

# 5G TECHNOLOGIES

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## Subject Description

The 5G technologies course covers not only 5G standards and applications but also related technologies, such as previous GSM generations and the development of various telecommunication standards. In general, the course is divided into two parts.

The first part provides an overview of the history of the GSM standard, from its early use in telecommunications to the projects and prospects for 6G. During these two hours, Mr. Sicard discussed various concepts and applications that could be useful for our choice of presentation topic. It was also an opportunity to gain a better understanding of the current application of GSM technologies and their planned evolution.

The second part of the course consists of 15-minute presentations made by students in pairs. These presentations offer an opportunity to explore topics from a long list of proposed themes. Our class selected topics in three main areas:

1. **Technical aspects**, mainly concerning 5G and 6G technologies, such as modulation, as well as their development by companies. Other technologies relying on GSM, like LTE-M or V2X (Vehicle to Everything), were also presented by other students.
2. **Applications of these technologies**, addressing topics such as autonomous trains or satellite constellations (Starlink, Kuiper).
3. **Risks and perceptions**, raising questions about these constantly evolving technologies, such as their environmental impact, mobile addictions, and the concerns felt by some parts of the population.

Together with my partner, we chose to present the topic of autonomous trains. We started by defining what autonomy means in the context of trains and transportation in general, before discussing the advantages and limitations of this technology, particularly in terms of cost and regulation. The next part covered the technologies used for autonomy, explaining the concept of **Grades of Automation** and the implementation of fixed block and moving block systems for subway systems. We also highlighted some ongoing projects in France and Europe, such as subway systems in several French cities and a German project for autonomous trains transporting people, in contrast with the "Train Drone" project, which focused on autonomous trains for freight transport.

## **IMPLEMENTATION**

As mentioned earlier, our main objective was to create a presentation on a specific topic. I chose the topic of the "Train Drone" because it seemed like an interesting subject I didn't know much about and wanted to learn more. Three main points were explored: teamwork, research on the topic, and presentation.

The first point, teamwork, mainly involved dividing the tasks between my partner Brian and me. We split the research into specific areas: I would research the definition and technologies of autonomous trains, while Brian would focus on the advantages and limitations. We also divided the speaking roles during the presentation based on our contributions.

The second point, research, quickly presented an issue: the term "Train Drone," which was our assigned topic, was only used to describe an autonomous train tested by SNCF in 2019. There was little detailed information available online about this specific project. We then agreed to use this project as the basis of our research and broaden the scope to cover autonomous trains in general. Numerous articles and papers were found on the subject, but it remained very broad, covering everything from assisted driving to fully driverless trains. After gathering an overview, I focused on a few projects that were either well-known or closest to a fully autonomous system. However, similar to the "Train Drone" project, I quickly realized that most projects followed a similar pattern: heavy media coverage during testing phases, but limited information after that. This made it difficult to focus on specific technical details. Fortunately, I was able to get valuable insights from a friend working in embedded systems for trains at Systerel, who provided me with links to articles regarding 5G for autonomy in subway systems, which was directly relevant to our presentation.

Finally, for the third and last part, we managed to prepare and present our topic. The slides can be found at the end of this page.

## **Analysis**

In conclusion, this course was a great opportunity to gain an overview of 5G technologies, other GSM technologies, and their applications. It deepened my understanding of how these technologies could be applied in IoT or embedded systems. It was also a chance to improve my oral presentation skills and my ability to conduct research for that purpose. Being able to present a complex topic in 10 to 15 minutes is an excellent exercise that will certainly be valuable in my future career as an engineer.