1SC2393 – Predicting the size of an operator's national network

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Department: DOMINANTE - SYSTÈMES COMMUNICANTS ET OBJETS CONNECTÉS
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description

This module is one of the three challenge weeks of the thematic sequence on Communicating Systems and Connected Objects. It consists in dimensioning a 4G/5G cellular network in a medium-sized city. This starts by the estimation of the number of radio sites for ensuring capacity and coverage, followed by a placement of sites in the city along with the dimensioning of the backhaul links towards the core network.

Quarter number
ST2

Prerequisites (in terms of CS courses)
course of ECT2

Syllabus
Day 1 :
(i) Problem statement and choice of the city for the network deployment
(ii) coverage dimensioning with a link budget
(iii) estimation of the number of sites for covering the city
Day 2 :
(i) dimensioning of the 4G access network.
(ii) backhaul design
Day 3 :
(i) prediction of 5G spectrum needs based on traffic projections
(ii) proposition of a plan for 4G site upgrades towards 5G in the next 5 years.
Day 4 :
solution refinements
Day 5 : Oral presentations and visit to an industrial site

Class components (lecture, labs, etc.)

This course is a Problem Solving pedagogical activity. It allows you to face a concrete telecommunication problem. The student must work in a team to carry out a mission that the group must present and argue according to technical and economic criteria.

The teaching is programmed over a "blocked" week. During the week, students work in groups of 5 to 6 students, supervised by a team composed of experts from Bouygues Telecom and teacher-researchers from CentraleSupelec.

Progress points will be made daily. Communication with the management team is horizontal and requests are handled throughout the week.

Grading

Will be evaluated the individual motivation, the collaboration quality and the adequacy of the proposed technical solutions to the scenario.

Resources

Supervision by professors from CentraleSupélec and by engineers from Bouygues Telecom

Learning outcomes covered on the course

Understand the general principles for deploying a cellular network in a practical scenario.

Description of the skills acquired at the end of the course

C1 Analyze, design and build complex systems with scientific, technological, human and economic components
C1.2 Use and develop appropriate models, choose the right scale of modelling and relevant simplifying assumptions to address the problem
C1.3 Solving the problem with a practice of approximation, simulation and experimentation
C1.4 Specify, design, build and validate all or part of a complex system
C8 Leading a project, a team
C8.1 Work in team/collaboration.
C8.4 Work in project mode by implementing appropriate project management methods

ST2 – 24 – ENERGY TRANSITION

Dominante : ENE (Energy)
Langue d'enseignement : French
Campus où le cours est proposé : Paris-Saclay

Engineering problem

The objective of this subject is twofold: on the one hand, to present the major issues of the energy transition (global and French context, technical and scientific barriers, economic, human and climatic issues), and on the other hand, to discover and implement the concepts and methods of modeling in engineering. The integration courses will implement the modeling of energy transfers in two key sectors of the energy transition: transportation (contactless recharging) and building (energy modeling of a neighborhood).

Adviced prerequisites

No prerequisites, but it is recommended to have taken Electrical Energy or Transfer Science

Context and issue modules: They will include a series of introductory conferences and round tables in which a panorama of the major issues of the energy transition will be drawn up, and several thematic presentations by various players in the energy sector where the economic, geopolitical and societal issues of the theme will be examined more specifically. A review will be made of the major technological and scientific obstacles related to the energy transition, and technological innovation workshops will be led by professionals in this field. Finally, half a day will be devoted to a visit to an R&D site in the field of automotive electrification.

Specific course (40 HEE): Study and modeling of electromagnetic conversion systems and unsteady heat transfer

Brief description: In a first part, this course will provide students with a set of knowledge necessary to approach the integration course on the modeling of a coupler for contactless charging. It will focus on the principle of electromagnetic conversion and the different modeling approaches to solve a problem in the energy domain. It is based on the electrical and magnetic circuits, the electromagnetic coupling and the different modeling approaches.

In the same way, in a second part, this course will provide students with all the knowledge necessary to carry out the integration course devoted to the modeling of the energy consumption of a group of buildings. Theoretical elements related to mathematical modeling and numerical simulation of unsteady energy transfers will be presented. The course will conclude with the presentation of a dynamic thermal simulation software of buildings; during the last session, students will use this software to solve simulation problems of unsteady energy behavior in simple configurations.

Challenge week n°1: Study, modeling and experimental validation of a non-contact energy transfer system.

- Associated partners: VeDeCoM, Renault

- Location: Paris-Saclay campus

- Brief description: The technique of contactless recharging has been gaining momentum in recent years. The principle consists in transferring energy between two systems without any electrical connection between them. This technique is of interest in various fields ranging from cell phones to electric vehicles. During this integration course, students will work on the modeling of a contactless charging system by induction.

After understanding the principle of energy transfer, the first step of the study will be devoted to the implementation of a modeling approach of an electromagnetic coupler in order to determine the electrical parameters. To achieve this objective, the students will use an electromagnetic modeling tool "COMSOL" and the results obtained by modeling will be validated experimentally. To reduce the electromagnetic radiation, the students will also have to predict the magnetic field radiated by the coupler and propose solutions to make it comply with the standards.

The second step will be to determine the compensation capacitors and to set up the associated electronics to adapt the system to the power source and the load. The whole chain, from the source to the load, will be simulated in matlab/simulink in the frequency and time domains. In this step, the students will have to quantify the electrical quantities (currents, voltages, efficiency...).

Finally, a validation of the whole modeling process will be performed on an experimental model.

Challenge n°2: Modeling the energy consumption of a group of buildings

- Associated partner: EDF

- Location: Paris-Saclay campus

- Brief description: The students will approach an engineering problem involving the modeling of energy transfers in an existing neighborhood and the definition of a renovation strategy to transform this neighborhood into a positive energy neighborhood. The first step of the work will be to collect the data necessary to evaluate the energy of the different buildings in the neighborhood. The software presented in the specific course n°2 will then be used to make a thermal diagnosis of the buildings, averaged over the day/night alternation and over the whole year. An analysis of the critical points that have a strong impact on the energy consumption of the buildings will then allow to make choices for the energy renovation of the buildings, and these choices will be evaluated with the software. At the end of this integration activity, the students should be able to propose a set of energy renovation actions, and they will have quantified the gain of these measures in terms of reduction of the energy bill of the whole building.