Telecom Showcase: An Exhibition of Old Technology Useful for Students and Teachers

Eric Grivel*, Susan Medina‡, Francine Krief†,
Jean-Remy Falleri†, Guillaume Ferre*, Laurent Reveillere†, Daniel Negru†,
*Univ. Bordeaux - ENSEIRB-MATMECA Bordeaux INP - IMS - UMR CNRS 5218, Talence, FRANCE
†Univ. Bordeaux - ENSEIRB-MATMECA Bordeaux INP - LaBRI - UMR CNRS 5800, Talence, FRANCE
‡ENSEIRB-MATMECA Bordeaux INP, Talence, FRANCE

***Abstract*—In this article, we share our positive experience about the creation of a Telecom showcase in our engineering school, which is an exhibition of old technology to help students learn about previous habits and think about some of the consequences of rapid innovation. This project was done in collaboration with industrial partners such as Thales and Orange. It includes the following steps: collecting objects, organizing and rendering the objects accessible to students, disseminating the history of the telecommunications industry by using a website and quizzes and helping students see how the telecommunications industry and engineers have contributed to social and cultural evolution. This exhibit is particularly useful for the Minute Telecom, inspired from the Minute Physics, where the students are invited to create a video on theoretical concepts such as Shannon's theorem, mobile communication systems or the impact of innovation on user habits.**

***Index Terms*—object collection, technology exhibition, video, history of telecommunications**

I. Introduction

The Telecommunications department at *ENSEIRB-MATMECA* (*Bordeaux INP*) [1] was created 17 years ago in Talence (France). The students spend three years (from BAC+3 to BAC+5, or equivalently from BSc to MSc) at school. The graduate studies enable them to gain skills and knowledge to become engineers in the telecommunications field. The curriculum includes lectures in management, language and human communication and courses in four scientific pillars: signal processing, digital communications, computer and telecommunications networking, and computer science. It covers various aspects of telecommunication systems together with the background necessary to understand them. The teaching team aims at continuously updating the courses to reflect the rapid changes in the technological fields and has experimented with new teaching methods over the past years: active learning as well as active and cooperative learning (ACL) methods [1] which include massive open online courses (MOOCs), flipped classrooms and project-based pedagogy. Previous contributions of our team consisted of small-group learning projects and the presentation of the role played by our industrial partners, namely *ORANGE*, *THALES*, *SOGETI* and *BULL-ATOS* [2] [3].

However, year after year, new problems arise:

On the one hand, it becomes more and more difficult to present the various technologies that have been created. Due to the lack of time, teachers have to focus on specific technologies and make choices in the concepts they introduce to the students.

On the other hand, the teaching team belongs to a generation that witnessed and even played a role in the technological and societal developments. However, the students they are currently training were born after the digital revolution of the 90ies. In today's world of smartphones, students are not necessarily aware of the outdated products used a few years ago nor of how habits have evolved. Moreover, the students to be trained in the years to come will be more or less familiar with current technologies but will not necessarily be aware of the technological revolutions that took place in the recent past. Finally, students today are asking for an increasingly growing part of concrete notions in the lectures they follow.

Therefore, the teaching team suggested bridging the gap by creating a telecom showcase, which is an exhibition of old technology to help students learn about the previous habits and think about some of the consequences of the innovations. The goal was to create a working environment showing and describing objects that have been used and marketed in the field of telecommunications over the past decades:

1) to help students gain a more concrete idea about the different materials and products that have been and/or were used in this sector.
2) to strengthen their understanding of the evolution of telecommunication technologies and to encourage them to think of technological innovation and its societal impact.

In this communication, we present the various steps of the project, from collecting the objects with the help of partners such as *ORANGE*, *THALES* and the alumni association to the ways the teaching team uses the showcase in connection with lectures given at school.

It should be noted that this project has been funded with support from *Bordeaux INP* and *ENSEIRB-MATMECA*, through a call for pedagogical innovation proposals.

[1] *ENSEIRB-MATMECA* is a graduate school of engineering in electronics, computer science, mathematics and mechanics and telecommunications. The diploma of Engineering delivered at *ENSEIRB-MATMECA* corresponds to five years of higher education. Students are admitted to school following two years of preparation in higher education, through the selective national exams for the French grandes ecoles. Therefore, first-year students are those doing their 5th and 6th semesters. The three years from BAC+3 to BAC+5 are designed to train top-level engineers. There are 1200 students and 350 diplomas of Engineering awarded each year.

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The remainder of this paper is organized as follows. In section II, the project is presented in detail. In section III, opinions and perspectives are given, before concluding along with some perspectives in section IV.

