Enabling Low Power Wide Area Networks in the Internet of Things with LoRa

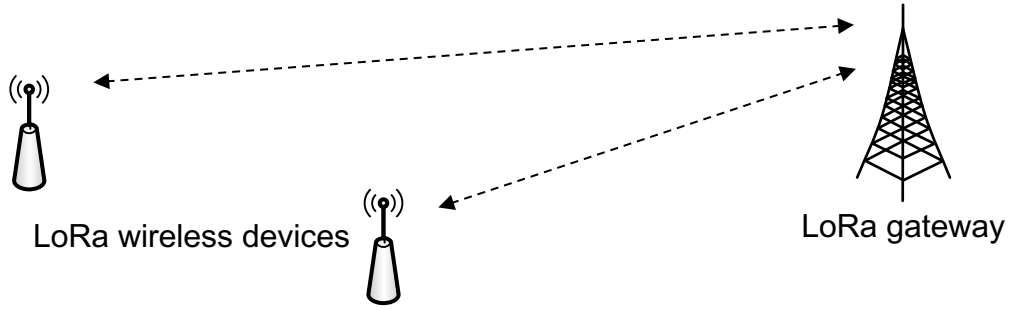
9èmes journées de la recherche de l'USJ

21-22 Juin 2018

Samer Lahoud
Melhem El Helou

Faculté d'Ingénierie - ESIB

LoRa Technology in Numbers



- **LoRa is a recent wireless communication technology with unprecedented performance**
  - Coverage: distance between transmitter and receiver can go up to tens of kilometers
  - Power consumption: a device can work for five years on a single battery charge
  - Device cost: a LoRa chip costs around 5 USD
  - Scalability: a Lora gateway supports thousands of connected devices

How Does LoRa Achieve Very Large Coverage?

- **The maximum coupling loss (*MCL*) defines the maximum loss the system can cope with between a transmitter and a receiver:**

$$MCL = \text{transmit power } (P_{Tx}) - \text{receiver sensitivity}$$

- **How to improve coverage?**
  - Increase P_{Tx}
  - Decrease receiver sensitivity
    - Reduce receiver noise figure
    - Reduce channel bandwidth
    - Reduce required signal-to-noise ratio
      ➔ **Chirp Spread Spectrum**

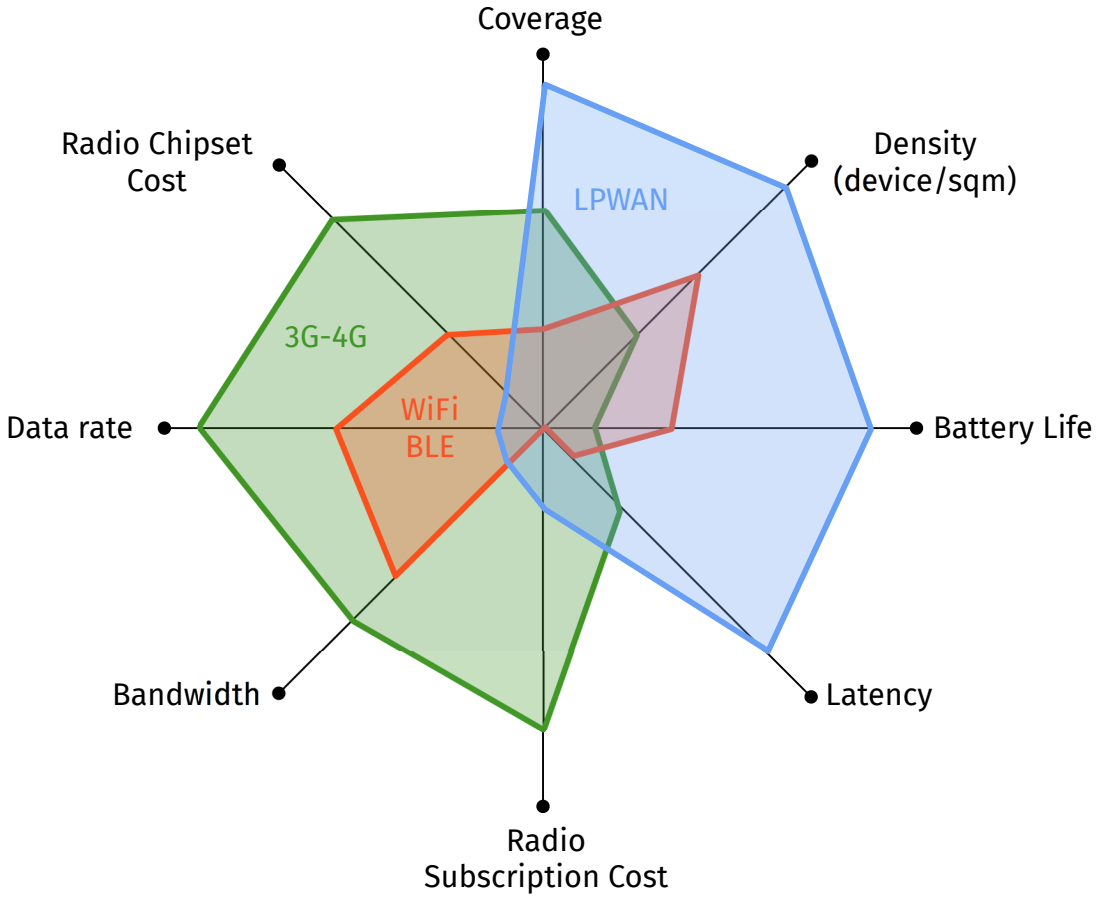
How does LoRa Consume Low Power?

