# Valorisation de publication

## Pourquoi faire une these ?


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# Outline

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# Problem statement

## Introduction[2] ?

- Parameters
  - Bandwidth (*BW*)
  - Spreading Factor (*SF*)
  - Coding Rate (*CR*)
  - Transmission Power (*Tx*)
- Metrics
  - Receiver Sensitivity (*RS*)
  - Signal Noise Rate (*SNR*)
  - Data Rate (*DR*)
  - Air Time (*AT*)
  - Payload length (*PktL*)

| Setting | Values | Rewards | Costs |
|---|---|---|---|
| *BW* | 7.8 ➠ 500$kHz$ | *DR* | *RS*, Range |
| *SF* | $2^6$ ➠ $2^{12}$ | *RS*, Range | *DR*, *SNR*, *PktL*, *Tx* |
| *CR* | $4/5$ ➠ $4/8$ | Resilience | *PktL*, *Tx*, *AT* |
| *Tx* | $-4$ ➠ 20$dBm$ | *SNR* | *Tx* |

Table 1: [1]

[1] Marco Cattani, Carlo Boano, and Kay Römer. " An Experimental Evaluation of the Reliability of Lora Long-Range Low-Power Wireless Communication ". In: *Journal of Sensor and Actuator Networks* 6.2 (2017). 00042, p. 7.

[2] B. Di Martino et al. " Internet of Things Reference Architectures, Security and Interoperability: A Survey ". In: *Internet of Things* 1-2 (Sept. 2018). 00006, pp. 99–112.

# Outline

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1. Genetic Algorithm For LoRa



1. Bandit Algorithm
2. Genetic Algorithm
3. Marcov chain
4. Game theory

# Outline

# Multi-Armed-Bandit Algorithm

## Related work

- Arms: K = 1, ... , K
- Decision: T = 1, ... , T
- Reward: $X_t^k$ with $\mu_t^k$ = E $[X_t^k]$
  - Best reward: $X_t^*$ with $\mu_t^*$ = max $\mu_t^k$, k∈K

# Outline

# Genetic Algorithm

## Related work [**alkhawlani_access_2008a**]

- Heterogeneous wireless network: (RAT 1 ,RAT 2 ,...,RAT n)
- Criteria up to i (c 1 ,c 2 ,...,c i ) the operators, the applications, and the network conditions.
- 
- The different sets of scores (d 1 , d 2 ,...,d i ) are sent to the MCDM in the second component.
- GA component assigns a suitable weight (w 1 ,w 2 ,...,w i )

# Genetic Algorithm

## Related work

- 
- S = SF12, BW125, 4/8, 17 dBm
- Input:
  - Problem: f(x) = max($x^2$), x ∈[0,32]
    - $x_1 : 01101_b$
    - $x_2 : 11000_b$
    - $x_3 : 01000_b$
    - $x_4 : 10011_b$
- Method: Genetic algorithm
  - Generate a set of random possible solution
  - Test each solution and see how good it is (ranking)
    - Remove some bad solutions
    - Duplicate some good solutions
    - Make small changes to some of them (Crossover, Mutation)
- Output:
  - $x_1$: 01101 (169) (14.4)

# Outline

# Marcov chain

## Related work

$$V(s,\pi) = \mathbb{E}_s^{\pi}\left(\sum_{k=0}^{\inf} \gamma^k \cdot r(s_k, a_k)\right), s \in \mathbb{S} \tag{1}$$

$$r(s_k, a_k) = G_k \cdot PRR(a_k) \tag{2}$$

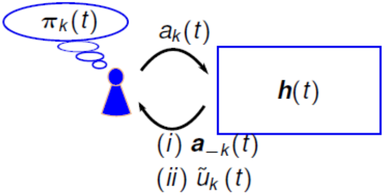
$$\pi^* = \arg\max_{\pi} V(s,\pi) \tag{3}$$

$$PRR = (1 - BER)^L \tag{4}$$

$$BER = 10^{\alpha e^{\beta SNR}} \tag{5}$$

Learning Iterative Steps:

- **Choose** action $a_k(t) \sim \pi_k(t)$.
- **Observe** game outcome, e.g.,
  $\boldsymbol{a}_{-k}(t)$
  $u_k(a_k(t), \boldsymbol{a}_{-k}(t))$.
- **Improve** $\pi_k(t+1)$.




