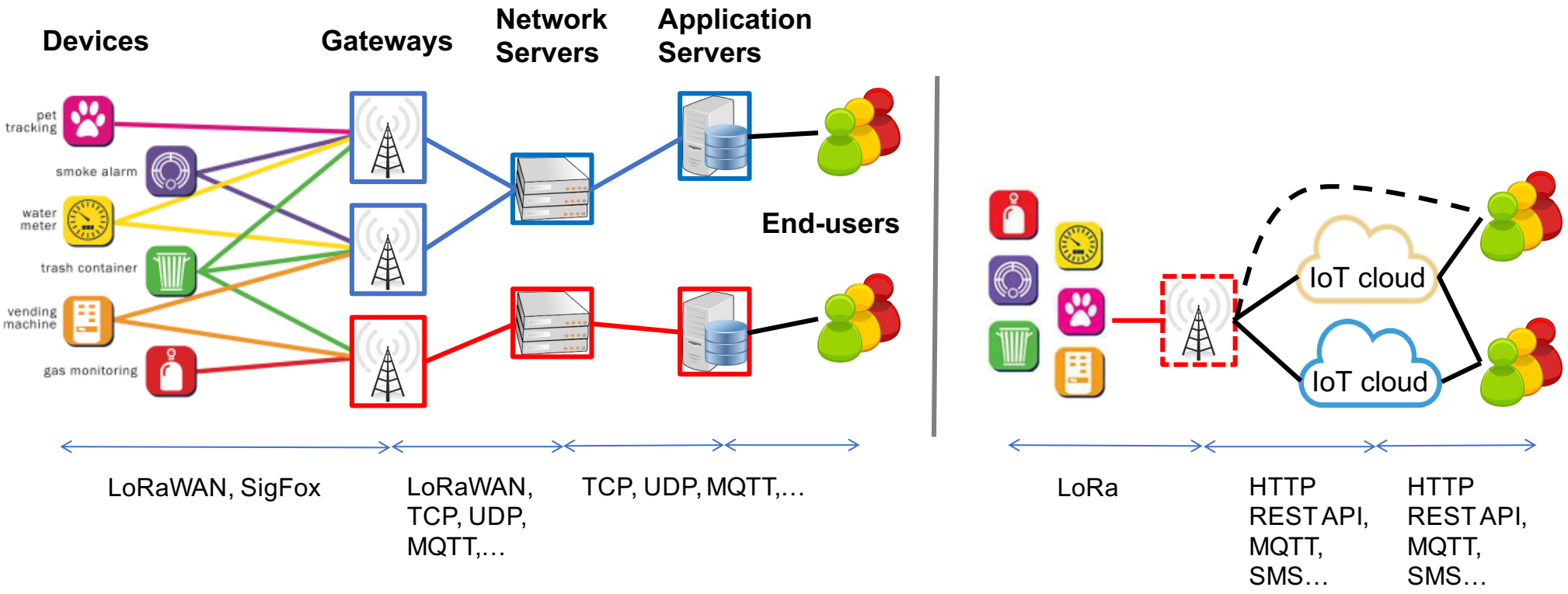
Install a LoRa gateway and start collecting data

Soil moisture
Leaf wetness

10-15kms

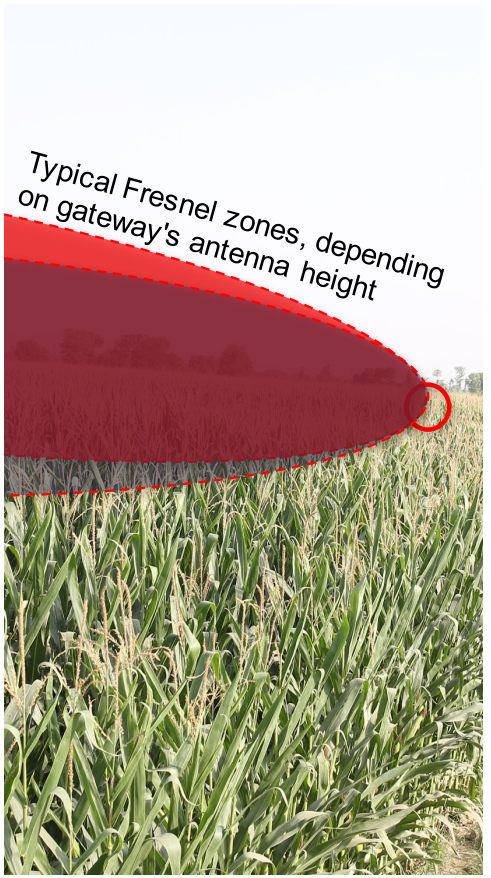
No subscription
Deploy own network
Low energy consumption