- **Idle devices enter in deep sleep mode. They:**
  - shut down their transceiver
  - keep track of time and scheduled events via a low-power oscillator (that is kept running)
- **Devices wake up from deep sleep to:**
  - transmit data uncoordinatedly
  - open receive windows either periodically, or only after an uplink transmission

How does LoRa Reduce Device Complexity and Cost?

- **Reduce device complexity and cost through:**
  - limiting message size
  - using simple channel codes
  - not using complex modulations or multiple-input multiple-output (MIMO) transmissions
  - supporting only half-duplex operation
  - on-chip integrating power amplifier (since transmit power is limited)

LPWAN Sweet Spot



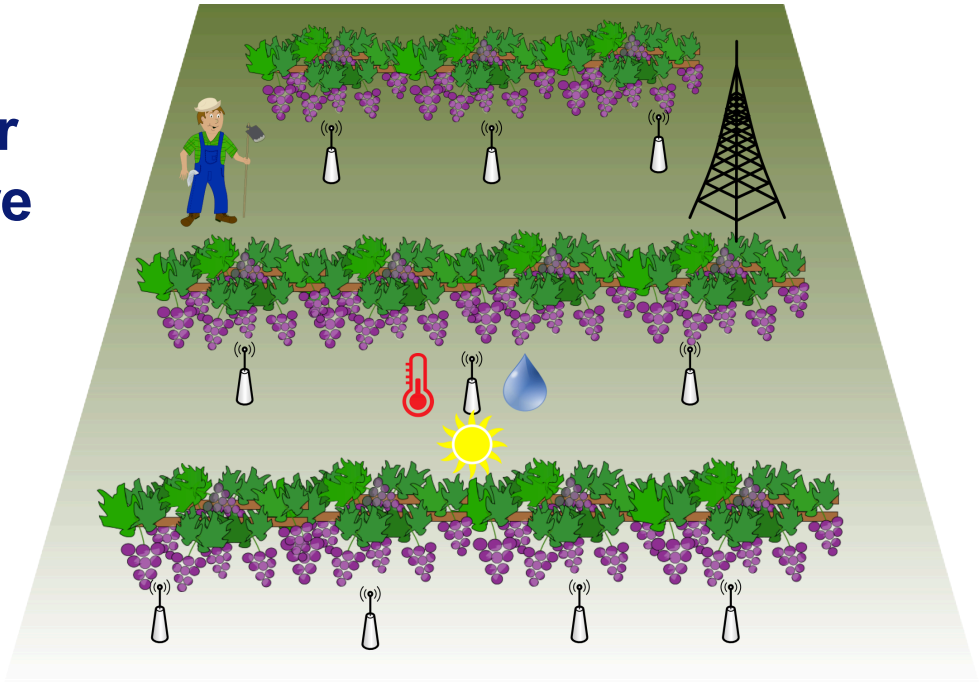
- **Low Power Wide Area Networks (LPWAN) complement traditional cellular technologies and short-range wireless technologies**

