

# IoT challenges

## State of the art

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August 31, 2019

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Context

What is IoT ?

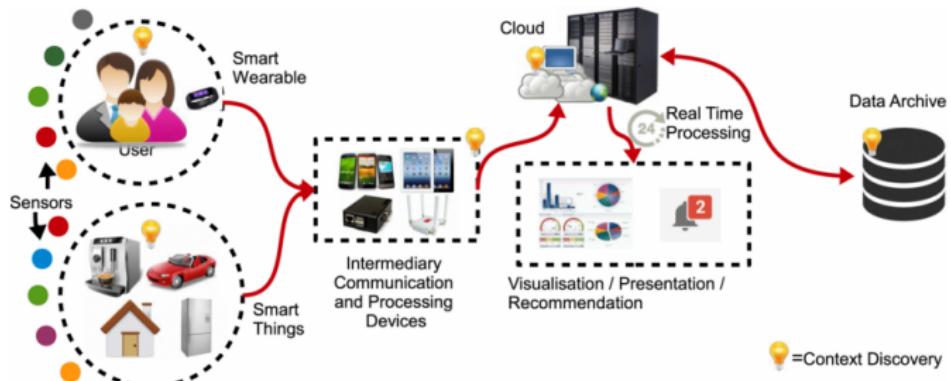


Figure 1: IoT platform.



Figure 2: IoT challenges.

# Context

## Introduction

- ➡ IoT Applications
  - ➡ Health care
  - ➡ **Transportation**
  - ➡ Industry
  - ➡ Market
  - ➡ School
  - ➡ Vehicles
  - ➡ Smart Home
  - ➡ Agriculture



Figure ??: IoT Applications

# Problematic

Where is the problem ?

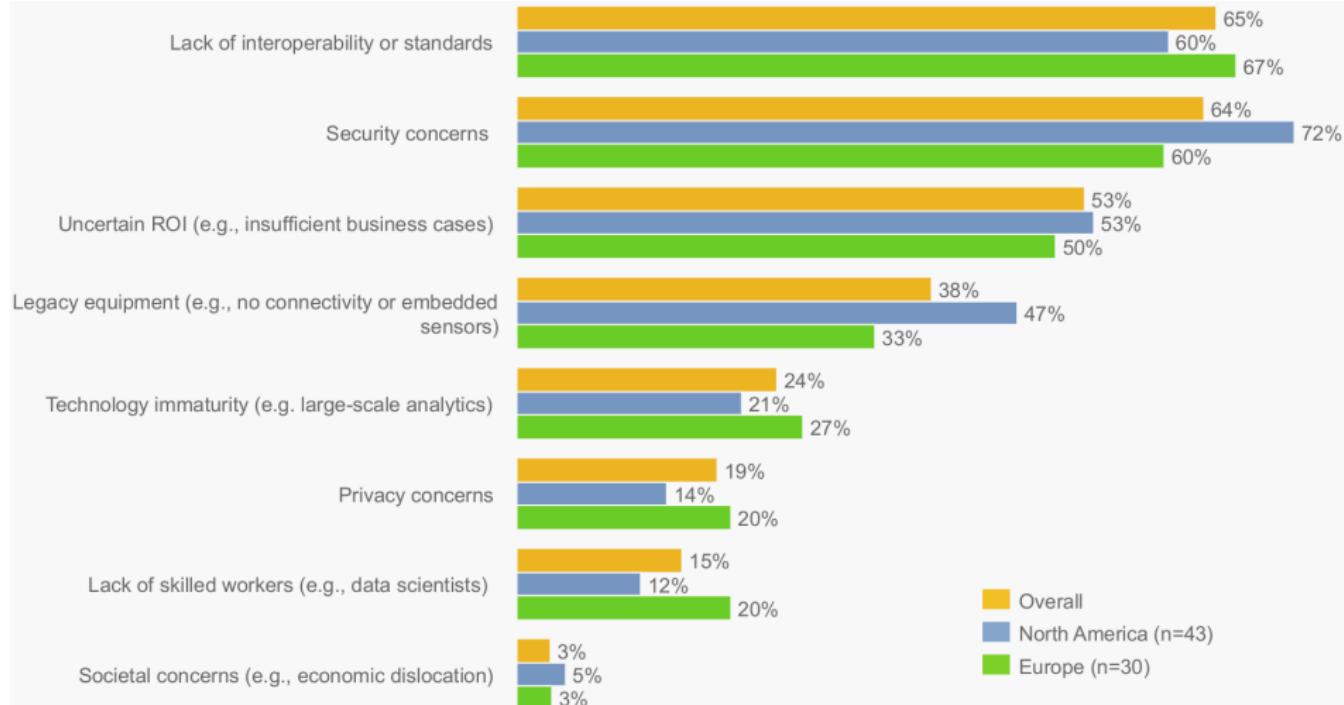


Figure 3: Key barriers in adopting the Industrial Internet [industrialinternetofthings\_executive\_].

# Problematic

Where is the problem ?

- ➡ Some network configuration are static and not adaptive to the application
  - ➡ Decision and optimisation problem..
  - ➡ Various network access
  - ➡ Various configuration of each network access
  - ➡ Lack of selection tools
- ➡ Users have to select the network and the application
  - ➡ How to select the **best** network.
  - ➡ How to select the network required by the application.

# Motivations

Who & why cares with such problems ?

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

## QoS Analysis

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

## Threats

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

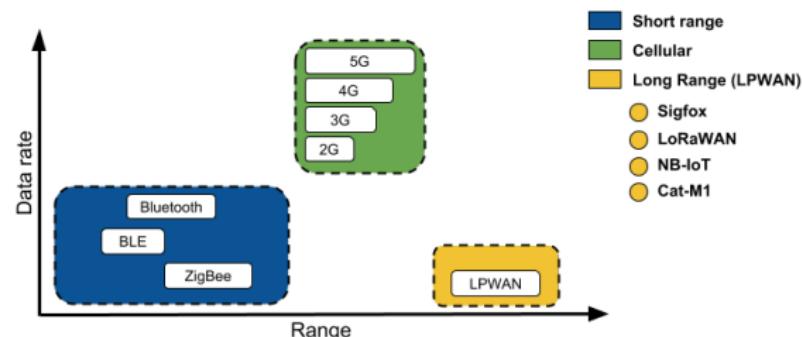


Figure 4: Communication diversity.

# Goal

What is the goal ?

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



Figure 5: wsn-IoT.

# Goal

What is the goal ?

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



Figure 5: wsn-IoT.

## Map the network to service requirement ?

# Challenges

Where is the difficulty ?

- ➡ Reasonable and acceptable delay before the decision appears.
- ➡ Cope with the different view points and goals of the operators and the users.
- ➡ React to the changing environment conditions.
- ➡ Allow any type of inputs and to be applicable to any type of ANs.
- ➡ Handle the increasing number of RATs and the large number of criteria.

# Contributions

## Contributions

- ➡ Use cases (Requirements)
  - ➡ Smart building: Videos, Voice, Text.
  - ➡ Smart traffic: Videos, Voice, Text
- ➡ Environments
  - ➡ 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 requirements
    - \* MAC configuration (SF, CR, BW, ...)
    - \* Network QoS metrics
  - ➡ Method:
    - \* MADM, Game, Neural
  - ➡ Outputs:
    - \* Ranked networks

# Contributions

## Contributions

- ▶ Use cases (Requirements)
  - ▶ Smart building: Videos, Voice, Text.
  - ▶ Smart traffic: Videos, Voice, Text
- ▶ Environments
  - ▶ 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
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    - \* MAC configuration (SF, CR, BW, ...)
    - \* Network QoS metrics
  - ▶ Methods:
    - \* MADM, Game, Neural
  - ▶ Outputs:
    - \* Ranked networks

Theoretical, Simulation & Real environment

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2. Contagion process
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## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 1: An example table.