Long-range IoT architecture



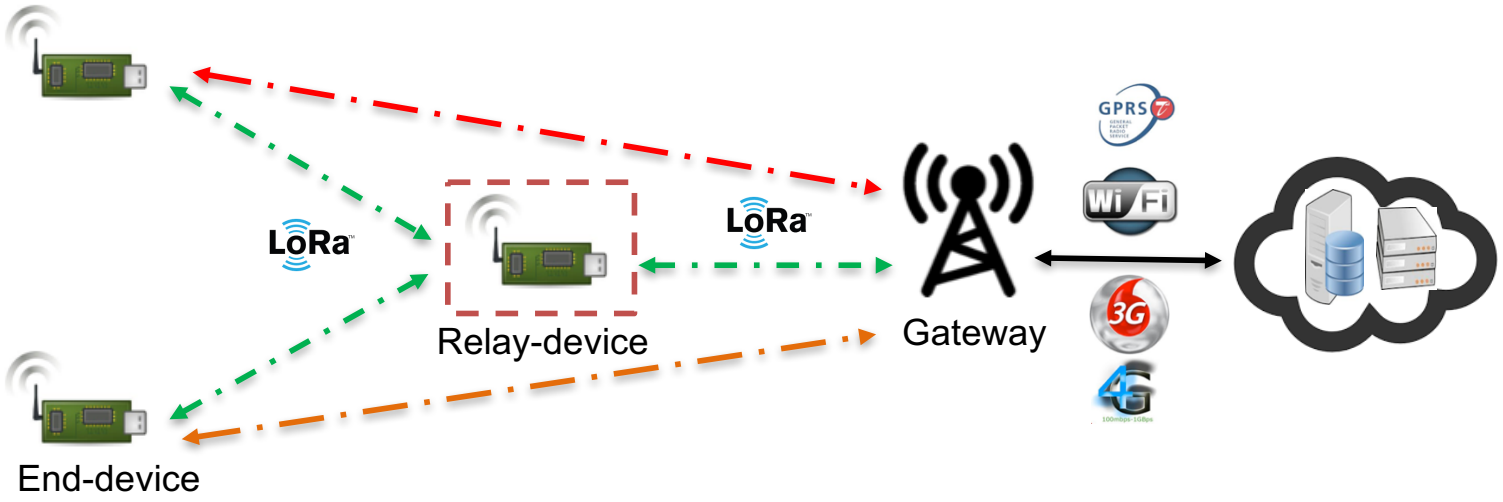
Real-world deployment

- 1-hop connectivity to gateway is difficult to achieve in real-world, remote, rural scenarios



2-hop long-range approach

- **smart, transparent** relay node should be able to be inserted at anytime between end-devices and gateway to increase range



WAZIUP Open IoT and Big data platform for Africans, by Africans

HORIZON 2020

Affordable technologies to empower rural economics

Exploit advanced research capitalizing on IoT and Big data state-of-the art findings

