

IoT challenges

State of the art

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Outline

1. Introduction

2. First contribution

3. Conclusion

Context

What is IoT ?

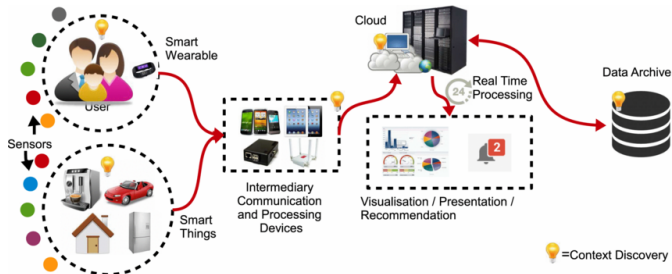


Figure 1: IoT platform.



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

^a 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*) ,Air Time (*AT*)

Setting	Values	Rewards	Cost
<i>BW</i>	7.8 ➡ 500kHz	<i>DR</i>	<i>RS</i> , <i>Range</i> .
<i>SF</i>	2^6 ➡ 2^{12}	<i>RS</i> , <i>Range</i>	<i>DR</i> , <i>SNR</i> , longer packets, <i>Tx</i> .
<i>CR</i>	4/5 ➡ 4/8	Resilience	longer packets, <i>Tx</i> , <i>AT</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

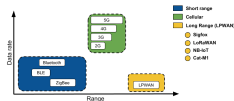


Figure 4: Communication diversity.

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

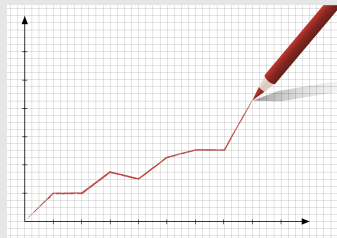


Figure 6: tets.

Contributions

Contributions

- ➡ Use cases (Requirements)
 - ➡ Smart building: Videos, Voice, Text.
 - ➡ Smart traffic: Videos, Voice, Text
- ➡ Environnements
 - ➡ Rural/Urban
 - ➡ Static/Mobile
 - ➡ Temperature
- ➡ Scenarios
 - ➡ For each application protocol (MQTT, COAP, XMPP)
 - ➡ For each network protocol (Star, Mesh)
 - ➡ For each MAC protocol (LoRaWan, Sigfox, ...)
- ➡ Algorithms
 - ➡ Input:
 - * Service QoS metrics requirements
 - * MAC configuration (SF, CR, BW, ...)
 - * Network QoS metrics
 - ➡ Method:
 - * MADM, Game, Neural
 - ➡ Outputs:
 - * Ranked networks

Contributions

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- ➡ Smart building: Videos, Voice, Text.
- ➡ Smart traffic: Videos, Voice, Text

➡ Environnements

- ➡ Rural/Urban
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- ➡ For each application protocol (MQTT, COAP, XMPP)
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Simulation & Real environment

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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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Multi-Armed-Bandit Algorithm

Methods

- ➡ Arms: $K = 1, \dots, K$
- ➡ Decision: $T = 1, \dots, T$
- ➡ Reward: X_t^k with $\mu_t^k = E[X_t^k]$
 - ➡ Best reward: X_t^* with $\mu_t^* = \max_{k \in K} \mu_t^k$

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^{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

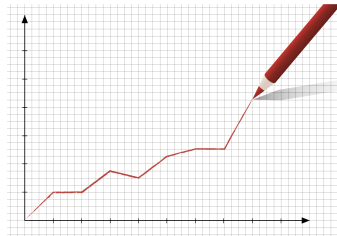


Figure 7: .

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Results

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➡ a

➡ b

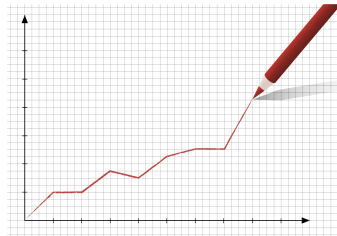


Figure 8: .

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Discussion

➡ a

➡ b

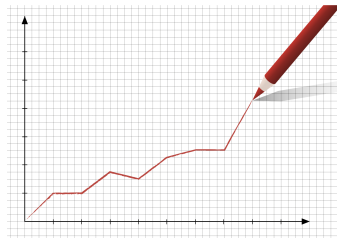


Figure 9: .

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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).