IoT challenges

State of the art

Aghiles DJOUDI

LIGM/ESIEE Paris & SIC/ECE Paris

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Outline

Context

What is IoT ?

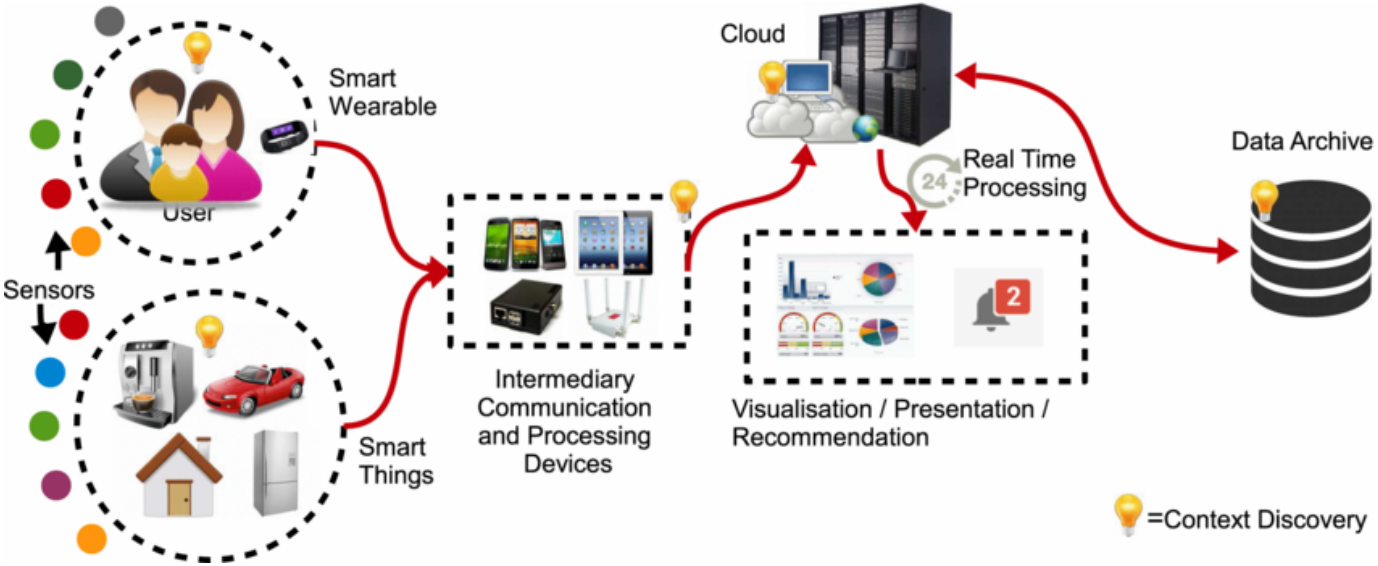

Figure 1: IoT platform.

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

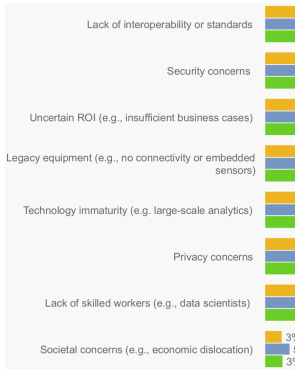

Figure 3: Key b
Industr

[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*)

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

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

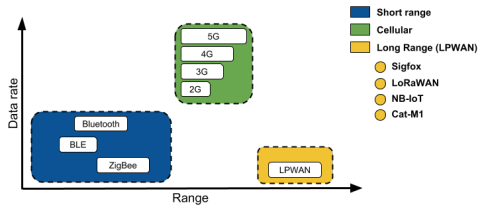

Figure 4: Communication diversity.

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

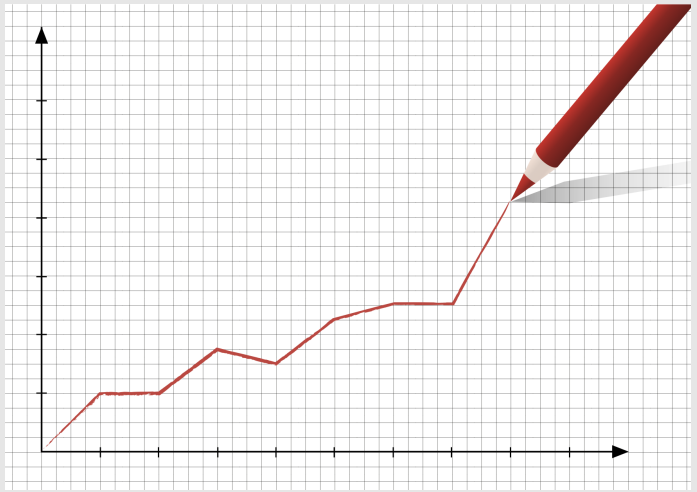

Figure 6: tets.