II. The various steps of the project

Our purpose in this project was the following:

1) Collecting objects relevant to the evolution of telephony and telecommunications.
2) Organizing and rendering the objects collected accessible to the students.
3) Disseminating the history of the telecommunications industry.
4) Helping the students see how the telecommunications industry and engineers have contributed to social and cultural evolution.

These steps were defined during preliminary meetings with all the team members. The next subsections explain each step in detail.

A. Collecting objects relevant to the evolution of telephony and telecommunications

As a starting point, the first objects were brought by colleagues and the alumni association. Then our corporate partners helped us search. Several meetings and discussions were scheduled with them in Bordeaux. Representatives of *ORANGE LA COLLECTION* or *THALES* came to Bordeaux to meet us. Finally, *THALES* provided us with some materials. Thanks to *ORANGE LA COLLECTION*, which supports *AMHITEL*, a Telecommunications museum in Bordeaux (See http://musee.telecom.aquitaine.pagesperso-orange.fr/), we also got various objects that provide insight into the history of the telecommunications industry. Then, insurance had to be obtained for some objects loaned by the *AMHITEL* museum. There is now a collection of old telephones with significant models such as phones from 1910 and from 1924, rotative phones from 1943 (the so-called U43) or 1963 known as U63. A variety of amateur radio equipment with different transmitters and receivers was also gathered and displayed. Some 120 objects now make up the Telecom exhibit at *ENSEIRB-MATMECA*. A logo was created by the marketing & communication office in our school, which includes the partner logos (see figure 1).

Fig. 1. Logos of the Telecom showcase

B. Organizing and rendering the objects collected accessible to the students

Several showcases were installed at school at different places, near coffee-break areas. The project team had to take into account the rules to be respected to set up showcases in a public area. Thus, the showcases were securely attached to avoid any damage. In addition, to make the areas more appealing, walls in the surroundings were also repainted. Finally, to present the objects, the project team spent a few hours at the makerspace at school. As it has a variety of maker equipment including 3D printers and laser cutters, object holders were designed with the help of another specially trained colleague.

This way, the showcases have become interesting places where visitors can spend a few minutes while having a coffee. Younger people now have an incentive to learn a great deal about the history of telecommunications. Older people are reminded of the time when they used these objects (see figures 2 and 3).

C. Disseminating the history of the telecommunications industry

A website was designed to provide visitors with information about the objects presented in the exhibit (see figure 4 and figure 5). Thanks to its responsive design, the website can be browsed using a desktop computer as well as a smartphone. It should be noted that the website is available both in French and in English so that foreign visitors can also benefit from it. Links to partners' websites are also provided, such as *ORANGE LA COLLECTION*[2]. Additionally, we placed QR codes on all showcases so that visitors can have direct access to the relevant content of the website.

The visitors can read about each object, such as the videophone set marketed by *Thomson CSF* and installed in Biarritz in the mid 80ies. In addition, objects are organized by themes

[2]http://collectionhistorique.orange.com/fr/accueil

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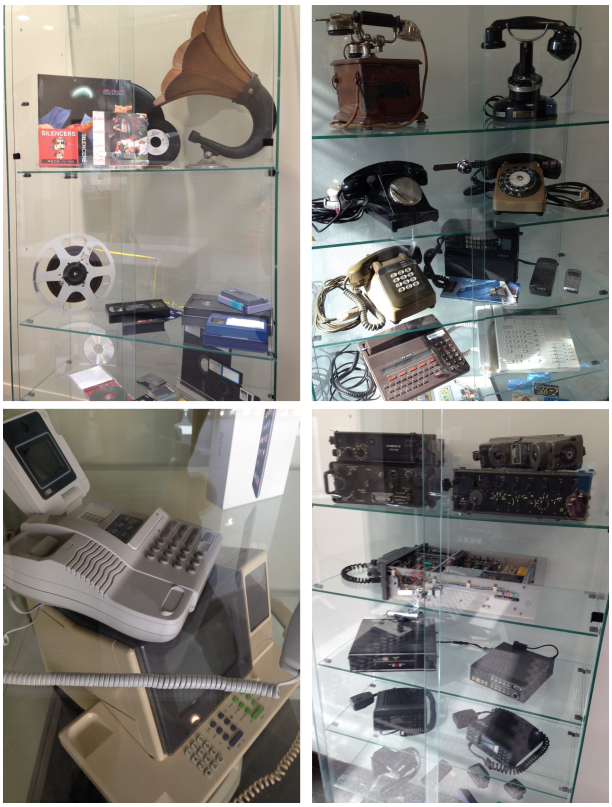