Develop IoT solutions and applications meeting African needs

DO MORE with LESS

www.waziup.eu

Waziup IoT

Waziup IoT

Waziup

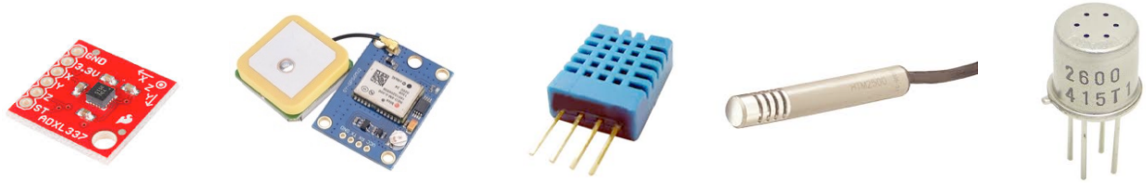
Waziup

CREATE-NET · CTIC · Farmerline · iSpace · coders africa · INNOTEC

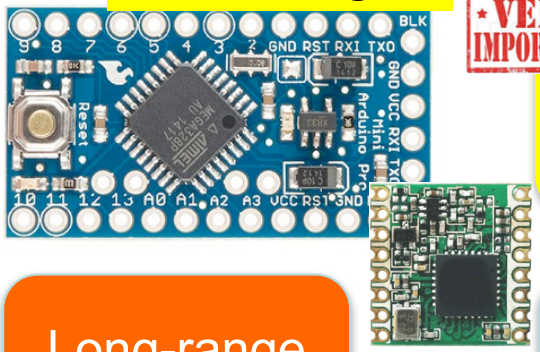
waziup.community@create-net.org

Ready-to-use templates

Physical sensor | Physical sensor | Physical sensor



Arduino Pro Mini @3.3V



Physical sensor mgmt

VERY IMPORTANT

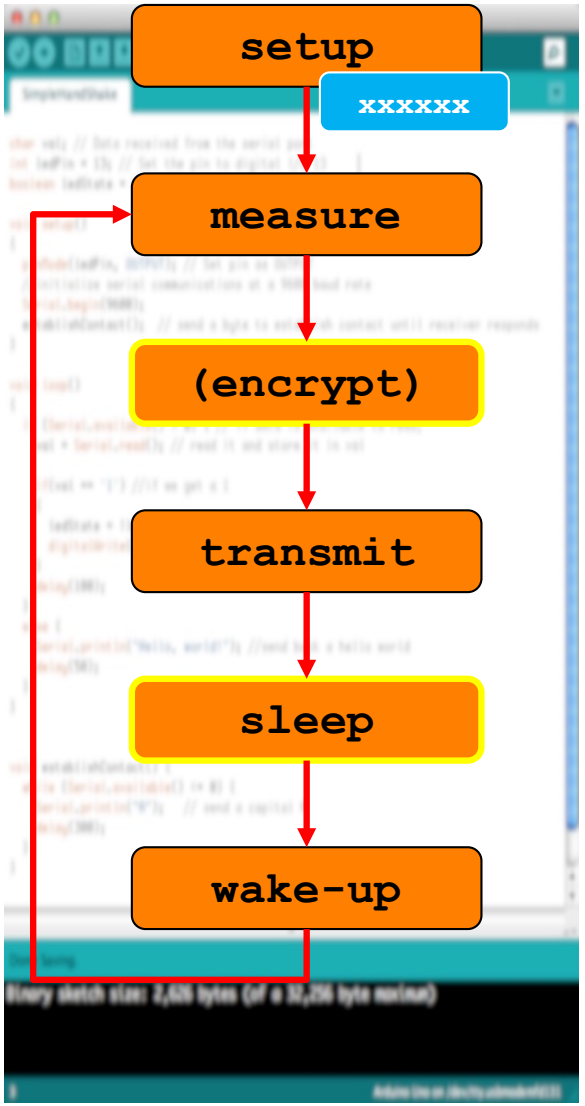
Activity duty-cycle, low power

VERY IMPORTANT

AES encryption

Long-range transmission

Logical sensor mgmt



From generic to specific applications

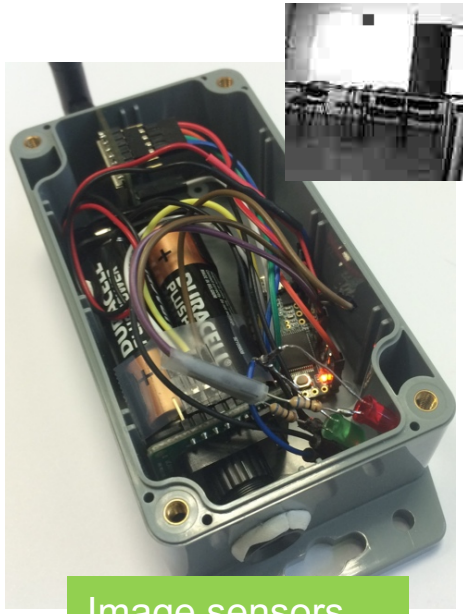
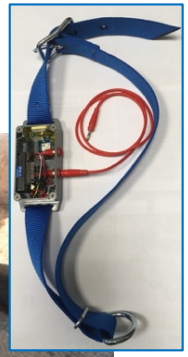
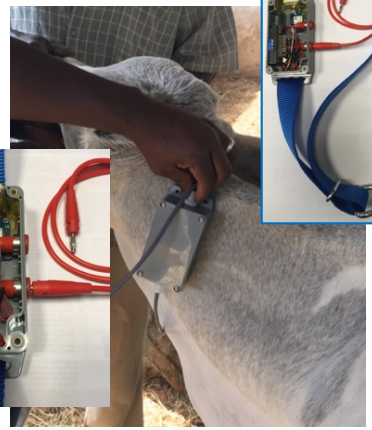
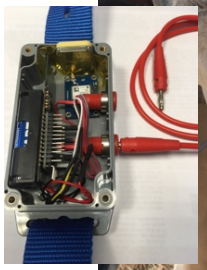