## Related work

### Comparison

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Table 2: An example table.

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... (step 1)

Methods



... (step 2)

Methods



... (step 3)

Methods



... (step 4)

Methods



# Results

## Comparison


Table 3

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# Experimentation

## Experimentation

- ➡ a
- ➡ b

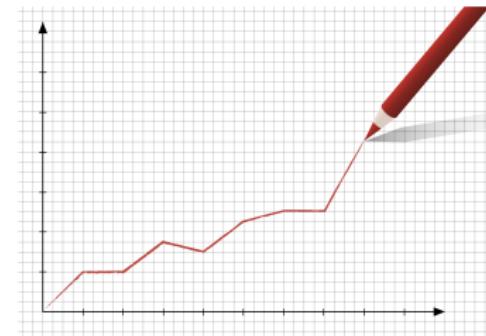


Figure 6: .

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# Results

## Comparison

- ➡ a
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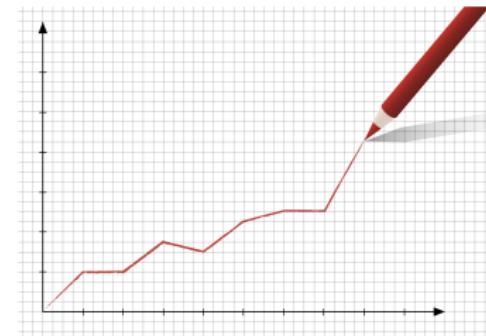


Figure 7: .

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## Discussion

- ➡ a
- ➡ b

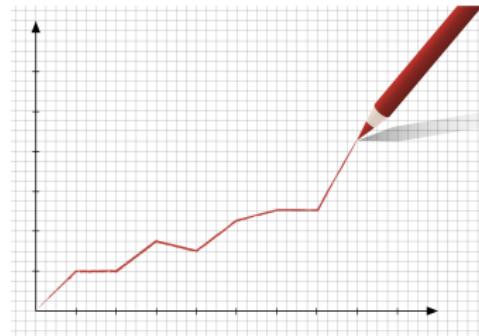


Figure 8: .

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# Problem statement

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- ➡ a
- ➡ b

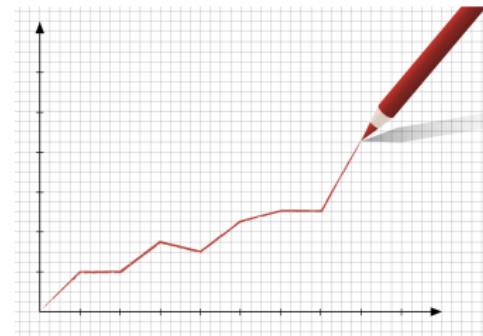


Figure 9: .

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## Related work

### Comparison

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Table 4: An example table.

## Related work

### Comparison

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Table 5: An example table.

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... (step 1)

Methods



... (step 2)

Methods



... (step 3)

Methods



... (step 4)

Methods



# Results

## Comparison


Table 6

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  2. State of the art
  - 3. x-Testbed**
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  7. Template
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# Experimentation

## Experimentation

- ➡ a
- ➡ b

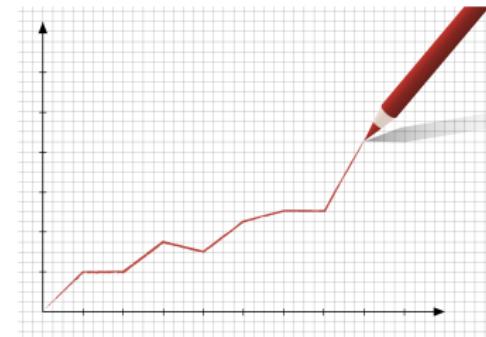


Figure 10: .

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# Results

## Comparison

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- ➡ b

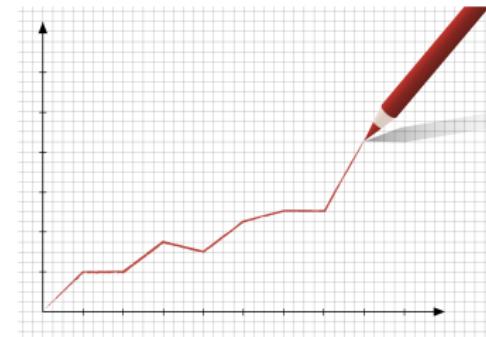


Figure 11: .

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1. Introduction
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- 3. x-Testbed**
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  2. Related work
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## Discussion

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→ b

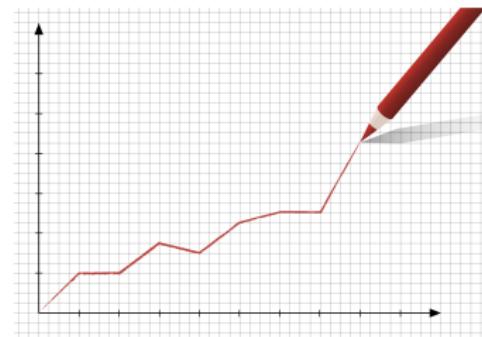


Figure 12: .

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  2. State of the art
  3. x-Testbed
  4. **x-Sentilo**
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
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  11. Privacy Framework
  12. Survey Privacy
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  2. State of the art
  3. x-Testbed
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  5. x-Long paper
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  7. Template
  8. UTLC
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# Problem statement

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- ➡ a
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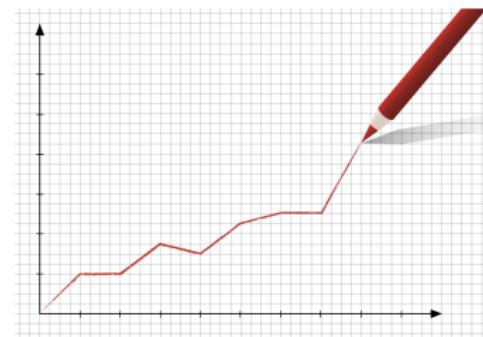


Figure 13: .

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## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 7: An example table.

## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 8: An example table.

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  6. Discussion

... (step 2)

Methods



... (step 3)

Methods



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Methods



# Results

## Comparison


Table 9

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  2. State of the art
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  7. Template
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# Experimentation

## Experimentation

- ➡ a
- ➡ b

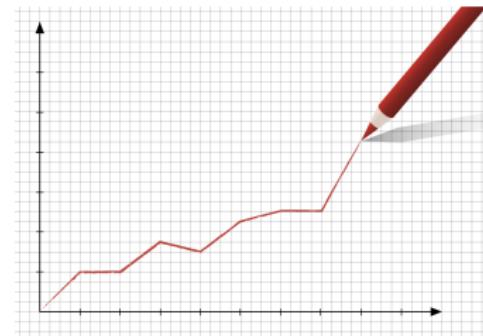


Figure 14: .

