

# IT.2306 Design of connected Systems

## General information

Title: Design of IoT systems

Code: IT.2306

Responsible: Lina MROUEH or Gilles Carpentier

ECTS: 5

Average amount of work per student: 150 hours, including 42 hours supervised.

Teamwork: yes

## **Presentation**

With more than 27 billion connected objects estimated in 2024, the Internet of Things is currently at the heart of digital evolution. The Internet of Things now makes it possible to offer secure and optimized services and daily applications. System integration corresponds to a set of activities that enable new solutions to be created from existing elements, in particular:

- Integration of different components to build a new system
- Porting software to another system or hardware
- Revamping
- Retro engineering
- Integration of a new application in an existing information system
- Creating a new solution by creating new relationships between existing services

This module gives a systemic and transverse vision of connected object systems. After an introduction of the fundamental notions, a transverse project will be carried out in a group allowing the integration of sensors and actuators, gateways, long distance networks, cloud and big data.

## **Content/Program**

The concepts developed in this module are:

- Architecture and eco-design of connected systems
- Data processing and analysis: Cloud and edge computing and big data
- Network security and reliability
- Introduction and overview of system integration
- Open-source strategy
- Tools for integration (BPM, ETL, BI, Spring)
- Testing and validation

## **Software tools used in the course**

Linux, Raspberry, Beaglebone, IntalioBPM, Weka, eclipse BIRT, Spring, Selenium

# IT.2307 Cellular and IoT Networks

## General information

Title: Cellular and IoT networks

Code: IT.2307

Responsible: Lina MROUEH

ECTS: 5

Average amount of work per student: 150 hours, including 42 hours supervised.

Teamwork: yes

## Presentation

According to a study by Ericsson, the number of connected objects in 2024 is estimated to reach more than 34 billion. Among these objects are the cellular network subscribers as well as the connected objects with short or long ranges. The use cases of wireless networks have largely evolved from a simple voice call at the end of the 20th century to the case of the more recently connected vehicle.

Designers of connected object systems must adapt the technological choice to the applications in terms of massive network access, throughput, latency and energy consumption. To do so, these professionals must master the fundamental rules of engineering, planning and dimensioning of wireless networks provided by this module.

## Content/program

This module consists of 3 parts. The first part presents the basics on the transmission chain, dimensioning and radio planification. The second part explains the different generations of cellular mobile wireless systems, from 3G to 5G. The third part is dedicated to the different unlicensed short-range IoT technologies: WiFi, Bluetooth, Zigbee, RFID and the long-range technologies NB-IoT, Lte-M, LoRa and Sigfox. In particular, it deepens the architecture and radio aspects such as multiple access, logical channels, mobility management, dimensioning, capacity, etc. The principles of maintenance and supervision of these networks are also discussed.

## Concepts

The following concepts, which are an objective of the module, will be discussed:

- Communications Network Architecture and Engineering
- Electromagnetic spectrum management
- Cellular technologies and IoT
- Optimization of network parameters in terms of latency, power consumption, spectral efficiency and throughput.
- User multiplexing and massive MIMO systems

**Software tools**

- Development tool (Octave, Python, Java, Matlab, etc.)

**Teaching methods Learning Methods**

- 45 hours of face-to-face learning with the teacher/speaker: lectures, illustrations, application exercises,
- 30 hours of personal learning: course review, memorization, reflection, application activities,
- 50 hours of learning in project mode, in teams of 4 learners: in autonomy with validation of the stages of progress and tutoring on request.

**Assessment procedures**

The evaluation of this module is based on individual examinations and work and a group project.

Individual assessment (66%):

- Homework
- Continuous exams: 3 (on each part)

Collective evaluation (33%): Evaluation of the project group's productions. A personal variation can be attributed to the participation of each member of the group in the completion of the project.

**Working language**

The courses in this module are taught in English. Students can work on their project in the language of their choice.