LPWAN Applications in the Internet of Things

- **Smart grid**
  - Connected electricity meters
- **Industrial asset monitoring**
  - Supply chain, airports
- **Critical infrastructure monitoring**
  - Transport, water installation
- **Smart agriculture**
  - Irrigation, fertilizing
- **Smart Cities**
  - Traffic control, environmental monitoring

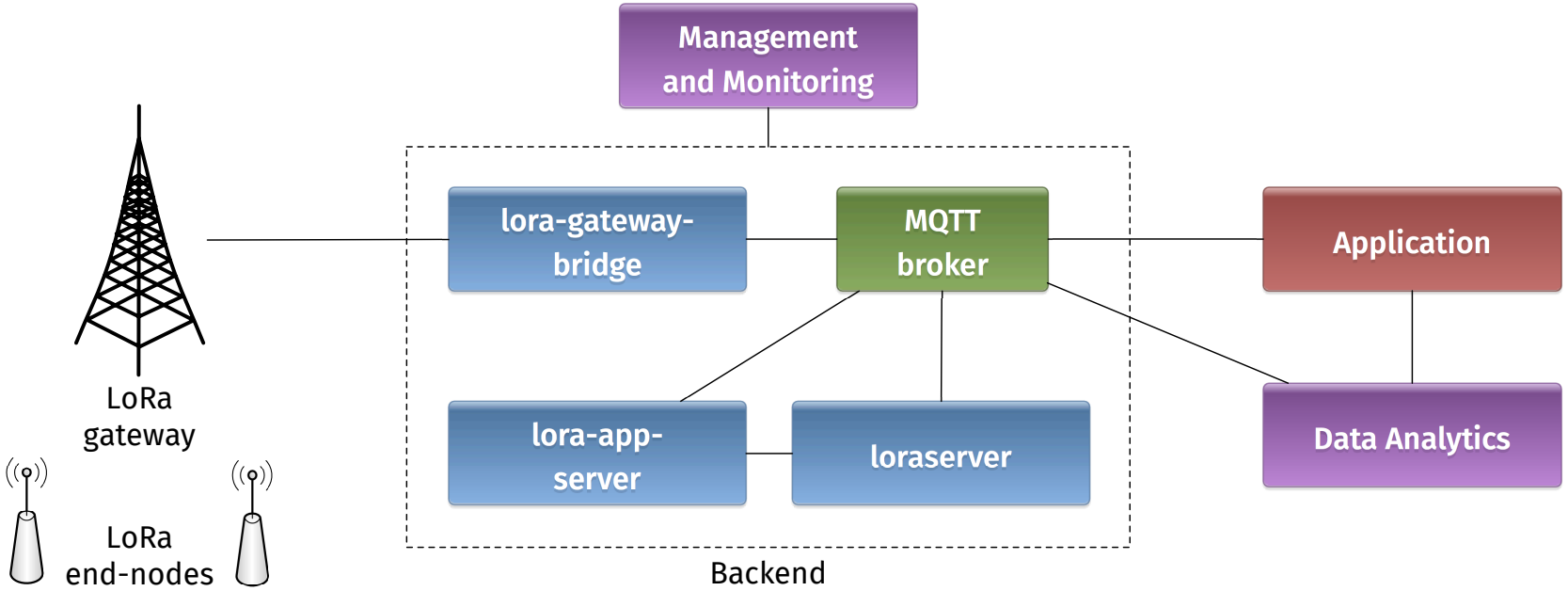
LISA: Long-range IoT for Smart Agriculture

- **Project launched at ESIB-USJ in Sept. 2016**
- **Scientific objectives cover networking and agriculture topics**
  - Deploy and test LoRa for agriculture
  - Automate measurement process of microclimates under vines
  - Test and assess different pruning lengths