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# Results

## Comparison

- ➡ a
- ➡ b

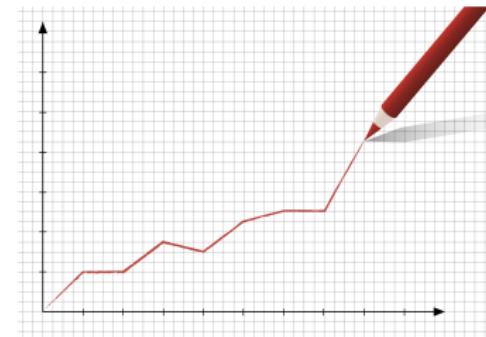


Figure 15: .

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## Discussion

→ a

→ b

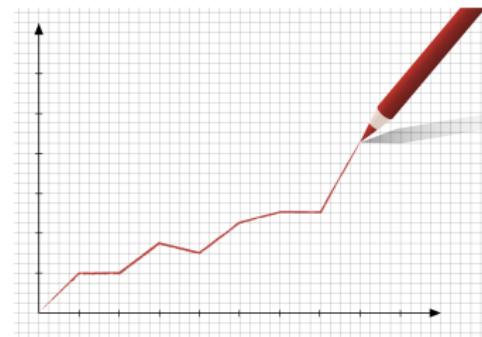


Figure 16: .

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5. x-Long paper
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# Problem statement

## Introduction

- ➡ a
- ➡ b

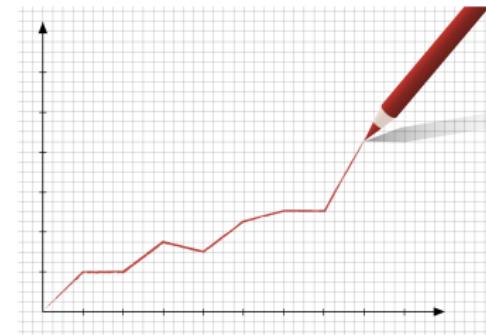


Figure 17: .

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## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 10: An example table.

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Table 11: An example table.

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... (step 1)

Methods



... (step 2)

Methods



... (step 3)

Methods



... (step 4)

Methods



# Results

## Comparison


Table 12

# Outline

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4. x-Sentilo
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# Experimentation

## Experimentation

- ➡ a
- ➡ b

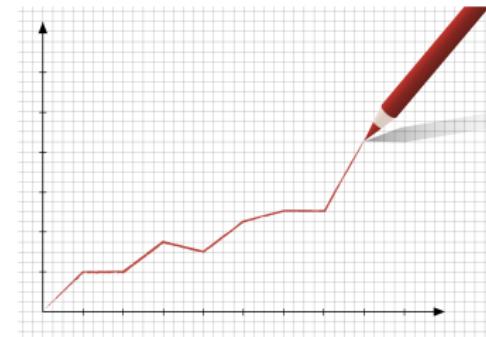


Figure 18: .

# Outline

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# Results

## Comparison

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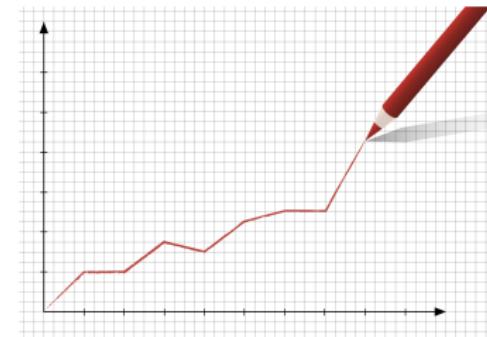


Figure 19: .

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# Discussion

→ a

→ b

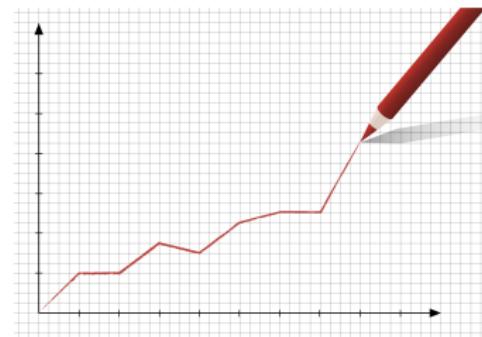


Figure 20: .

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# Problem statement

## Introduction

- ➡ a
- ➡ b

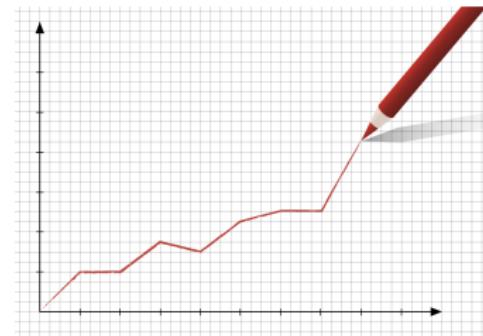


Figure 21: .

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## Related work

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Table 13: An example table.

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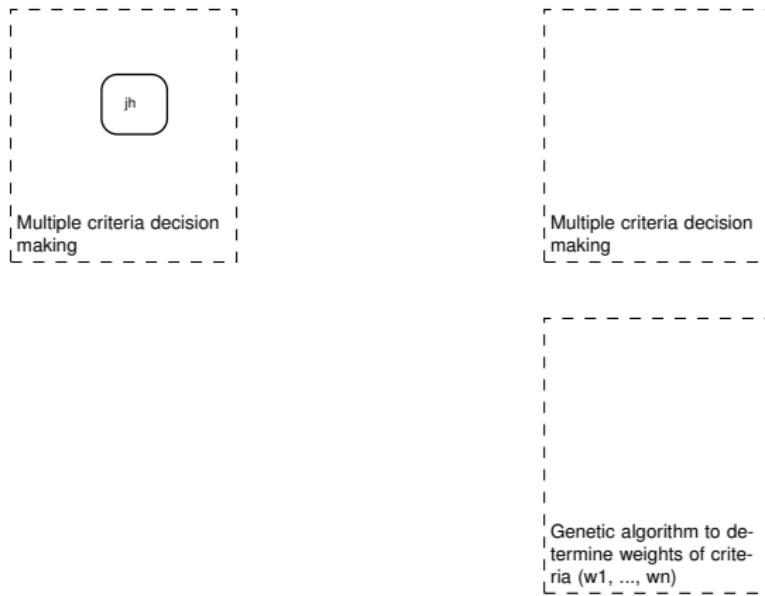
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    6. Discussion
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  12. Survey Privacy
1. **Bandit Algorithm**
  2. Genetic Algorithm
  3. Marcov chain
  4. Game theory

# Multi-Armed-Bandit Algorithm

## Related work

- ▶ 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  $\mu_t^* = \max \mu_t^k, k \in K$

# Binary code analysis: Why?



# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. **Genetic Algorithm For LoRa**
  1. Problem statement
  2. **Related work**
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. Discussion
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Genetic Algorithm

Related work [alkhawlani\_access\_2008a]

- ▶ Heterogeneous wireless network: (RAT 1 ,RAT 2 ,...,RAT n)
- ▶ Criteria up to i ( $c_1, c_2, \dots, c_i$ ) the operators, the applications, and the network conditions.
- ▶
- ▶ The different sets of scores ( $d_1, d_2, \dots, d_i$ ) are sent to the MCDM in the second component.
- ▶ GA component assigns a suitable weight ( $w_1, w_2, \dots, w_i$ )

# Genetic Algorithm

## Related work



→ 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)