Contributions

Contributions

- Environnement
  - Rural/Urban
  - Static/Mobile
  -
- Senarios
  - For each service (Smart building:Videos, Voice, Text. Smart trafic: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

Outline

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Related work

Comparison

Paper	A1	A2	A3	A4

Table 2: An example table.

Related work

Comparison

Paper	A1	A2	A3	A4

Table 3: An example table.

Outline

Multi-Armed-Bandit Algorithm

Methods

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

Marcov chain

Methods

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

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

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

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

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

Marcov chain

Methods

HGHG

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

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

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

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

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: $K = \{1, ..., K\}$
- 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 $r_k(s_k, s_{-k})$
  - $s_{-k} = (s_1, \ldots, s_{k-1}, s_{k+1}, \ldots, s_K) \in S_1 \times \ldots \times S_{k-1} \times S_{k+1} \times \ldots \times S_K$

... (step 2)

Methods

... (step 3)

Methods

... (step 4)

Methods

Results

Comparison

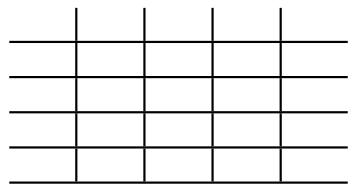

Table 4

Outline

Experimentation

Experimentation

- a
- b

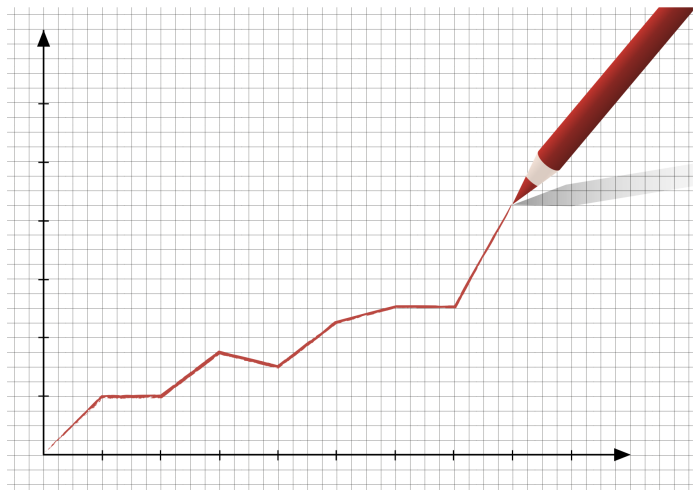

Figure 7: .

Outline

Results

Comparison

- a
- b

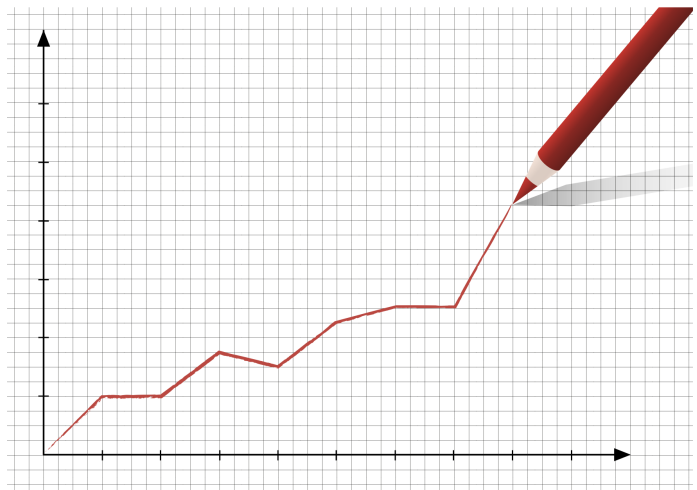

Figure 8: .

Outline

Discussion

- a
- b

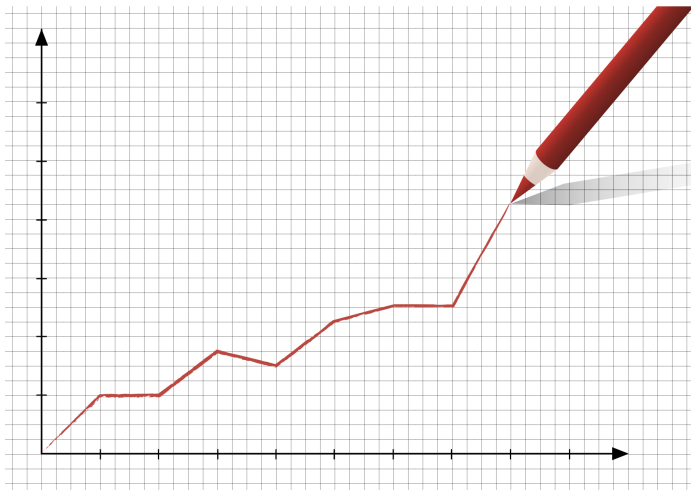

Figure 9: .

Outline

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).