Fig. 2. Some of the showcases

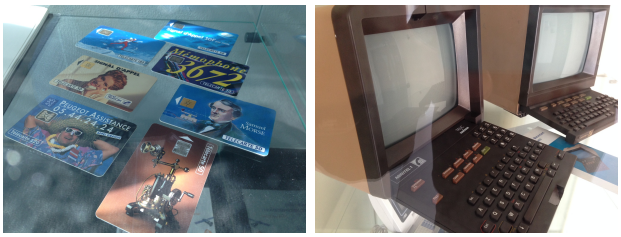

Fig. 3. Some other showcases

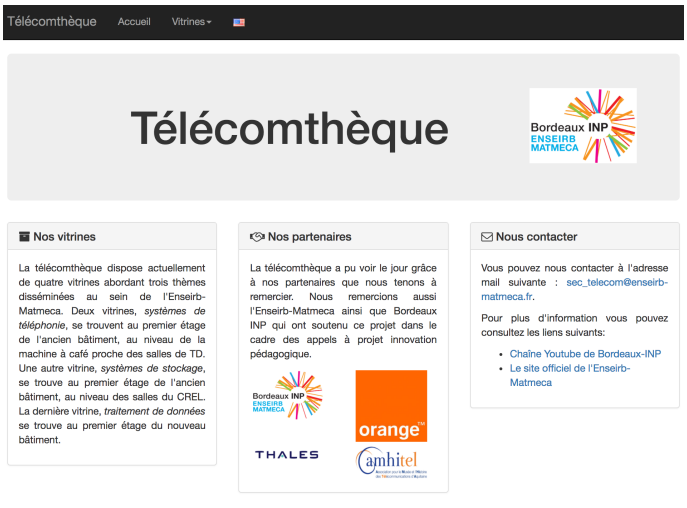

Fig. 4. The french homepage of the website

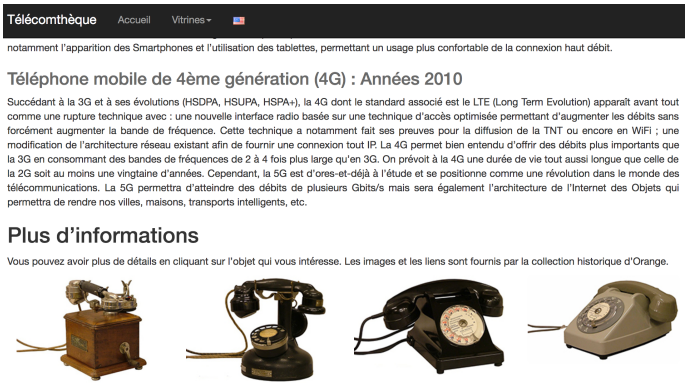

Fig. 5. The french page about telephony devices of the website

such as telephony and storage for example. Explanations of significant evolutions in each theme, written by the teaching team, can also be found.

Firstly, visitors can have details about telephone operating principles, which point out differences and similarities. Thus, after giving general information about landline telephones, the principles of the rotary telephone and the touchtone landline telephone are given. This makes it possible to introduce the dual-tone multiple frequency (DTMF) concept. Mobile telephony is then addressed, describing the different generations used for the past decades and the way the data are transmitted, from the 1^{st} Generation Mobile Telephony (1G), marketed in the 80s, with analog phones where voices were not digitized but were instead directly modulated around a carrier, followed by 3G and its evolution (HSDPA, HSUPA, HSPA +), and up to the 4G standard, associated with LTE (Long Term Evolution).

A second topic is data storage, starting from punch cards, rectangular sheets of stiff paper, with holes punched in lines and columns to code characters or information, through flash drives, and finally dematerialization via the cloud. Sound reproduction is also presented, from the black gum-lacquered phonographic disk spinning at 78 rotations per minute (RPM) to the CDs, entering the market slowly in the mid-80s, where the signal was sampled at a 44.1 kHz rate. Video media evolution is then illustrated from videocassettes, viewed using a VCR to VOD, to the Laserdiscs, DVDs, Blu-rays and 3D Blu-rays. The presentation concludes with the fact that whatever the application intended, data, audio and video recording is now converging via:

1) personal physical storage media (smartphones, tablets) used to store photos, audio files and videos
2) personal virtual storage media, such as Google Drive or Dropbox
3) public virtual storage media to share: *Facebook*, *YouTube*, and others.

D. Helping the students to see how the telecommunications industry and engineers have contributed to social and cultural evolution.