\* 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

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. **Genetic Algorithm For LoRa**
    1. Problem statement
    2. **Related work**
    3. Contagion process
    4. Experimentation
    5. Results exploitation
    6. Discussion
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  12. Survey Privacy
1. Bandit Algorithm
  2. Genetic Algorithm
  3. **Marcov chain**
  4. Game theory

# Marcov chain

## Related work

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

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

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

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

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

# Marcov chain

Related work

HGHGJ

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

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

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

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

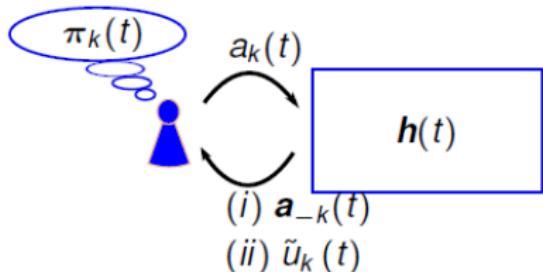
$$BER = 10^{\alpha e^{\beta SNR}} \quad (5)$$

# Marcov chain

## Related work

Learning Iterative Steps:

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



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

$$\pi_k(t) \xrightarrow{t \rightarrow \infty} \pi_k^* \quad (1)$$

$$\bar{u}_k(\pi_k(t), \pi_{-k}(t)) \xrightarrow{t \rightarrow \infty} \bar{u}_k(\pi_k^*, \pi_{-k}^*) \quad (2)$$

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

Figure 22: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. **Genetic Algorithm For LoRa**
  1. Problem statement
  2. **Related work**
    1. Bandit Algorithm
    2. Genetic Algorithm
    3. Marcov chain
    4. **Game theory**
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. Discussion
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Game theory

## Related work

- ▶ 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  $r_k(s_k, s_{-k})$ 
  - ▶  $s_{-k} = (s_1, \dots, s_{k-1}, s_{k+1}, \dots, s_K) \in S_1 \times \dots \times S_{k-1} \times S_{k+1} \times \dots \times S_K$

## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 14: An example table.

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. **Genetic Algorithm For LoRa**
  1. Problem statement
  2. Related work
  - 3. Contagion process**
  4. Experimentation
  5. Results exploitation
  6. Discussion
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

... (step 2)

Methods



... (step 3)

Methods



... (step 4)

Methods



# Results

## Comparison


Table 15

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. **Genetic Algorithm For LoRa**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. **Experimentation**
  5. Results exploitation
  6. Discussion
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# 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

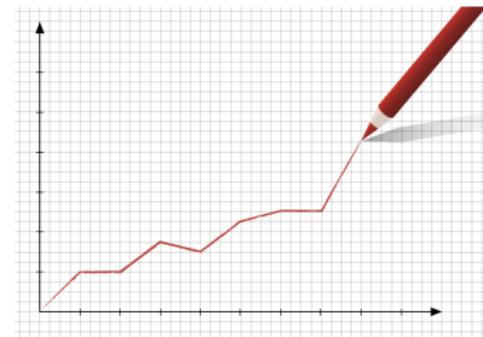


Figure 23: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. **Genetic Algorithm For LoRa**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  - 5. Results exploitation**
  6. Discussion
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Results

## Comparison

- ➡ a
- ➡ b

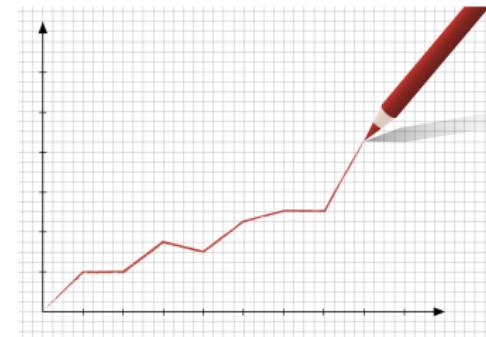


Figure 24: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. **Genetic Algorithm For LoRa**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. **Discussion**
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

## Discussion

→ a

→ b

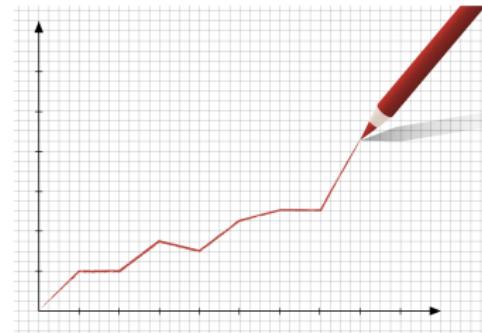


Figure 25: .

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  12. Survey Privacy
1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. Discussion

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
- 7. Template**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. Discussion
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Problem statement

## Introduction

- ➡ a
- ➡ b

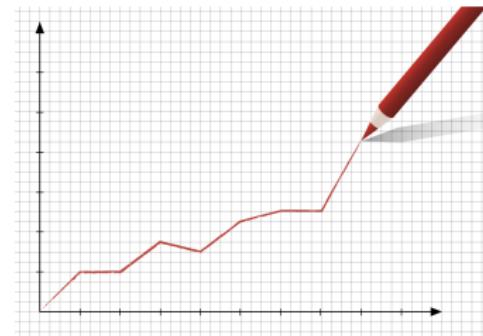


Figure 26: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. **Template**
  1. Problem statement
  2. **Related work**
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. Discussion
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 16: An example table.

## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 17: An example table.

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. **Template**
  1. Problem statement
  2. Related work
  - 3. Contagion process**
  4. Experimentation
  5. Results exploitation
  6. Discussion
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

... (step 1)

Methods



... (step 2)

Methods



... (step 3)

Methods



... (step 4)

Methods



# Results

## Comparison


Table 18

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. **Template**
  - 1. Problem statement
  - 2. Related work
  - 3. Contagion process
  - 4. Experimentation**
  - 5. Results exploitation
  - 6. Discussion
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Experimentation

## Experimentation

- ➡ a
- ➡ b

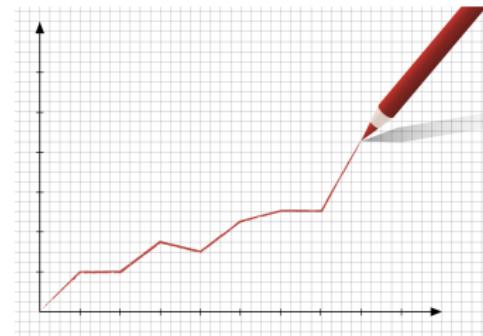


Figure 27: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. **Template**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  - 5. Results exploitation**
  6. Discussion
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Results

## Comparison

■ a

■ b

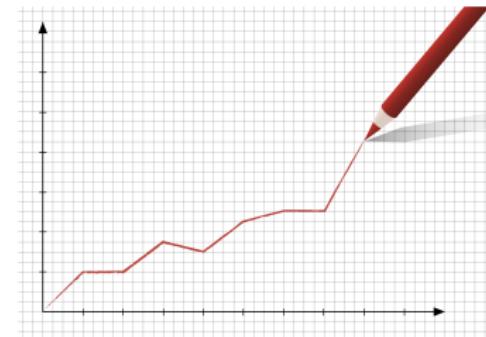


Figure 28: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. **Template**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  - 6. Discussion**
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