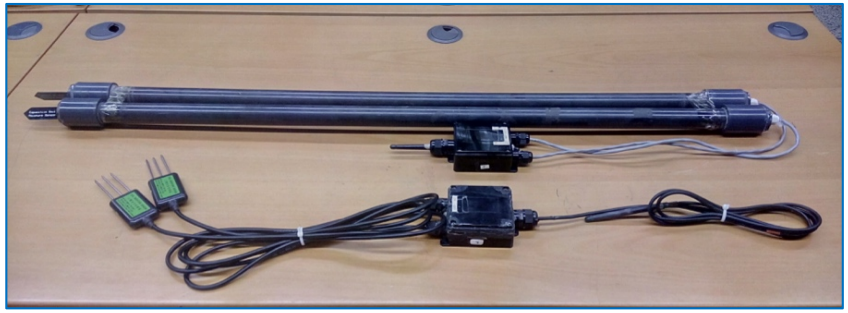
Image sensors

GPS collar









Soil Moisture

Photo from Unparallel

Bin presented at Woelab

Waste Mngt

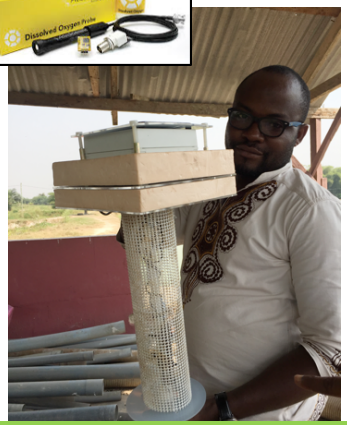
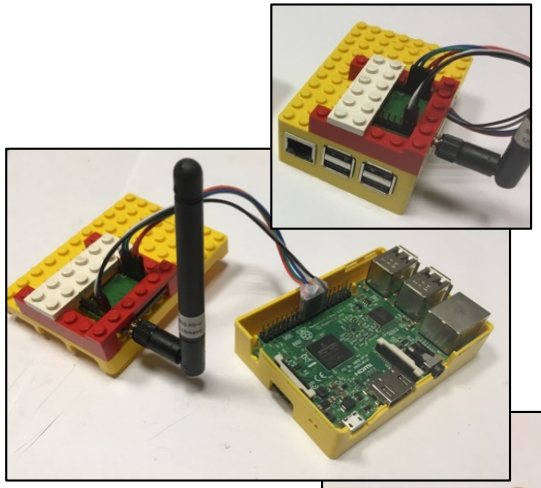


