Wireless Sensors Network

- **Cours magistraux (CM) :** 8
- **Travaux pratiques (TP) :** 3

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General Information

The Wireless Sensors Network (WSN) subject explores the design and deployment of wireless networks composed of sensors and connected devices, mainly used in the Internet of Things (IoT). Wireless sensor networks are essential in many applications, such as environmental monitoring, health management, and asset tracking. This technology allows the collection and transmission of data in real time, while being optimized for low power consumption and wide coverage.

Part A: Descriptive Part

The course on wireless sensor networks (WSN) was structured around two major complementary axes.

The first part, theoretical, allowed us to deepen the fundamental concepts of the protocols and technologies used in the Internet of Things (IoT) and sensor networks. This component also called upon notions already covered in previous years, such as modulation and communication. The presentations given by the students provided a detailed overview of various protocols, including **LoRa, Sigfox, BLE, ZigBee, NB-IoT, M2M, as well as protocols specific to the MAC layer.**

The second part, more focused on practice, asked us to imagine a concrete situation of setting up a wireless sensor network. In teams of five, we had to think about the optimal choices for the physical and MAC layers, while proposing a lightweight implementation adapted to the envisaged context.

Part B: Implementation

The course was accompanied by two main projects, which allowed the concepts studied to be put into practice:

1. **Project 1: Study of a specific protocol**

Each group selected a protocol from those studied in class (LoRa, Sigfox, BLE, ZigBee, NB-IoT, or M2M) in order to conduct an in-depth analysis. My group and I are working on the Sigfox network in which we studied the MAC and physical layer of the network, the analysis of the energy consumption per data bit as well as the advantages and limitations of the Sigfox network.

This work included a literature search, a detailed report and an oral presentation in front of the class. This activity allowed us to better understand the advantages, limitations and fields of application of these protocols.

2. **Project 2: Deepening of MAC protocols**

A second task led us to explore in detail MAC protocols in the context of wireless sensor networks. Through a group project, we studied their key role in the efficient management of networks, based on a practical case: the concept of "Smart Subway". This project aimed to optimize the communication between sensors embedded in the wagons and a relay antenna per train, using a star topology. Several crucial aspects were analyzed, including energy consumption, quality of service, collision management, as well as the clock synchronization required for the operation of scheduled access protocols (such as TDMA). This work resulted in a report that you can consult on the portfolio.

Part C: Analytical Part

This course was an excellent opportunity to acquire both theoretical and practical knowledge on wireless sensor networks. The theoretical part reinforced our understanding of the protocols and their role in the IoT, while the practical part encouraged in-depth reflection on the technological choices to be made in real-world scenarios.

However, one aspect that could be improved is the limited time allocated to the practical part. This lack of time did not allow us to fully delve into the implementation or validate the viability of the choices made. Despite this, this exercise proved to be very educational, as it pushed us to apply our knowledge in a concrete way, which is essential for our future careers.

In conclusion, this course provides a solid foundation for addressing the challenges of designing IoT and sensor networks in a professional environment.

Matrice D'évaluation

Protocols and communication	**Expected**	**estimated**
Understand the major development phases for mobile communications and development of the associated technology	4	**4**
Understand the impact of new mobile technology	4	**3**
Be able to analyse and evaluate optimal wireless network technologies	4	**3**
Be able to suggest optimal technological solutions for IoT networks	4	**4**
Understand and master optimisation of communication protocols for IoT with respect to energy limitations	4	**3**
Understand and master optimisation of communication protocols with respect to security concerns	4	**3**
Know the main processing techniques used for digital communication and know how to explain the basic structure of digital RF transmitter-receiver	4	**4**
Mastering the architecture of an energy management system, simple storage, energy recovery, know how to size the storage element according to the specifications	4	**3**