IoT challenges

State of the art

Aghiles DJOUDI

LIGM/ESIEE Paris & SIC/ECE Paris

July 19, 2019

Outline

1. Introduction

2. First contribution

3. Conclusion

Context

What is IoT ?

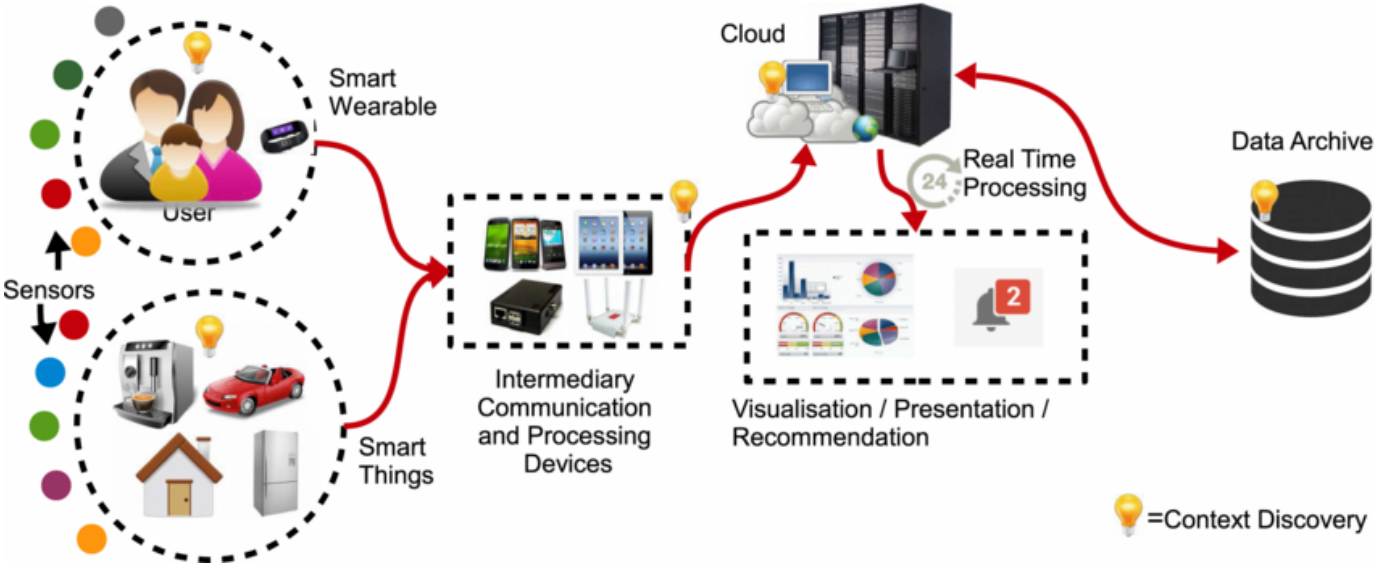

Figure 1: IoT platform.

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

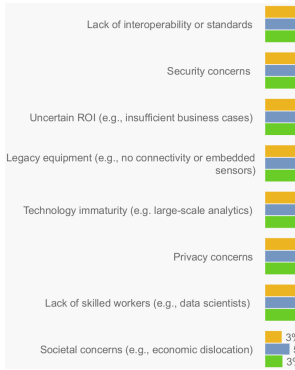

Figure 3: Key b
Industr

[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

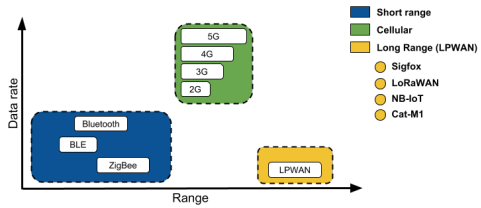

Figure 4: Communication diversity.

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

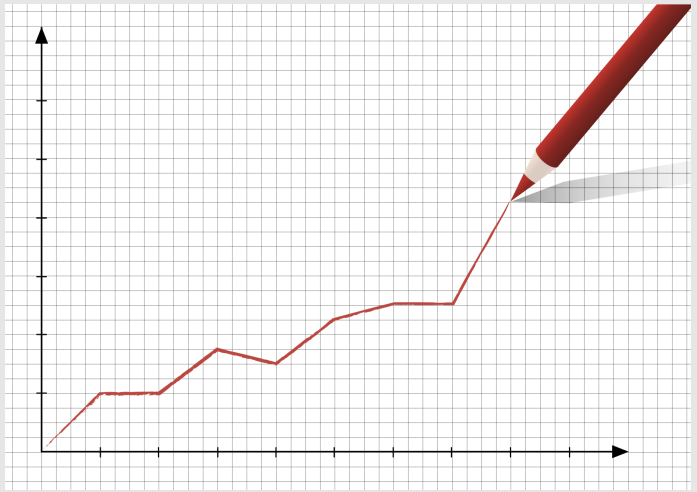

Figure 6: tets.