These showcases are used for different purposes.

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1) **quizzes**: Several quizzes about communication systems were created. The quizzes do not have a time limit, so students have as much time as they need to complete them. The answers can be found by reading the articles available on the website. Here are some questions related to a switched telephone network:
   a) What are the advantages of the DTMF?
   b) Which letter was not on the rotary phone dial?
2) **Minute Telecom**: During the second semester in school, the students are invited to create a video in English to explain a notion they were able to learn during the previous semester or to address the question of innovation and its impact on our everyday life. This is inspired from the *Minute Physics* (See https://www.youtube.com/user/minutephysics).
   The subjects are not imposed, but to help students, a non-exhaustive list of topics is proposed. It includes not only theoretical notions such as the Markov chains, Shannon's theorem, central limit theorem, biomedical signal analysis based on *a priori* model and OSI model, but also questions such as *what is this object?*. In the latter case, the purpose of the teaching team is to encourage the students to look at the showcases in school where various objects are exhibited or to go to the *AMHITEL* in order to find an old object, to explain what it was designed for and how it was used.
   English teachers support engineering students in the preparation of the scientific text and in the pronunciation.
   The videos can be made with a smartphone, a go-pro camera or can be based on the use of software like *powtoon*. Digital recorders are also made available by the department to guarantee the sound quality of the clips that are produced. Video duration should not exceed 90 seconds.
   The videos are then put online, no later than the end of April, on a dedicated youtube channel. Second year students in their fourth semester in school and the teaching team can watch them, comment on them and vote through the *moodle* pedagogical platform. The three favorite videos are shown at an awards ceremony, attended by 1^{st} and 2^{nd}-year students. A prize is awarded to the three pairs who proposed the best videos.
   It should be noted that these approaches can be part of the general framework of CLIL (Content and Language Integrated Learning) methods targeting both scientific and English learning objectives in authentic communication [4] [5].
3) **Discussion about the impact of innovation on everyday use and habits**: In the communications field, it seems obvious that technology has a strong impact on society. What is not so obvious is how quickly that change has been taking place, and how it may be important to consider different generations' communication habits in order to better communicate with them. Analyzing the social impact of communication tools from the recent past is one way for students to gain perspective on their own practices and better understand the practices of others. In addition, all technological progress can lead to drawbacks unforeseen by the designers. Taking the long view can provide good examples of what each new technology added, but also what may have been lost. We communicate more quickly today, but we can wonder whether we communicate better than before. Through discussions based on concrete examples provided by the Telecom showcase, students can gain a deeper understanding of what better communication may be, and thereby become not only better communicators, but also better able to design tools for the future.

III. Points of view

A. Testimonies from students

Minute videos are an asset both for technical vocabulary learning and a new experience to explain complex concepts to non-specialists. The experience is appreciated. The need to adapt one's speech is seen as very formative. Knowing know how to synthesize a subject and to explain a complicated concept in an original form requires practice. Deferred speaking helps overcome the difficulty of live oral expression. The video format is therefore relevant, although video editing can take time in some cases. The minutes Telecom are therefore a fun and original way of appropriating a scientific notion and history. In terms of improvement, some of us felt that it would be desirable for future classes to add subtitles to videos.

B. Testimonies from teachers

It is more and more difficult to present all the concepts and the systems that were proposed in the last 30 years. During lectures dedicated to digital communications or wireless communications, these types of exhibits can be useful. Concerning the minutes Telecom, it is very interesting to see how the students present the notions they learnt or how they analyze the evolutions of habits. The teaching team develop another relation with the students this way.

Having a common project, where several colleagues work in different fields (signal and image processing, mobile communication system, computer and telecommunications networking, programming and language), brings in much. Scientific issues are addressed as well as societal aspects. Hence, a continuum is created, which is a very interesting aspect to instantiate in an engineering school, especially when partners and alumni are also involved.

IV. Conclusions and perspectives

The Telecom showcase has several advantages. It brings the opportunity:

1) for the teacher to present the evolution of technologies more concretely, thus facilitating the perspective of his lecture,

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2) for English teachers to initiate discussions on progress and societal impact of technological innovations,
3) for students to have a more concrete idea of the evolution of technologies, products and materials - their look, their sizes, their weights, etc.

The Telecom showcase definitely contributes to the creation of a favorable environment for learning a discipline and can trigger the involvement of the student in his training. It is part of an educational approach that aims at consolidating not only knowledge but also skills and perspectives. It should be noted that new showcases could be created on other topics, such as electronic devices.

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