

# REALIZATION OF A NETWORK STACK THAT SUPPORTS TAKS+WIDS ON WSN WITH MOTE RUNNER

---

DISIM - Università degli Studi dell'Aquila

## Students:

Andrea Salini - 231413

Lorenzo Di Giuseppe - 227515

Matteo Gentile - 230997

## Professors:

Fortunato Santucci

Luigi Pomante

April 15, 2015

# INTRODUCTION

.

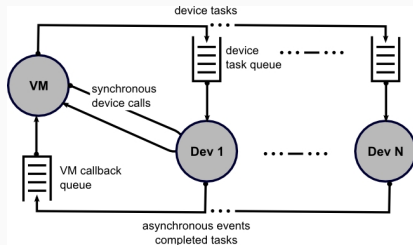
- Introduction to Mote Runner
- Testing Mote Runner

# INTRODUCTION TO MOTE RUNNER

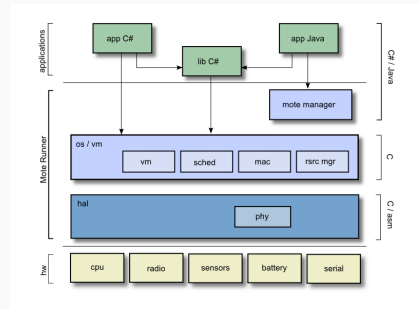
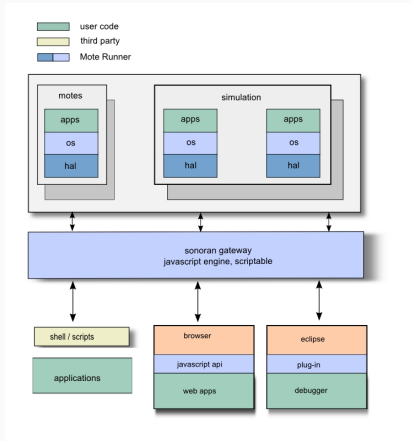
---

- An OS and a runtime and development environment for WSN
- Key features:
  - Support for RT constraints & energy awareness
  - Portability thanks to a VM that abstracts the HW
  - Event oriented programming paradigm
  - High level coding (Java - C#)
  - Debugging & simulation environments
- It's still in beta and is evolving towards IoT

# MOTE RUNNER



# MOTE RUNNER



- They support IEEE 802.15.4
  - exposing a low radio level API that can be used to implement custom MAC layer
  - dropping messages with header structure not 802.15.4 compliant in the radio stack
- Offer Hopi
  - A multi-hop data gathering protocol
  - Used to collect data from motes setting automatically a tree network

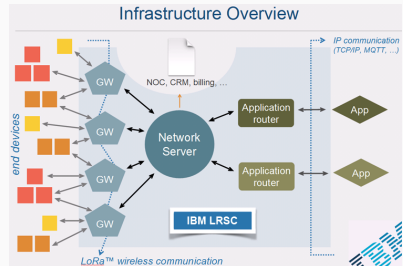


# MOTE RUNNER - V.17.1.8C (LATEST)

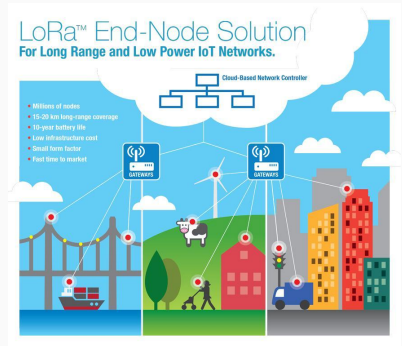
- Supports only two platforms: IMST & Blipper
- It's based on a different radio layer: LoRa™
- It offers a build-in MAC layer: LRSC - Low Range Signaling & Control
  - It supports only a network topology: the LRSC one
  - The offered API is poor since the radio is hidden in the firmware (not compatible with previous versions)

# LRSC - ARCHITECTURE

- Gateways (GW) are connected to server on IP
- Motes communicate with server in tunneling TCP/UDP over IP
- Motes communicate with GW with LoRa single-hop



- LoRa™ Alliance
  - Target: IoT, machine-to-machine (M2M), smart city, and industrial applications
  - Initiated to standardize Low Power Wide Area Networks (LPWAN)



- LoRa™Technology
  - LoRaWAN pledges to extend the radio range by 10x while using only one third of the power used by competing solutions
  - Star (of stars?) topology
  - Gateways relay messages between end-devices and a central network server
  - Communication between end-devices and gateways is spread out on different frequency channels and data rates.
  - Data rates: 0.3 - 50 kbps

- ...and more
  - adaptive data rate (ADR)
  - secure communication (on network and application layers and end-point device key)
  - three classes of end-point devices.
  - More info on <http://lora-alliance.org/>

## MOTE RUNNER - CONCLUSION

- For the purpose of this work (TAKS & WIDS):
  - MR allows dynamic reprogramming of motes with a control server using WLIP
  - v.17.1.8c is not suitable
    - LoRa is available only for a limited number of platforms (until now!)
    - LRSC doesn't permit to customize the MAC behaviour
    - The radio is not exposed
  - v.11, v.13 are better choices:
    - radio interface could be used to implement an 802.15.4 MAC with TAKS support
    - this MAC could be used to build upper layer with WIDS
- This does not exclude a future integration with LoRa-LRSC

.

## TESTING MOTE RUNNER

---



- MR v.13 offers:
  - Radio interface IEEE 802.15.4 compliant
  - Hopi
  - A simulation environment IRIS friendly
  - Many nice features (Debugger, Logger and so on)

# PROGRAMMING THE RADIO

- `com.ibm.saguaro.system.Radio`
  - This is a generic class in the IBM saguaro system to use the device radio
  - It offers a low level API with the following functionality:
    - `open`: opens the radio, once opened no other assembly can use it
    - `close`: releases the radio so that others can use it
    - setter and getters for channel and network parameters (addresses, panid...)
    - `startReceive`: listens the channel (in one of the many reception mode)
    - `transmit`: begin to transmit a pdu

- These operations require much attention:
  - The radio permits to transmit every type of pdu, but it's possible to receive only 802.15.4 well formed packets
  - It's also possible to receive in promiscuous mode to sniff for every packet
  - However it's suitable to adopt IEEE 802.15.4 packets to reduce interferences in reception
  - Radio

.

.

.

.

.