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

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

Simulation & Real environnement

Outline

1. Introduction

2. First contribution

3. Conclusion

Outline

1. Introduction

2. First contribution
   1. Related work
   2. Contagion process
   3. Experimentation
   4. Results exploitation
   5. Discussion

3. Conclusion

Outline

1. Introduction

2. First contribution

3. Conclusion

1. Related work
2. Contagion process
3. Experimentation
4. Results exploitation
5. Discussion

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

1. Introduction

2. First contribution

3. Conclusion

1. Related work
2. Contagion process
3. Experimentation
4. Results exploitation
5. Discussion

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

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

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

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

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

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

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

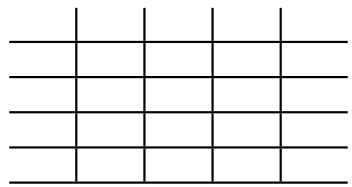

Table 4

Outline

1. Introduction

2. First contribution

3. Conclusion

1. Related work
2. Contagion process
3. Experimentation
4. Results exploitation
5. Discussion

Experimentation

Experimentation

- a
- b

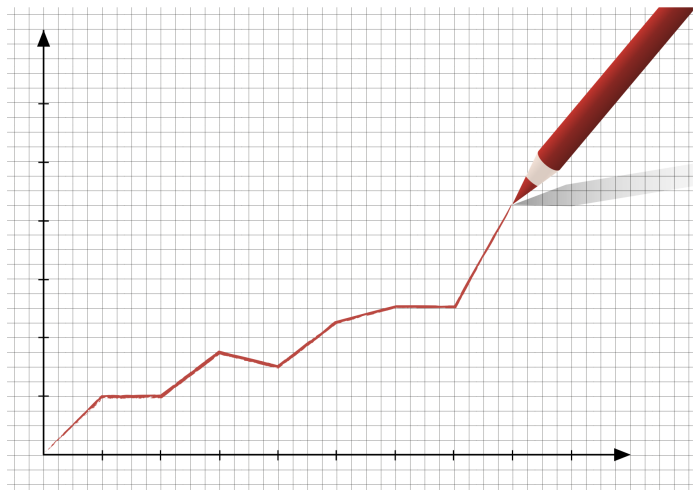

Figure 7: .

Outline

1. Introduction

2. First contribution

3. Conclusion

1. Related work
2. Contagion process
3. Experimentation
4. Results exploitation
5. Discussion

Results

Comparison

- a
- b

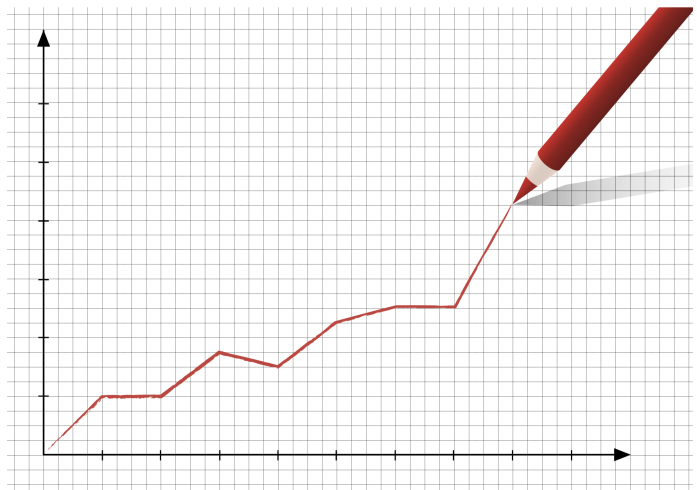

Figure 8: .

Outline

1. Introduction

2. First contribution
   1. Related work
   2. Contagion process
   3. Experimentation
   4. Results exploitation
   5. Discussion

3. Conclusion

Discussion

- a
- b

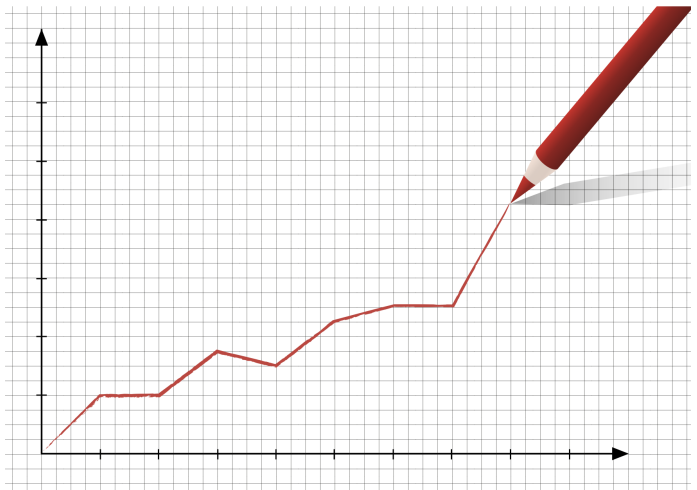

Figure 9: .

Outline

1. Introduction

2. First contribution

3. Conclusion

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).