

# IoT challenges

State of the art

Aghiles DJOUDI

LIGM/ESIEE Paris & SIC/ECE Paris

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# Outline

1. Introduction

2. First contribution

3. Conclusion

# Context

What is IoT ?

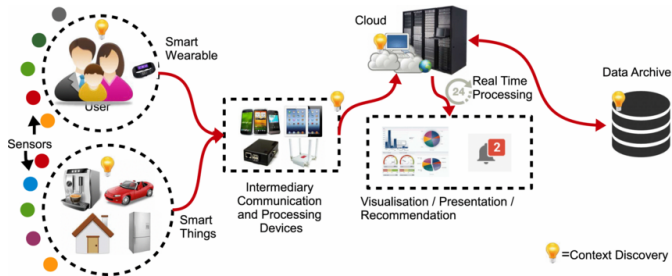


Figure 1: IoT platform.



Figure 2: IoT challenges.

# Problematic

Where is the problem ?

## 1. How to Connect sensors to the best gateway?

- Decision and optimisation problem.
- Various network acces
- Various configuration of each network acces
- Lake of selection tools

## 2. How to connect sensors to this gateway with high Security level.

- Technical problem.
- Lake of selective tools
- How to select the **best** access point

## 3. How to extract knowledge from sensors data [1].

- a
- Lake of selective tools
- How to select the **best** access point



Figure 3: Key barriers to Industrial Internet of Things (IIoT) adoption

<sup>a</sup> industrialinternetofthings

[1] Pascal Thubert, Maria Rita Palattella, and Thomas Engel. "6TiSCH Centralized Scheduling: When SDN Meet IoT". In: 2015 IEEE Conference on Standards for Communications and Networking (CSCN). 2015 IEEE Conference on Standards for Communications and Networking (CSCN). 00035. Tokyo, Japan: Oct. 2015, pp. 42–47.

# Problematic

Where is the problem [3] ?

Bandwidth (*BW*) Spreading Factor (*SF*) Coding Rate (*CR*) Transmission Energy (*Tx*) Receiver Sensitivity (*RS*) Signal Noise Rate (*SNR*) Data Rate (*DR*)

Setting	Values	Rewards	Cost
<i>BW</i>	125 ➡ 500kHz	<i>DR</i>	<i>RS</i> , Range.
<i>SF</i>	$2^6$ ➡ $2^{12}$	<i>RS</i> , Range	<i>SNR</i> , longer packets, <i>Tx</i> .
<i>CR</i>	4/5 ➡ 4/8	Resilience	longer packets, <i>Tx</i> .
<i>Tx</i>	-4 ➡ 20dBm	<i>SNR</i>	<i>Tx</i>

Table 1: [2]

# Motivations

Why should we deal with such problems

1. → a  
→ Lake of selective tools  
→ How to select the **best** access point

## 2. QoS Analysis

- a
- Lake of selective tools
- How to select the **best** access point

## 3. Threats

- a
- Lake of selective tools
- How to select the **best** access point



Figure 4: Communication diversity.

# Goal

Is it specific, measurable, achievable, réalistic, for 3 years ?

- ➡ 1. Allow heterogeneous network to communicate
- 2. QoS Analysis
- 3. Threats
- ➡ How to select the **best** access point
  - 1. Allow heterogeneous network to communicate
  - 2. QoS Analysis
  - 3. Threats



Figure 5: wsn-IoT.

# Challenges

Where is the difficulty ?

## 1. Challenge 1

- 6720 possible settings
- Lake of selective tools
- How to select the **best** configuration

## 2. Challenge 2

- a
- Lake of selective tools
- How to select the **best** access point

## 3. Challenge 3

- a
- Lake of selective tools
- How to select the **best** access point

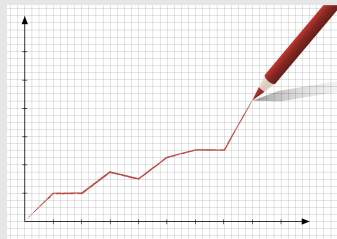


Figure 6: tets.