## Discussion

→ a

→ b

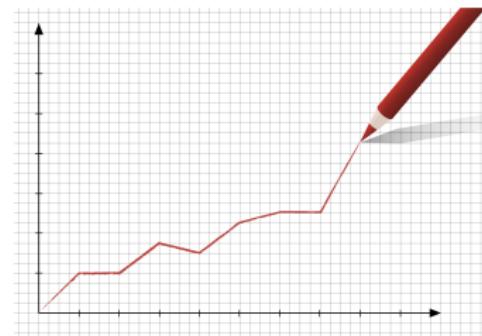


Figure 29: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
8. UTLC
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. Discussion
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
- 8. UTLC**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. Discussion
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Problem statement

## Introduction

- ➡ a
- ➡ b

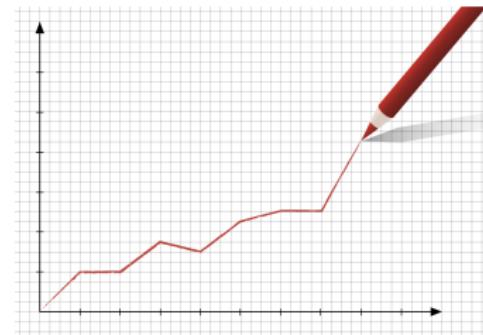


Figure 30: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
- 8. UTLC**
  1. Problem statement
  - 2. Related work**
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  6. Discussion
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 19: An example table.

## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 20: An example table.

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
- 8. UTLC**
  1. Problem statement
  2. Related work
  - 3. Contagion process**
  4. Experimentation
  5. Results exploitation
  6. Discussion
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

... (step 1)

Methods



... (step 2)

Methods



... (step 3)

Methods



... (step 4)

Methods



# Results

## Comparison


Table 21

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
- 8. UTLC**
  1. Problem statement
  2. Related work
  3. Contagion process
  - 4. Experimentation**
  5. Results exploitation
  6. Discussion
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Experimentation

## Experimentation

- ➡ a
- ➡ b

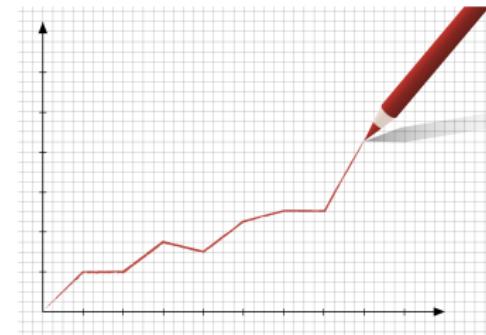


Figure 31: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
- 8. UTLC**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  - 5. Results exploitation**
  6. Discussion
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Results

## Comparison

- ➡ a
- ➡ b

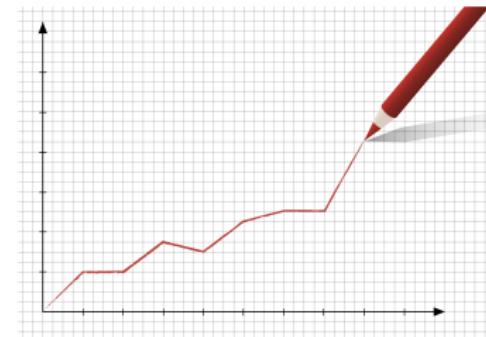


Figure 32: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
- 8. UTLC**
  1. Problem statement
  2. Related work
  3. Contagion process
  4. Experimentation
  5. Results exploitation
  - 6. Discussion**
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

## Discussion

→ a

→ b

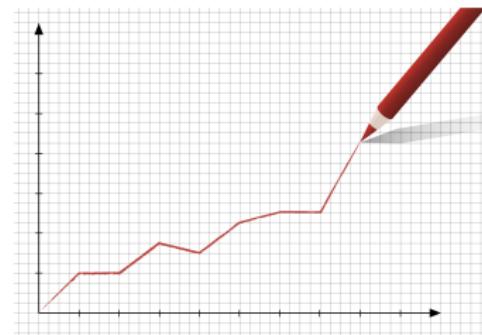


Figure 33: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
8. UTLC
- 9. Conclusion**
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# 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 !

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  12. Survey Privacy
1. Related work
  2. Diffusion process
  3. Experimentation
  4. Results
  5. Discussion

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  - 10. Social privacy score**
  11. Privacy Framework
  12. Survey Privacy
- 1. Related work**
  2. Diffusion process
  3. Experimentation
  4. Results
  5. Discussion

## Related work

### Comparison

Works	Contribution	Goal
[1] Protect U	Classification of interlocutors	Friends lists management
[2] Privacy Wizard	Friends Classification	Permission Configuration
[3] SocialMarket	Common Interests	Assessment of Trust Relationships
[4] PARE	Information Leakage	Evaluation of Information Dissemination
[5] LENS	Spam Protection	Trusted Emitters Evaluation
[6] SocialEmail	Classify msg by paths	Evaluate message reliability
[7] Privacy Index	Visibility, sensitivity	Msg exposure assessment

Table 22: Contributions from existing work.

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
8. UTLC
9. Conclusion
- 10. Social privacy score**
11. Privacy Framework
12. Survey Privacy

## Step 1: Individual vulnerability measurement

### Method

Parameter	Value
Network connection	Private, Public [1:2]
Technology	Ethernet, 5G, 4G, Wifi [1:4]
Operating system	Windows, Unix, Mac [1:3]
Web browser	Firefox, Chrome, Opera, ... [1:10]
Password strength	low, medium, strength [1:3]
Sessions opened	counter [1:10]
TLS version	v1.0, v1.1, v1.2, v1.3 [1:4]

Table 23: Individual Vulnerability parameter

$$Y = \sum_i^n \frac{w * V}{n} \quad (6)$$

- **Y:** Individual vulnerability
- **w:** Weight of each vulnerability
- **V:** Scores mentioned above

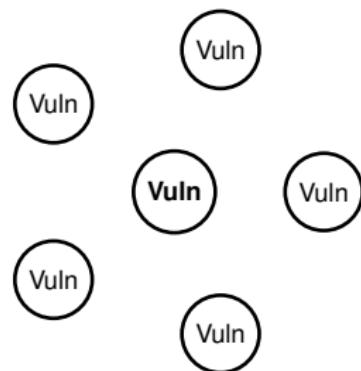


Figure 34: Individual vulnerability level.

## Step 2: Users reputation estimation

### Method

Parameter	Value
Frequency of msg exchanged	continuous
Discussion time	continuous
% of messages exchanged	cipher, signed or clear [1:3]
Message type exchanged	Text, images, videos, script [1:4]

Table 24: Trust grant features

$$\alpha = P(\text{reputation}) = P(X \geq 1) = 1 - (1 - P(\text{trust}))^n \quad (7)$$

- » Where,
  - » **X:** trust grant, random variable,  $X \sim B(n,p)$
  - » **n:** deg(node)
  - » **P(X=1):** The probability of being assigned one trust grant by an interlocutor

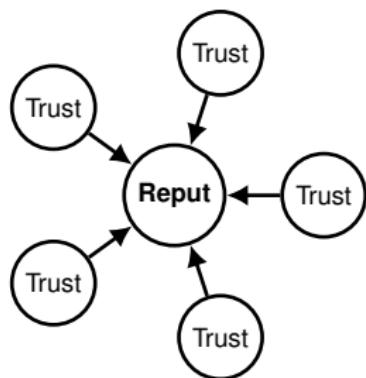


Figure 35: Reputation level.

