



## Course guides

# 230369 - CR - Cognitive Radio and Spectrum Sharing: a Key Technology of 5G Networks

Last modified: 29/04/2020

**Unit in charge:** Barcelona School of Telecommunications Engineering  
**Teaching unit:** 739 - TSC - Department of Signal Theory and Communications.  
**Degree:** MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).  
**Academic year:** 2020    **ECTS Credits:** 2.5    **Languages:** English

### LECTURER

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**Coordinating lecturer:** Casadevall Palacio, Fernando-Jose  
**Others:** Casadevall Palacio, Fernando-Jose

### PRIOR SKILLS

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Basic knowledge about radiocommunications.

### REQUIREMENTS

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none

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CE1. Ability to apply information theory methods, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing to communication and audiovisual systems.  
CE2. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.  
CE9. Ability to deal with the convergence, interoperability and design of heterogeneous networks with local, access and core networks, as well as with service integration (telephony, data, television and interactive services).

**Transversal:**

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.  
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

### TEACHING METHODOLOGY

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- Lectures
- Individual work
- Extended answer test (Final Exam)



## LEARNING OBJECTIVES OF THE SUBJECT

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Most of the today's Wireless System are allocated in spectrum bands devoted for exclusive use of licensed users (licensed bands). New and advanced technological improvements has resulted in the huge development of personal wireless technologies. As the result spectrum scarcity happens. A solution to this problem is to let unlicensed users use the licensed frequencies, provided they can guarantee interference perceived by the primary license holders will be minimal. This new concept is called Cognitive Radio.

In this seminar you will know and understand the main concepts related to:

- Cognitive Radio and their applications and limitations in the context of the new 5G systems
- TV White Spaces and their applications
- Dynamic spectrum management, particularly the Licensed-Assisted Access (LAA) concept

## STUDY LOAD

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Type	Hours	Percentage
Hours large group	20,0	32.00
Self study	42,5	68.00

**Total learning time:** 62.5 h

## CONTENTS

### COGNITIVE RADIO AND SPECTRUM SHARED TECHNIQUES: A KEY TECHNOLOGY FOR 5G NETWORKS

#### Description:

Topic 1.- Introduction to Cognitive Radio

1.1 Reasons for the deployment of Cognitive Radio

1.2 Cognitive Radio Concept

1.1.1 Cognitive Cycle: Spectrum Awareness; Spectrum Selection; Spectrum Sharing; Spectrum mobility

1.3 Structure of a Cognitive Transceiver:

1.3.1 Transceiver Reconfigurability and Software Defined Radio

Topic 2.- TV-White Spaces

2.1 Digital Dividend & TV-White Spaces concept

2.2 Regulatory Aspects

2.3 Characteristics of the CR devices for TV-WS

2.4 Protection zone: Dimensioning

2.5 Standards: IEEE 802.22 and IEEE 802.11af

Topic 3.- Dynamic Access Technologies and Shared Spectrum Use

3.1 Introduction: Spectrum Licensing Schemes

3.2 Licensed Shared Access (LSA)

3.2.1 Concept: LSA rolls and responsibilities

3.2.2 LSA architecture for Cellular Systems: LSA functional blocks and interactions

3.2.3 European position with respect to LSA: ETSI framework on LSA

3.2.4 LSA in 3GPP: Functional split between LSA Controller and OAM

3.3 Spectrum Access System(SAS)

3.3.1 Concept: Rolls and responsibilities

3.3.2 SAS architecture: SAS functional blocks and interactions

Topic 4.- Unlicensed Systems in 5G context

4.1 Benefits and Challenges of LTE in Unlicensed Spectrum

4.2 LTE in unlicensed spectrum: LTE-Unlicensed (LTE-U); Licensed assisted access (LAA) and MulteFire

4.3 5G unlicensed Spectrum Allocation: Regulatory Requirements

4.4 5G-NR in unlicensed spectrum: Technologies: Licensed assisted access NR-U (LAA NR-U) and Stand-alone NR-U.

#### Related competencies :

CE1. Ability to apply information theory methods, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing to communication and audiovisual systems.

CE2. Ability to develop radio-communication systems: antennas design, equipment and subsystems, channel modeling, link dimensioning and planning.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

**Full-or-part-time:** 62h 30m

Theory classes: 20h

Self study : 42h 30m

## GRADING SYSTEM

Continuous assessment 50% of the final mark

Final exam 50% of final mark.



## BIBLIOGRAPHY

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### Basic:

- Venkataraman, H.; Muntean, G.-M. Cognitive radio and its application for next generation cellular and wireless networks [on line]. Dordrecht: Springer, 2012 [Consultation: 02/04/2020]. Available on: <http://dx.doi.org/10.1007/978-94-007-1827-2>. ISBN 9789400718265.

## RESOURCES

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### Audiovisual material:

- Transparències del seminari. Seminari slides

### Other resources:

- Papers and presentation published in IEEE, ITU, ETSI and other standardization bodies  
- Papers published in magazines, conferences and other research bodies.