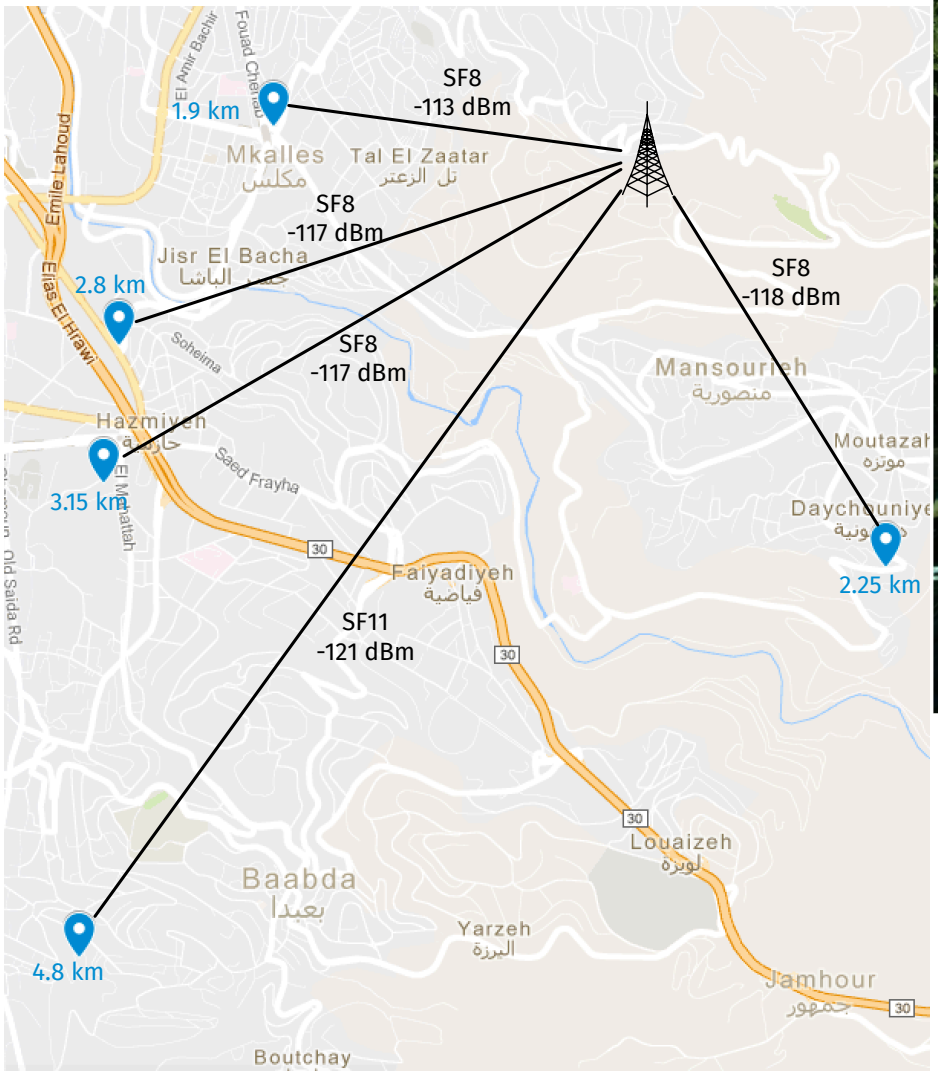
LISA members:
Marc Ibrahim, Samer Lahoud, Melhem El Helou, Maroun Chamoun, Rima Kilany Chamoun, Yolla Ghorra Chamoun, Maya Kharrat Sarkis

First LoRa Pilot in Lebanon at ESIB



- **Course on IoT technologies, engineering projects, and research studies**
- **Participation in the PoC with Libatel for OGERO**
  - Deployment at Château Kefraya
- **Participation in the FOSS4I international research project**
  - Development of a smart irrigation module controlled via LoRa

LoRa Drive Test



LoRa Cool Services

- **View the live dashboard**
  - https://goo.gl/jksaJW
- **Connect with our plant**
  - Twitter: @allo_laplante
  - Hangout: rt.laplante@gmail.com and type /bot eguz