## Step 3: Social vulnerability measurement

Freidkin's theory of social influence

- Input (Features):

- $Y^{(1)}$  = Vector of the individual vulnerabilities of N users (eq 9)
- $\alpha$  = The level of reputation (influence) of each user (eq 10)
- $M$  = Adjacency matrix  $N \times N$

- Model:

$$Y^{(t)} = \alpha M Y^{(t-1)} + (1 - \alpha) Y^{(t-1)} \quad (8)$$

- Output:

- $Y^{(t)}$  = Vector of the social vulnerabilities of the N users

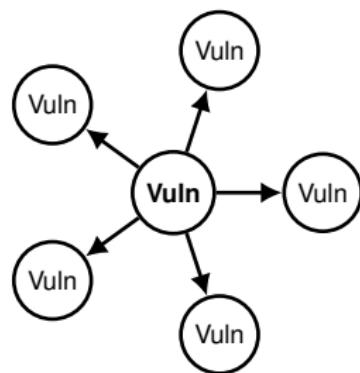


Figure 36: Social vulnerability.

## Step 3: Social vulnerability measurement

Freidkin's theory of social influence

Formal properties of the model:

- When a user's influence is high, the model is reduced to:
  - average vulnerabilities of his friends weighted by their trust levels.

$$Y^{(t)} = \mathbf{1} * \mathbf{M} Y^{(t-1)} + (1 - \mathbf{1}) Y^{(t-1)} \quad (11)$$

$$Y^{(t)} = \mathbf{M} Y^{(t-1)}$$

- In the absence of influence, the model is reduced to:
  - his own vulnerability weighted by the level of mistrust of his friends

$$Y^{(t)} = 0 * \mathbf{M} Y^{(t-1)} + (1 - 0) Y^{(t-1)} \quad (11)$$

$$Y^{(t)} = Y^{(t-1)}$$

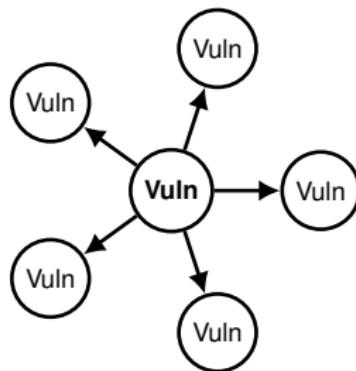


Figure 37: Social vulnerability.



# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  - 10. Social privacy score**
  11. Privacy Framework
  12. Survey Privacy
1. Related work
  2. Diffusion process
  - 3. Experimentation**
  4. Results
  5. Discussion

# Email datasets

## Experimentation

Parameter	Value
Users	958
Messages	6966
Diameter	958
# of msg on average	2.413361
Msg density	0.00252
Modularity	0.654600
Average distance	3.042114

Table 25: Enron dataset properties.



Figure 38: Enron logo.

Parameter	Value
Users	5885
Messages	26547
Diameter	2096
# of msg on average	9.02192
Msg density	0.001533
Modularity	0.86526
Average distance	3.914097

Table 26: Caliopen dataset properties.



Figure 39: Caliopen logo.

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
8. UTLC
9. Conclusion
- 10. Social privacy score**
11. Privacy Framework
12. Survey Privacy

1. Related work
2. Diffusion process
3. Experimentation
- 4. Results**
5. Discussion

# Results

## Comparison

Initial values:

- generated randomly (normal distribution)
- represent individual vulnerabilities.
- dark color = highly infected



(a) Individual privacy vulnerability.

(b) Social privacy vulnerability.

Final values:

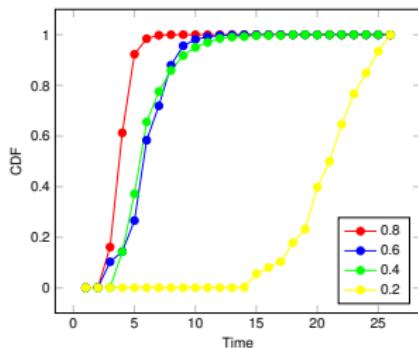
- obtained after convergence.
- represent social vulnerabilities.

Figure 40: Individual & Social privacy vulnerabilities.

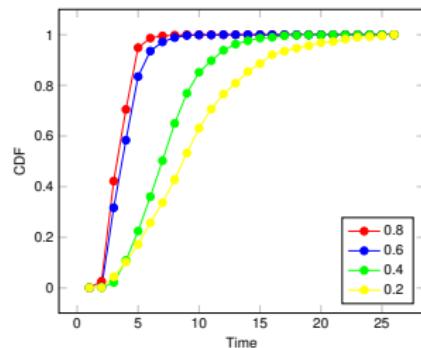
User ID	Individual Vul	Social Vul
34	0.84	0.67
67	0.12	0.87
206	0.76	0.33
588	0.23	0.78

Table 27: Individual and social privacy vulnerabilities.

## Results exploitation



(a) Enron dataset.

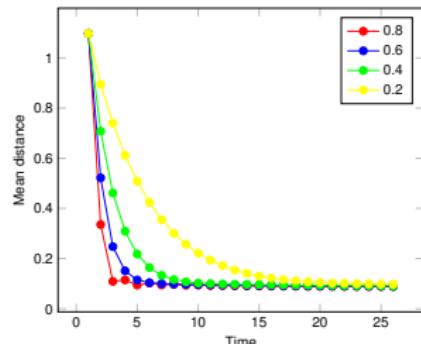


(b) Caliopen dataset.

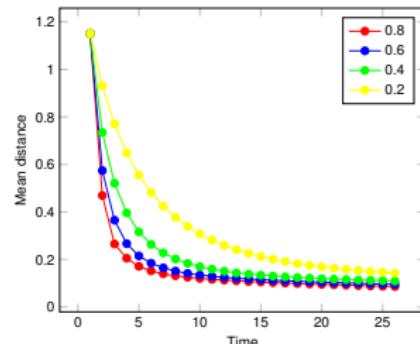
Figure 41: Cumulative distribution function of infected users.

- ▶ Figures shows the CDF of the vulnerability diffusion process.
- ▶ The vulnerability diffusion process increases as the reputation level of vulnerable users increases.
- ▶ Users with high reputation values contribute significantly to the diffusion
  - ▶ They spread their vulnerabilities quickly and widely through the network.

## Results exploitation



(a) Enron dataset.



(b) Caliopen dataset.

Figure 42: Convergence of the diffusion process.

- ▶ The process converge when the mean distance between social vulnerability scores is the minimum.
- ▶ Assigning trust to vulnerable users allows them to achieve a high level of reputation.
- ▶ Consequently, they infect all other vulnerability values.

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
  1. Related work
  2. Diffusion process
  3. Experimentation
  4. Results
  - 5. Discussion**
7. Template
8. UTLC
9. Conclusion
- 10. Social privacy score**
11. Privacy Framework
12. Survey Privacy

## Discussion

- ➡ The purpose of this work is to simulate a diffusion process of individual vulnerabilities.
  - ➡ The vulnerability of one user is the vulnerability of all users.
  - ➡ At the end of the diffusion (convergence), all users gets their social vulnerability scores.
- ➡ Future work
  - ➡ To propose mechanisms to improve the reputation of non-vulnerable users.
    - \* Suggest well known interlocutors with acceptable vulnerability scores.
  - ➡ To propose mechanisms to improve the vulnerability of reputed users.
    - \* recommend configurations and softwares.

## Discussion

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    - \* recommend configurations and softwares.

Thank you

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
  - 1. Travaux connexes
  - 2. Processus de diffusion
  - 3. Expérimentation
  - 4. Exploitation des résultats
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
12. Survey Privacy

## **1. Travaux connexes**

2. Processus de diffusion
3. Expérimentation
4. Exploitation des résultats

# Travaux connexes

## Comparaison

Travaux	Contribution	Performance
[1] Protect U	Classification des interlocuteurs	Configuration des listes d'amis
[2] Privacy Wizard	Classification des interlocuteurs	Configuration des permissions
[3] SocialMarket	Intérêt communs	Évaluation des relations de confiance
[4] TAPE	Fuite d'information	Évaluation de la diffusion de l'info
[5] LENS	Protection anti-spam	Évaluation des émetteurs de confiance
[6] SocialEmail	Classer les chemins des msg	Évaluation de la fiabilité du message
[7] Privacy Index	Visibilité, sensibilité	Évaluation de l'exposition des msg

Table 28: Contributions des travaux existants.

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  - 11. Privacy Framework**
  12. Survey Privacy
1. Travaux connexes
  - 2. Processus de diffusion**
  3. Expérimentation
  4. Exploitation des résultats

# Etape 1: Calcule de la vulnérabilité individuelle

## Méthode

### ➡ Entrée:

#### ➡ Vulnérabilité de la machine utilisée:

- \* Connexion réseaux (privé (1) ou publique (2))
- \* Type d'architecture: Ethernet, 5G, 4G, Wifi (1:4)
- \* Système d'exploitation (Windows, Unix) (1:2)
- \* Navigateur web (1:10)

#### ➡ Vulnérabilité du compte utilisé

- \* Mdp utilisé, mode de récupération des mdp (1:5)
- \* Nombre de sessions ouvertes en même temps.(1:nbr)
- \* Mode de chiffrement, signature, version TLS

### ➡ Sortie:

$$P_i = \sum_i^n \frac{w * V}{n} \quad (9)$$

## Etape 2: Calcule de la réputation des utilisateurs

### Méthode

#### ➡ Entrée:

- Fréquence d'utilisation de la messagerie.
- Horaire, durée des échanges (1:5)
- % des échanges chiffrés, signés, claires (1:3)
- Importance des interlocuteurs: Liste favoris (2), noir(1)
- Type de données: Texte, images, vidéos, script (1:4)

#### ➡ Méthode:

- Loi binomiale

#### ➡ Output:

$$P(\text{reputation}) = P(X \geq 1) = 1 - (1 - P(\text{trust}))^n \quad (10)$$

- Where,

\* X: Niveau de confiance,  $X \sim B(n, p)$

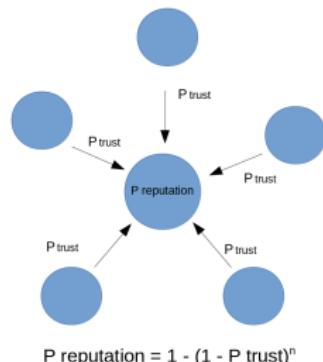


Figure 43: Niveau de réputation.

## Etape 3: Calcule de la vulnérabilité sociale

Théorie de l'influence sociale de Freidkin

### ➡ Entrée:

- $Y^{(1)}$  = Vecteur des vulnérabilités individuelles de N utilisateurs (eq 9)
- $\alpha$  = Le niveau de réputation (d'influence) de chaque utilisateur (eq 10)
- $M$  = Matrice d'adjacence  $N \times N$

### ➡ Modèle:

$$Y^{(t)} = \alpha M Y^{(t-1)} + (1 - \alpha) Y^{(t-1)} \quad (11)$$

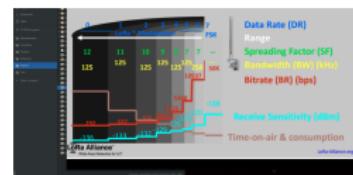


Figure 44: Vulnérabilité Sociale.

### ➡ Sortie:

- $Y^{(t)}$  = Vecteur des vulnérabilités sociales des N utilisateurs



## Etape 3: Calcule de la vulnérabilité sociale

Théorie de l'influence sociale de Freidkin

Propriétés formelles du modèle:

- Lorsque l'influence d'un utilisateur est élevé, le modèle se réduit aux:
  - vulnérabilités moyennes de ses amis pondérées par leur niveaux de confiances.

$$Y^{(t)} = 1 * M Y^{(t-1)} + (1 - 1) Y^{(t-1)} \quad (11)$$
$$Y^{(t)} = M Y^{(t-1)}$$

- En absence d'influence, le modèle se réduit à:

- sa propre vulnérabilité pondérée par le niveau de méfiance de ses amis

$$Y^{(t)} = 0 * M Y^{(t-1)} + (1 - 0) Y^{(t-1)} \quad (11)$$
$$Y^{(t)} = Y^{(t-1)}$$

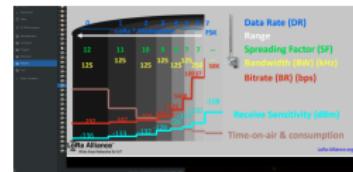


Figure 45: Vulnérabilité sociale.

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  - 11. Privacy Framework**
  12. Survey Privacy
1. Travaux connexes
  2. Processus de diffusion
  - 3. Expérimentation**
  4. Exploitation des résultats

# Expérimentation

## Expérimentation

Paramètre	Valeur
Utilisateurs	958
Messages	6966
Diamètre	958
# de msg en moyenne	2.413361
Densité des msg	0.00252
Modularité	0.654600
Distance moyenne	3.042114

Table 29: Propriétés des données Enron.



Figure 46: Enron logo.

Paramètre	Valeur
Utilisateurs	5885
Messages	26547
Diamètre	2096
# de msg en moyenne	9.02192
Densité des msg	0.001533
Modularité	0.86526
Distance moyenne	3.914097

Table 30: Propriétés des données Caliopen.



Figure 47: Caliopen logo.

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  - 11. Privacy Framework**
  12. Survey Privacy
1. Travaux connexes
  2. Processus de diffusion
  3. Expérimentation
  - 4. Exploitation des résultats**

# Résultats

## Comparaison

Valeurs initiales:

- générées aléatoirement (distribution normale)
- représentent les vulnérabilités individuelles.
- couleur foncée = vulnérabilité élevé



(a) Vulnérabilité individuelle.

(b) Vulnérabilité Sociale.

Valeurs finales:

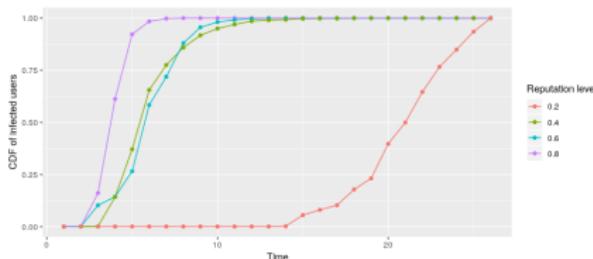
- obtenu après convergence.
- représentent les vulnérabilités sociales.

Figure 48: Vulnérabilité individuelle & sociale.

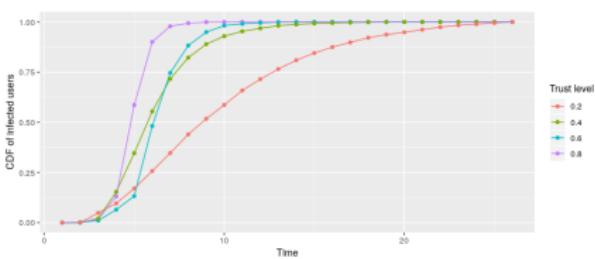
User ID	Vul individuel	Vul sociale
34	0.84	0.67
67	0.12	0.87
206	0.76	0.33
588	0.23	0.78

Table 31: Différence entre les vulnérabilités individuelles et sociales en matière de protection de la vie privée.

