Wireless Laboratory

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ECTS: 5 ECTSs, Mandatory
Period: February - June
Location: Campus Nord, UPC

KNOWLEDGE, SKILLS and COMPETENCES

The aim of this course is to train students in the analysis, modelling and design of radio resource management mechanisms for wireless communications systems, with a focus on mobile communications. The course will start by developing the concepts for designing and operating a mobile communication network, including the planning and dimensioning processes. Then, it will present the models and strategies for managing the network and the spectrum. For that purpose, the course will study different strategies for radio resource management and network optimisation, including advanced concepts for automated network optimisation (SON: Self-Organizing Networks).

• Ability to apply the main techniques for accessing and sharing the radio spectrum available for the design of communication protocols, including radio resource planning techniques, while at the same time justifying the pros and cons of each one in terms of efficiency, flow, delay and fairness.

• Ability to dimension high-performance networks from the base station sites and access points to the requisite radio spectrum and interconnection networks.

• Ability to analyse, model and design protocol architectures, mechanisms and features for mobile networks, including the interconnection between heterogeneous networks.

Other competences:

• Solvent use of information resources. Managing the acquisition, structure, analysis and visualization of data and information in the field of the speciality and critically evaluate the results of this effort.

Learning results of the subject:

• Knowledge of how to model, design and evaluate strategies and mechanisms for the management of the radio resources and the flexible use of the spectrum in wireless networks
• Knowledge of the deployment and resource management options for heterogeneous networks
• Knowledge of the strategies used for the automatic configuration and optimisation of wireless networks (self-organising networks)
• Knowledge of radio resource management strategies in wireless networks, including the modelling and the application of advanced decision making and machine learning strategies
• Knowledge of flexible spectrum management concepts: regulation, spectrum management components, spectrum sharing, dynamic spectrum access and cognitive radio.
• Knowledge about heterogeneous networks, including deployment, interference management, load control and use of multiple radio interfaces.
• Ability to analyze, model and evaluate advanced resource management and optimization techniques for wireless networks.

CONTENTS

1. Mobile Communication Networks: design and operation
   Description:
   – Engineering functions, organisation and processes
   – Base station radio design
   – Dimensioning
   – Integration and operation
   – Transmission
   – Optimisation
   Dedication: 35h
2. - Network planning and dimensioning
Description:
- Introduction: Planning objectives and requirements
- Link budget in LTE for Uplink and Downlink: Propagation models; Receiver sensitivity; signal to noise ratio and Interference Margin. Clutter Concept.
- Traffic Dimensioning for LTE
- LTE network design: Frequency planning options; Dimensioning and planning of Control channels
- Backhaul and X2 interface dimensioning
Dedication: 19h
- Large group/Theory classes: 4h
- Medium group/Practical classes: 2h
- Small group/Laboratory classes: 0h
- Guided study: 0h
- Self study: 13h

3. - Network resource management
Description:
- Context, models and framework for network management (ITU FCAPS, eTOM, BSS/OSS/NMS)
- Radio Resource Management strategies (admission control, scheduling, handover, cell selection, eICIC, carrier aggregation, load balancing)
- Advanced algorithmic solutions for radio resource management (applicability of machine learning techniques)
- Network optimisation and SON (network quality cycle, optimisation methodologies and tools, network monitoring and optimisation)
Dedication: 55h
- Large group/Theory classes: 13h
- Medium group/Practical classes: 4h
- Small group/Laboratory classes: 0h
- Guided study: 0h
- Self study: 38h

4. - Spectrum management
Description:
- Licensing regimes and spectrum management models (LSA, TVWS, etc.)
- Coexistence studies
Dedication: 16h
- Large group/Theory classes: 4h
- Medium group/Practical classes: 1h
- Small group/Laboratory classes: 0h
- Guided study: 0h
- Self study: 11h

Planning of activities:

- Laboratory:
  - Description: Practices with commercial test equipment and software to work the different contents of LTE systems.
- Exercises:
  - Description: Exercises to strengthen the theoretical knowledge
- Short answer test (Control):
EVALUATION CRITERIA

- Final examination: from 40% to 50%
- Partial examinations and controls: from 20% to 40%
- Exercises: from 10% to 30%

BIBLIOGRAPHY

Basic:


Complementary: