

Valorisation de publication

Pourquoi faire une these ?

Aghiles DJOUDI

PhD student
LIGM/ESIEE Paris & SIC/ECE Paris

September 10, 2019

What is IoT ?

Context

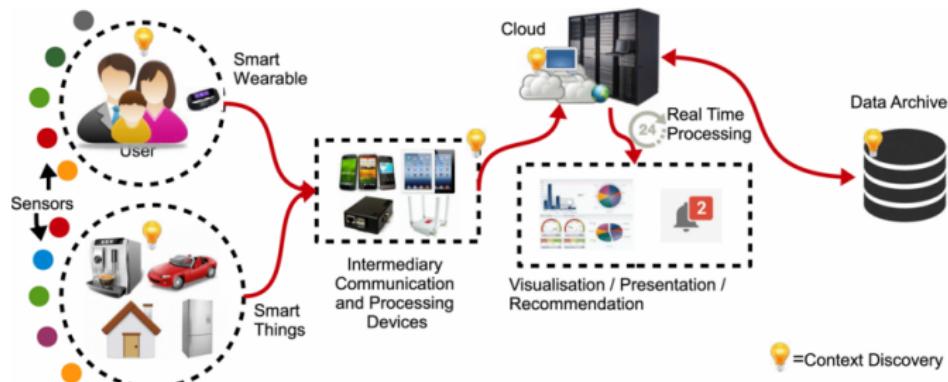


Figure 1: IoT platform.



Figure 2: IoT challenges.

IoT Applications requirements

Context

Challenges-Applications	Grids	EHealth	Transport	Cities	Building
Resources constraints	✗	✓	✗	-	✗
Mobility	✗	-	✓	✓	✗
Heterogeneity	-	-	-	✓	✗
Scalability	✓	-	✓	✓	-
QoS constraints	-	-	✓	✓	✓
Data management	-	✗	✓	✓	-
Standardization	-	-	-	-	✓
Amount of attacks	✗	✗	✓	✓	✓
Safety	-	-	✓	-	✓

Table 1: Main IoT challenges[1] ✓[2]



Figure 3: IoT Applications.

IoT Applications requirements

Context

Use Case	Packet rate () [packet/day]	Minimum success rate (Ps,min)	Grouping
Wearables	10	90	Group A PL = 10/20B
Smoke Detectors	2	90	
Smart Grid	10	90	
White Goods	3	90	
Waste Management	24	90	
VIP/Pet Tracking	48	90	Group B PL = 50B
Smart Bicycle	192	90	
Animal Tracking	100	90	
Environmental Monitoring	5	90	
Asset Tracking	100	90	
Smart Parking	60	90	
Alarms/Actuators	5	90	
Home Automation	5	90	
Machinery Control	100	90	
Water/Gas Metering	8	90	Group C PL = 100/200B
Environmental Data Collection	24	90	
Medical Assisted Living	8	90	
Microgeneration	2	90	
Safety Monitoring	2	90	
Propane Tank Monitoring	2	90	
Stationary Monitoring	4	90	
Urban Lighting	5	90	
Vending Machines Payment	100	90	
Vending Machines General	1	90	Group D PL = 1KB

Table 2: Application requirements for the use cases of interest [3] [2].

Wireless communication

Context

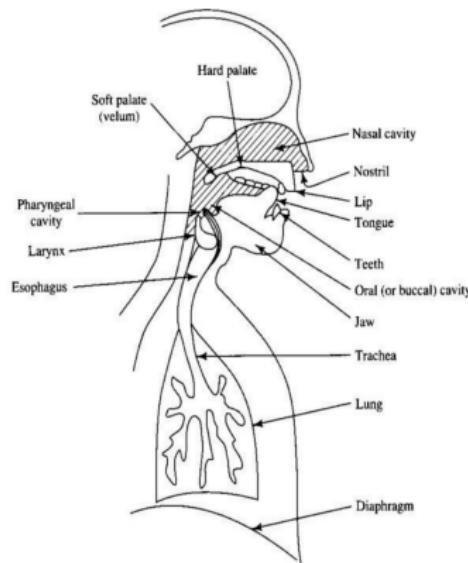


Figure 4: Human voice.

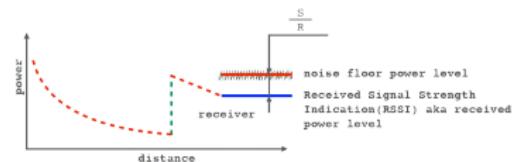


Figure 5: SNR.

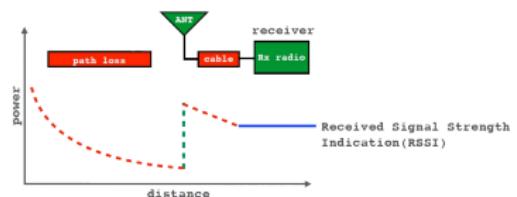


Figure 6: RSSI.

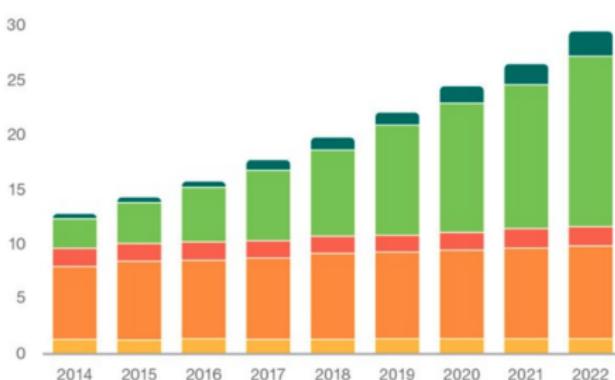


Figure 7: Time on air.

IoT devices

Context

Connected devices (billions)



	2016	2022	CAGR
Wide-area IoT	0.4	2.1	30%
Short-range IoT	5.2	16	20%
PC/laptop/tablet	1.6	1.7	0%
Mobile phones	7.3	8.6	3%
Fixed phones	1.4	1.3	0%
	16 billion	29 billion	10%



Figure 8: IoT devices [4].

Problematic

Where is the problem ?

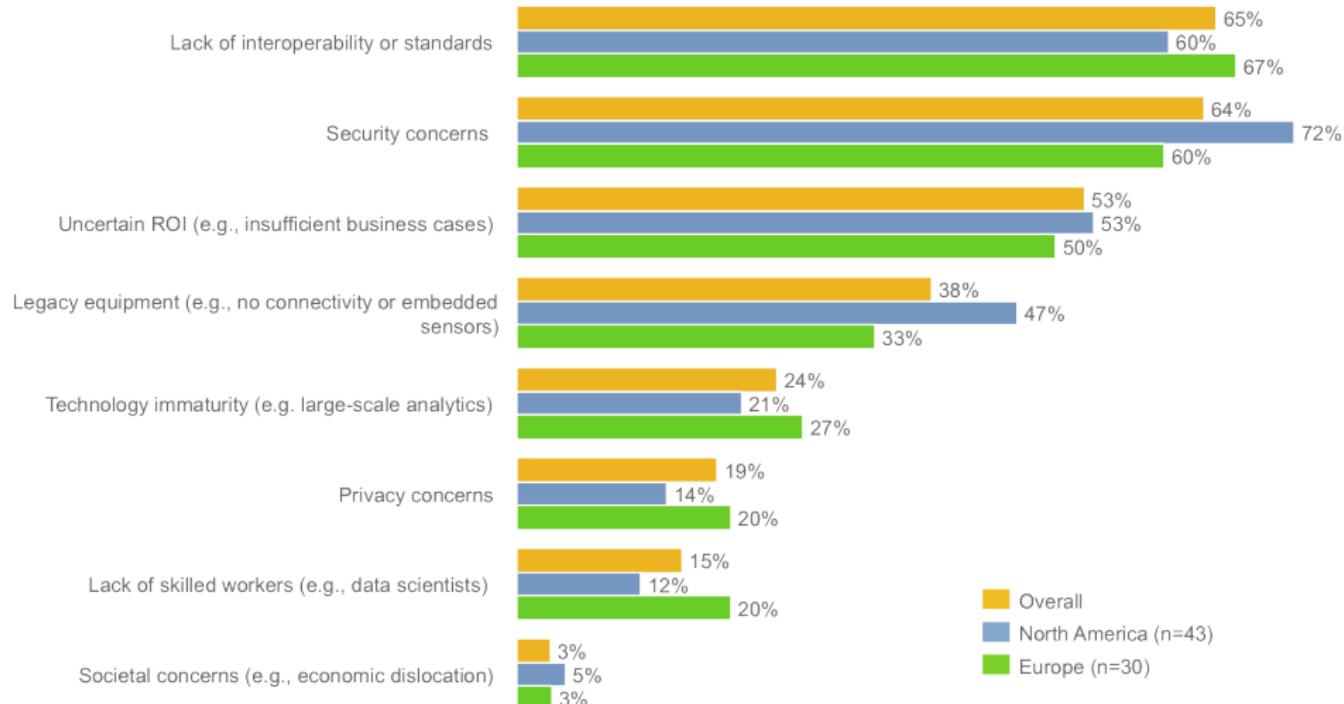


Figure 9: Key barriers in adopting the Industrial Internet [5].

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.

Network slicing

Motivations

- ➡ 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

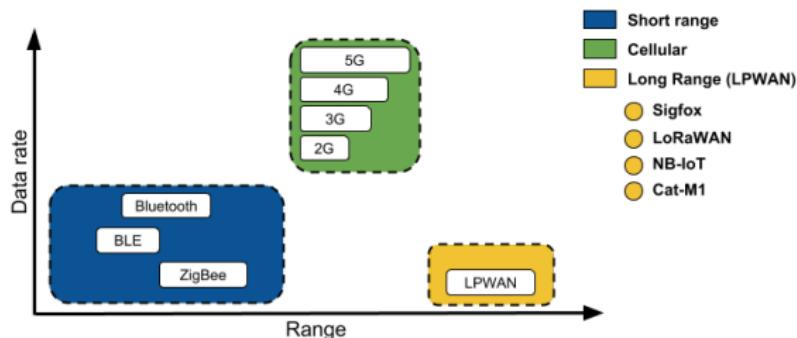


Figure 10: Communication diversity.

Network slicing

Motivations

- 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

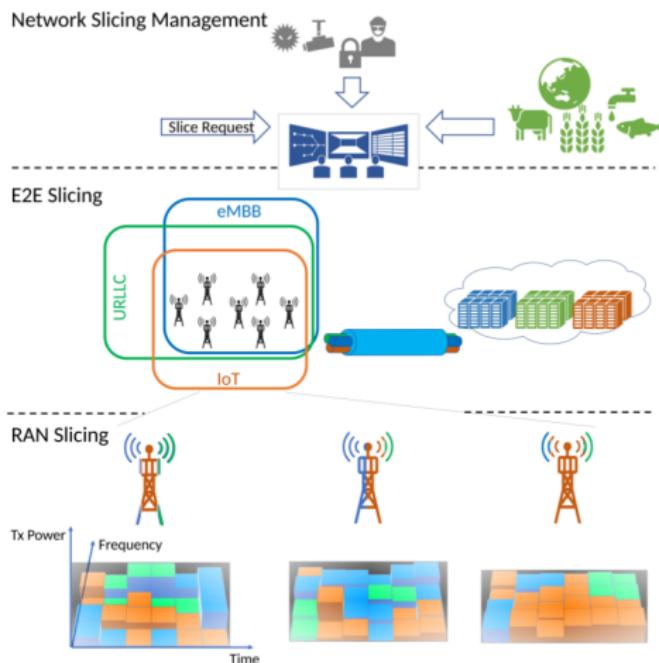


Figure 11: Network slicing [6].

Network slicing

Motivations

- 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

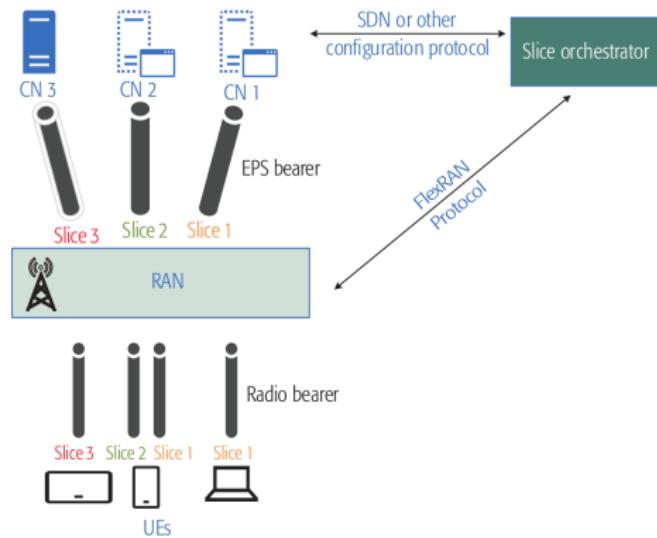
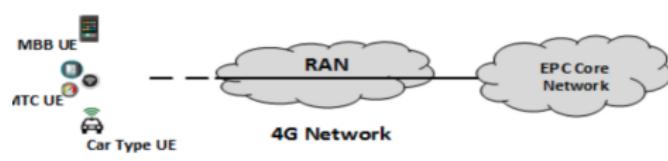


Figure 12: Network slicing [7].

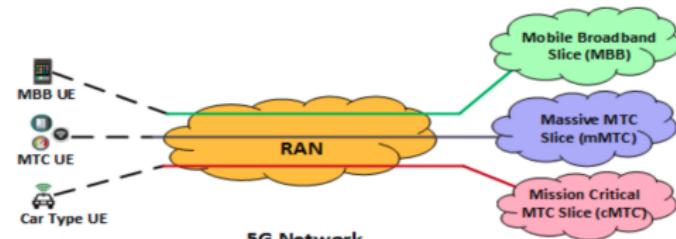
Network slicing

Motivations

- 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



(a) 4G without network slicing.



(b) 5G with network slicing.

Figure 13: Network slicing concept [8].

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 14: 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 14: wsn-IoT.

How to adapt the network to applications ?

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
 - ▶ Input:
 - * Service QoS requirements
 - * MAC configuration (SF, CR, BW, ...)
 - * Network QoS metrics
 - ▶ Methods:
 - * MADM, Game, Neural
 - ▶ Outputs:
 - * Ranked networks

Theoretical, Simulation & Real environment

Contributions

Contributions

- ➡ Network selection
 - ➡ MADM
 - * Ranking methods
 - * Ranking & weighted methods
 - ➡ Game theory
 - * Users vs users
 - * Users vs networks
 - * Networks vs network
 - ➡ Fuzzy logic
 - * as a score method
 - * another theory
 - ➡ Utility function
 - * 1
 - * 2

References

- [2] V. Prasanna Venkatesan, C. Punitha Devi, and M. Sivarajanji. " Design of a Smart Gateway Solution Based on the Exploration of Specific Challenges in IoT ". In: *2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*. 2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC). 00004. Palladam, Tamilnadu, India: IEEE, Feb. 2017, pp. 22–31.
- [3] Luca Feltrin et al. " LoRaWAN: Evaluation of Link- and System-Level Performance ". In: *IEEE Internet of Things Journal* 5.3 (June 2018). 00000, pp. 2249–2258.
- [1] Djamel Eddine Kouicem, Abdelmadjid Bouabdallah, and Hicham Lakhlef. " Internet of Things Security: A Top-down Survey ". In: *Computer Networks* 141 (Aug. 4, 2018). 00029, pp. 199–221.
- [4] Charith Perera et al. " MOSDEN: An Internet of Things Middleware for Resource Constrained Mobile Devices ". In: (Oct. 15, 2013). 00107. arXiv: 1310.4038 [cs].
- [5] all. *Industrial Internet of Things: Unleashing the Potential of Connected Products and Services*. 00000. 2015.
- [6] Vincenzo Sciancalepore, Marco Di Renzo, and Xavier Costa-Perez. " STORNS: Stochastic Radio Access Network Slicing ". In: (Jan. 16, 2019). 00001. arXiv: 1901.05336 [cs, math].
- [7] Adlen Ksentini and Navid Nikaein. " Toward Enforcing Network Slicing on RAN: Flexibility and Resources Abstraction ". In: *IEEE Communications Magazine* 55.6 (2017). 00063, pp. 102–108.
- [8] Malla Reddy Sama et al. " Service-Based Slice Selection Function for 5G ". In: *2016 IEEE Global Communications Conference (GLOBECOM)*. GLOBECOM 2016 - 2016 IEEE Global Communications Conference. 00016. Washington, DC, USA: IEEE, Dec. 2016, pp. 1–6.