Photo from EGM

Buoy for water quality

Weather Station

Data post-processing stage



RPI 3
WiFi
LoRa

RPI ZeroW
WiFi
LoRa+2G/3G shield

RPI 3
LoRa
WiFi
PoE
2G/3G dongle
DHT22 in-case sensor

radio bridge program

stdout

stdin

post processing

stdout

JSON

post-processing

Handle downlink data

AES encryption decryption

LoRaWAN interoperability

Incoming data parsing block

Periodic task

JSON

Handle data from other radio interfaces

Monitor gateway temperature

user/app-specific

Cloud definition

cloud_script_1

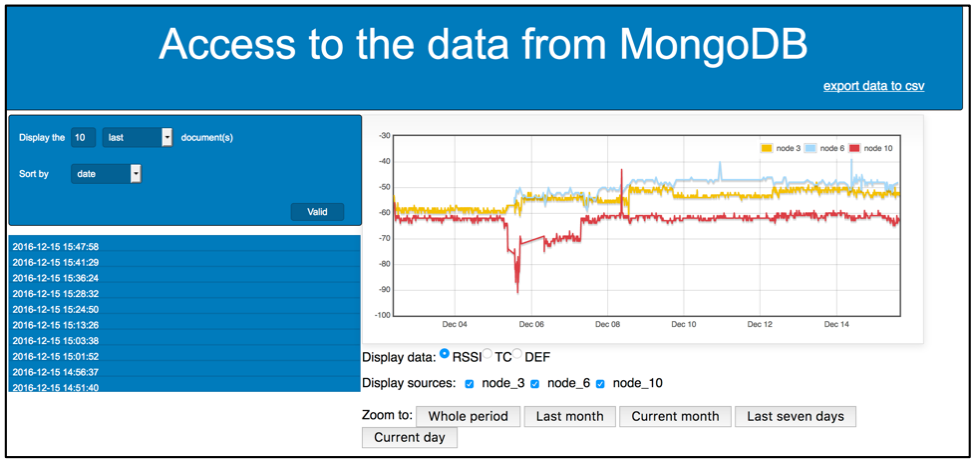
cloud_script_2

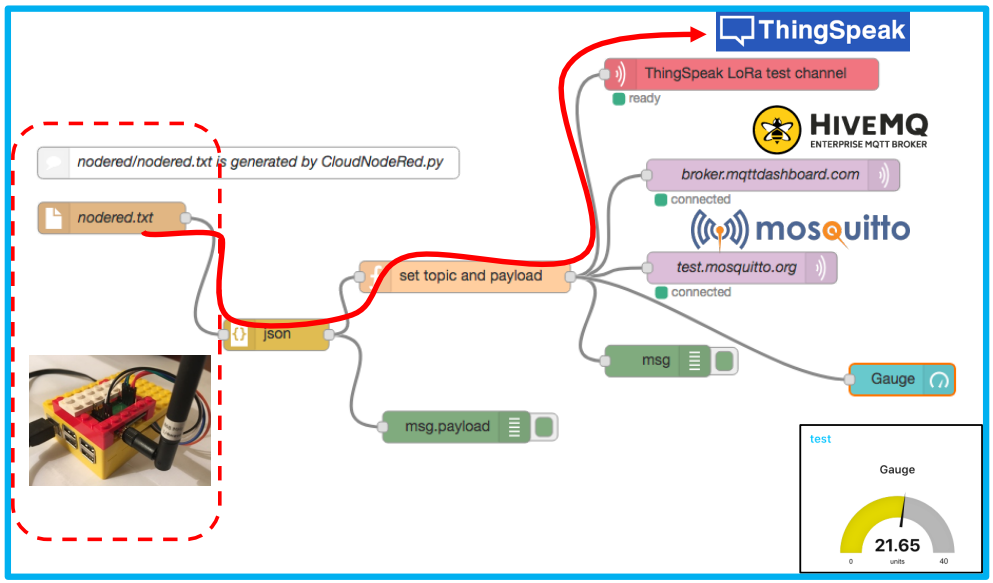
cloud_script_n

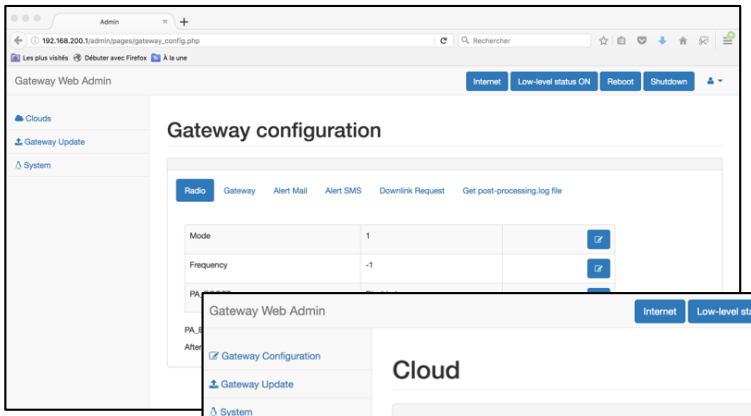
WAZIUP

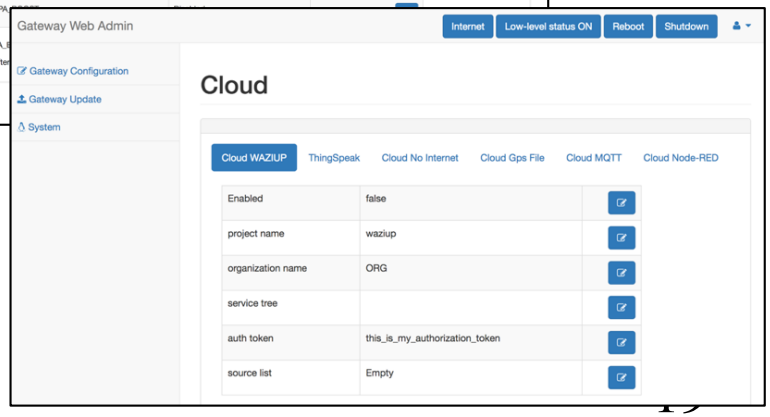
local database

Open, versatile gateway









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 ☺)
- In the Africa context, both operator coverage and Internet access issues must be taken into account
- Good long-range radio candidates must allow ad-hoc deployment and local gateway on customer premises