# Exploitation des résultats



(a) Les données de Enron.

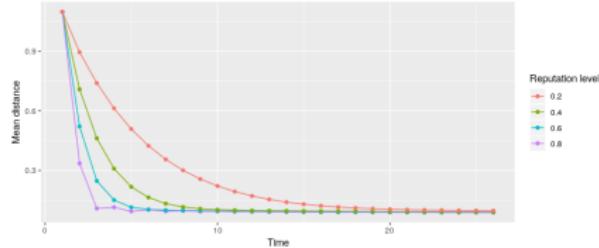


(b) Les données de Caliopen.

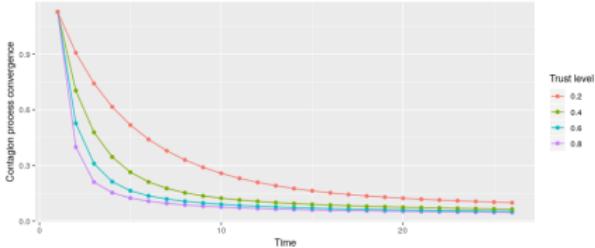
Figure 49: Fonction de distribution cumulative des utilisateurs infectés.

- ▶ Les utilisateurs avec des valeurs de réputation élevées contribuent considérablement à la diffusion
- ▶ Ils diffusent leur vulnérabilités rapidement et largement dans la messagerie.

# Exploitation des résultats



(a) Les données de Enron.



(b) Les données de Caliopen.

Figure 50: Convergence du processus de diffusion.

- Attribuer une confiance à des utilisateurs vulnérables leur permet d'obtenir un niveau de réputation élevé.
- Par conséquent, infecter l'ensemble des valeurs de vulnérabilité de la messagerie.

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  12. Survey Privacy
1. Related work
  2. Contagion process
  3. Experimentation
  4. Results exploitation
  5. Discussion

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  - 12. Survey Privacy**
- 1. Related work**
  2. Contagion process
  3. Experimentation
  4. Results exploitation
  5. Discussion

## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 32: An example table.

## Related work

### Comparison

Paper	A1	A2	A3	A4

Table 33: An example table.

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  - 12. Survey Privacy**
1. Related work
  - 2. Contagion process**
  3. Experimentation
  4. Results exploitation
  5. Discussion

... (step 1)

Methods



... (step 2)

Methods



... (step 3)

Methods



... (step 4)

Methods



# Results

## Comparison


Table 34

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  - 12. Survey Privacy**
1. Related work
  2. Contagion process
  - 3. Experimentation**
  4. Results exploitation
  5. Discussion

# Experimentation

## Experimentation

- ➡ a
- ➡ b

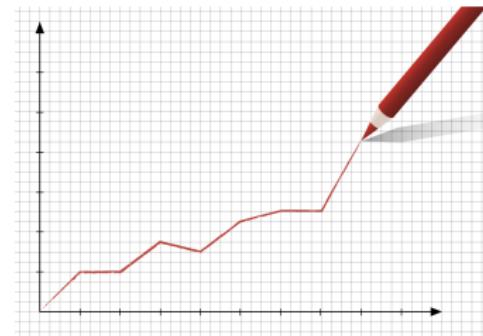


Figure 51: .

# Outline

1. Introduction
  2. State of the art
  3. x-Testbed
  4. x-Sentilo
  5. x-Long paper
  6. Genetic Algorithm For LoRa
  7. Template
  8. UTLC
  9. Conclusion
  10. Social privacy score
  11. Privacy Framework
  - 12. Survey Privacy**
1. Related work
  2. Contagion process
  3. Experimentation
  - 4. Results exploitation**
  5. Discussion

# Results

## Comparison

- ➡ a
- ➡ b

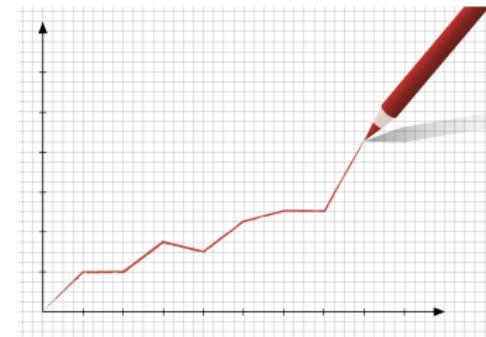


Figure 52: .

# Outline

1. Introduction
2. State of the art
3. x-Testbed
4. x-Sentilo
5. x-Long paper
6. Genetic Algorithm For LoRa
  1. Related work
  2. Contagion process
  3. Experimentation
  4. Results exploitation
  - 5. Discussion**
7. Template
8. UTLC
9. Conclusion
10. Social privacy score
11. Privacy Framework
- 12. Survey Privacy**

## Discussion

→ a

→ b

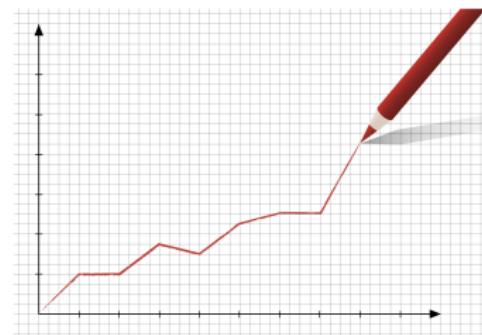


Figure 53: .

# References

- [1] Ala Eddine Gandouz. " PROTECT\_U: Un Systeme Communautaire Pour La Protection Des Usagers de Facebook ". In: (2012). 00001, p. 77.
- [2] Lujun Fang and Kristen LeFevre. " Privacy Wizards for Social Networking Sites ". In: 00397. ACM Press, 2010, p. 351.
- [3] Davide Frey, Arnaud Jégou, and Anne-Marie Kermarrec. " Social Market: Combining Explicit and Implicit Social Networks ". In: *Stabilization, Safety, and Security of Distributed Systems. Symposium on Self-Stabilizing Systems. Lecture Notes in Computer Science. 00019*. Springer, Berlin, Heidelberg, Oct. 10, 2011, pp. 193–207.
- [4] Yongbo Zeng et al. " A Study of Online Social Network Privacy Via the TAPE Framework ". In: *IEEE Journal of Selected Topics in Signal Processing 9.7* (Oct. 2015). 00003, pp. 1270–1284.
- [5] Sufian Hameed et al. " LENS: Leveraging Social Networking and Trust to Prevent Spam Transmission ". In: *Network Protocols (ICNP), 2011 19th IEEE International Conference On. 00019*. IEEE, 2011, pp. 13–18.
- [6] Thomas Tran, Jeff Rowe, and S. Felix Wu. " Social Email: A Framework and Application for More Socially-Aware Communications ". In: *Social Informatics*. Ed. by Leonard Bolc, Marek Makowski, and Adam Wierzbicki. Vol. 6430. 00000. Berlin, Heidelberg: Springer Berlin Heidelberg, 2010, pp. 203–215.
- [7] Raj Kumar Nepali and Yong Wang. " SONET: A SOcial NETwork Model for Privacy Monitoring and Ranking ". In: 00021. IEEE, July 2013, pp. 162–166.