# Contributions

## Contributions

### → Environnement

- Rural/Urban
- Static/Mobile
- 

### → Senarios

- For each service (Smart building:Videos, Voice, Text. Smart traffic:Videos, Voice, Text)
- For each application protocol (MQTT, COAP, XMPP)
- For each network protocol (Start, Mesh)
- For each MAC protocol (LoraWan, Sigfox, ...)
- For each MAC configuration (SF, CR, BW, ...)

### → Algorithms

- Input:
  - \* Service QoS metrics requiremnts
  - \* Network Transmission Parameters
  - \* Network QoS metrics
- Method:
  - \* MADM
  - \* Game
  - \* Neural
- Outputs:
  - \* Ranked networks

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Simulation & Real environnement

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1. Related work

2. Contagion process

3. Experimentation

4. Results exploitation

5. Discussion

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# Related work

## Comparison

Paper	A1	A2	A3	A4

Table 2: An example table.

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# Marcov chain

## Methods

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

$$r(s_k, a_k) = G_k \cdot PRR(a_k) \quad (2)$$

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

$$PRR = (1 - BER)^L \quad (4)$$

$$BER = 10^{\alpha} e^{\beta SNR} \quad (5)$$



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# Genetic Algorithm

## Methods



➡ S = SF12, BW125, 4/8, 17 dBm

➡ Input:

➡ Problem:  $f(x) = \max(x^2)$ ,  $x \in [0,32]$

\*  $x_1 : 01101_b$

\*  $x_2 : 11000_b$

\*  $x_3 : 01000_b$

\*  $x_4 : 10011_b$

➡ Method: Genetic algorithm

➡ Generate a set of random possible solution

➡ Test each solution and see how good it is (ranking)

1. Remove some bad solutions

2. Duplicate some good solutions

3. Make small changes to some of them (Crossover, Mutation)

➡ Output:

➡  $x_1 : 01101$  (169) (14.4)

➡  $x_2 : 11000$  (576) (49.2)

➡  $x_3 : 01000$  (64) (5.5)

➡  $x_4 : 10011$  (361) (30.9)

# Game theory

## Methods

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

## ... (step 2)

Methods



## ... (step 3)

Methods



# ... (step 4)

Methods



# Results

## Comparison


Table 4



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# Experimentation

## Experimentation

➡ a

➡ b

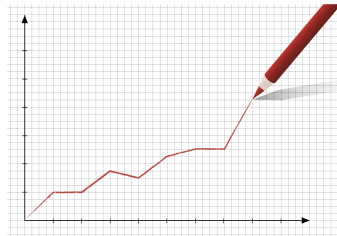


Figure 7: .

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# Results

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➡ a

➡ b

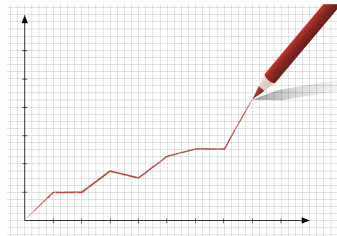


Figure 8: .

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# Discussion

➡ a

➡ b

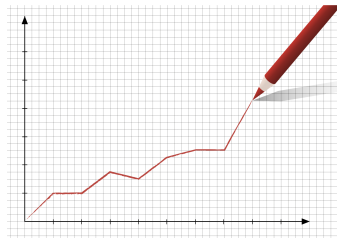


Figure 9: .

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# Conclusion

Our main goal was



Our main contribution was



Our main results was





# Future Challenges

## Conclusion

Our future goal was



# Future Challenges

## Conclusion

Our future goal was



# Thank you !

# References

- [1] Pascal Thubert, Maria Rita Palattella, and Thomas Engel. " 6TiSCH Centralized Scheduling: When SDN Meet IoT ". In: *2015 IEEE Conference on Standards for Communications and Networking (CSCN)*. 2015 IEEE Conference on Standards for Communications and Networking (CSCN). 00035. Tokyo, Japan: Oct. 2015, pp. 42–47 (p. 4).
- [2] 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 (p. 5).
- [3] 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 (p. 5).