Thus, we can expect that: $\forall k \in \mathcal{K}$,

$$\pi_k(t) \xrightarrow{t\to\infty} \pi_k^* \qquad (1)$$

$$\bar{u}_k\left(\pi_k(t), \pi_{-k}(t)\right) \xrightarrow{t\to\infty} \bar{u}_k\left(\pi_k^*, \pi_{-k}^*\right) \qquad (2)$$

where, $\pi^* = (\pi_1^*, \ldots, \pi_K^*)$ is a NE strategy profile.

Figure 1: .

# Outline

# Game theory

## Related work

- Players: $K = \{1, ..., K\}$
- Strategies: $S = S_1 \times \ldots \times S_K$
  - $S_k$ is the strategy set of the $k^{th}$ player.
- Rewards: $u_k : S \longrightarrow R_+$ and is denoted by $r_k(s_k, s_{-k})$
  - $s_{-k} = (s_1, \ldots, s_{k-1}, s_{k+1}, \ldots, s_K) \in S_1 \times \ldots \times S_{k-1} \times S_{k+1} \times \ldots \times S_K$

# Outline

# ... (step 2)

## Methods

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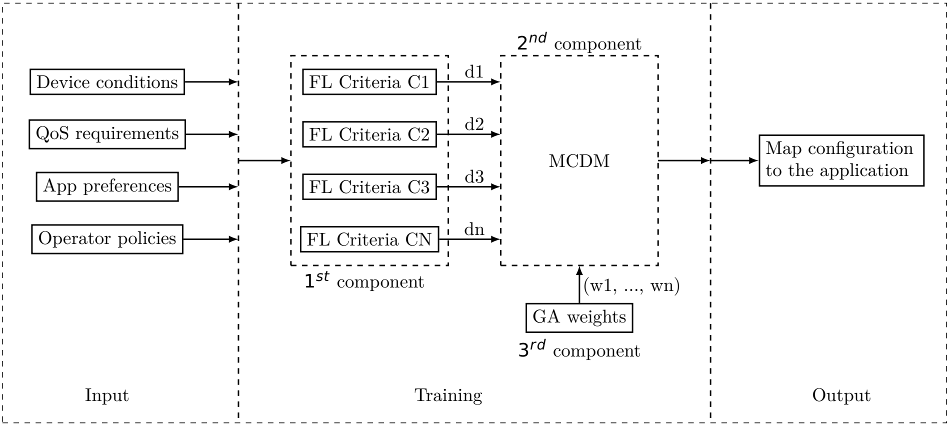


Figure 2: HH.

# ... (step 3)

## Methods

# ... (step 4)

## Methods

# Outline

1. Genetic Algorithm For LoRa

# Contribution

## Contributions

- **Use cases (Application Requirements)**
  - Smart building: Voice, Images, Text.
- **Environments**
  - Rural/Urban
  - Static/Mobile
  - Temperature
- **Scenarios**
  - Application protocol (MQTT, COAP, XMPP)
  - Network protocol (Start, Mesh)
  - MAC protocol (LoraWan, Sigfox, ...)
- **Input:**
  - Service QoS metrics requirements
  - MAC configuration (SF, CR, BW, ...)
  - Network QoS metrics
- **Algorithms:**
  - MADM
    - Ranking methods
    - Ranking & weighted methods
  - Game theory
    - Users vs users
    - Users vs networks
    - Networks vs network
  - Fuzzy logic
    - as a score method
    - another theory
  - Utility function
    - 1
    - 2
- **Outputs:**
  - Ranked networks

# Technical choice

## Implementation

- ZOLERTIA RE-MOTE
  - Low consumption component
  - ADC port for placing sensors on it
- CONTIKI OS
  - Operating system for wireless and low power development
  - Support for newer standards (6LowPAN, RPL, CoAP, MQTT)
- 6LowPAN
  - Based on IPv6 and IEEE 802.15.4
  - IPv6-based network with low power consumption
  - Ability to create a mesh network
- Sending packages
  - UDP in the 6LowPAN network
  - MQTT between the cloud platform and the router

# Experimentation

## Experimentation

- a
- b

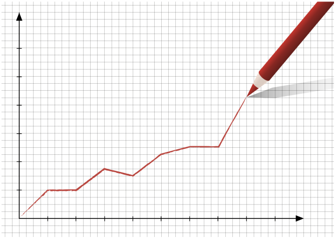

Figure 3: .

# References

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