

Guia docent 300273 - SDR - Software Radio

Última modificació: 09/06/2023

Unitat responsable: Escola d'Enginyeria de Telecomunicació i Aeroespacial de Castelldefels
Unitat que imparteix: 739 - TSC - Departament de Teoria del Senyal i Comunicacions.

Titulació: MÀSTER UNIVERSITARI EN APLICACIONS I GESTIÓ DE L'ENGINYERIA DE TELECOMUNICACIÓ (MASTEAM) (Pla 2015). (Assignatura optativa).
MÀSTER UNIVERSITARI EN TECNOLOGIES AVANÇADES DE TELECOMUNICACIÓ (Pla 2019). (Assignatura optativa).

Curs: 2023 **Crèdits ECTS:** 3.0 **Idiomes:** Anglès

PROFESSORAT

Professorat responsable: Gilabert Pinal, Pere Lluís
Montoro Lopez, Gabriel
Gelonch Bosch, Antonio Jose

Altres:

COMPETÈNCIES DE LA TITULACIÓ A LES QUALS CONTRIBUEIX L'ASSIGNATURA

Específiques:

01 MTM. Dissenyar, implementar i avaluar xarxes de comunicacions mòbils cel·lulars d'última generació, així com de les generacions previstes per al futur proper.

02 MTM. Dissenyar, implementar i avaluar xarxes heterogènies d'elevada densitat mitjançant tècniques de virtualització de la xarxa d'accés.

Genèriques:

03 DIS. Dissenyar aplicacions d'alt valor afegit basades en les Tecnologies de la Informació i les Comunicacions (TIC), aplicades a qualsevol àmbit de la societat.

Transversals:

03 TLG. TERCERA LENGUA: Conèixer una tercera llengua, que serà preferentment l'anglès, amb un nivell adequat de forma oral i per escrit i amb consonància amb les necessitats que tindran les titulades i els titulats en cada ensenyament.

Bàsiques:

CB6. Tenir i comprendre coneixements que aportin una base o oportunitat de ser originals en el desenvolupament i/o aplicació d'idees, sovint en un context d'investigació.

METODOLOGIES DOCENTS

Thanks to the material developed by instructors: slides, class notes, etc. available at the digital campus ATENEA, the student has enough tools to work autonomously, either in groups or individually.

In the theory sessions based on expository classes, the formal explanation of the teacher is combined with informal questions to the students to promote discussion.

In the laboratory sessions, groups will be formed to develop specific mini projects related to the subject areas indicated. Each group will have to write a report indicating the results obtained or show them through a performance demonstration of the implemented system.

OBJECTIUS D'APRENTATGE DE L'ASSIGNATURA

At the end of the course the student should be able to:

- 1) Apply proper technologies for designing and managing versatile implementations of powerful, efficient and portable wireless systems.
- 2) Identify the best solution for each part and component of wireless system attending the flexibility demanded by Cloud RAN approach.
- 3) Apply optimization methodologies for the complete wireless system, the demanded infrastructure or part of the system.

HORES TOTS DE DEDICACIÓ DE L'ESTUDIANTAT

Tipus	Hores	Percentatge
Hores grup gran	17,0	22.67
Hores grup petit	10,0	13.33
Hores aprenentatge autònom	48,0	64.00

Dedicació total: 75 h

CONTINGUTS

Cognitive and Software Defined Radio

Descripció:

The evolution of wireless systems has followed a long path from the conventional voice-centric cellular systems. The data traffic associated to wireless communications has experienced a high increase thanks to the arrival of multimedia applications. New generation of wireless systems tries to accommodate this increasing demand by means of new transmission technologies and an improved resource management. The improvement in the efficiency of Spectrum use combined with Software Radio and the idea that cognitive learning can be applied to wireless system deployment and management is creating new research and business possibilities. Application of Cognitive Radio and SDR in advanced communications systems constitutes the basis for incorporating learning functions for the management of spectrum and network resources.

Activitats vinculades:

- 1) Lecture.
- 2) Hands-on wireless project

Dedicació: 3h

Grup gran/Teoria: 2h

Grup petit/Laboratori: 1h



Cloud-RAN

Descripció:

An emerging term in radio access network (RAN) architecture is defined by “Cloud-RAN” concept. The basic idea behind C-RAN is changing the traditional RAN architecture to take advantage of cloud computing, Software-Defined Radio (SDR), Software-Defined Networks (SDN) and Distributed Antenna Systems (DAS). C-RAN is a RAN architecture that is not bound to a single RAN air interface technology. Essentially, conventional cellular base stations are replaced by small remote radio heads connected by optical fiber to a data center where digital processing of physical layer, and the rest of network layers, is carried out. Current cloud computing management frameworks, like OpenStack, OpenNebula, etc, needs to address the intensive real-time computing requirements of modern and future wireless systems. Incorporation of cloud concepts, like a centralised management that facilitates the extensive use of Coordinated Multi-Point (CoMP) transmission and reception or Inter-cell interference coordination (ICIC) techniques, or the resource virtualization, that promotes the development and evolution of Mobile Virtual Network Operator (MVNO) concepts, promises relevant reduction in CAPEX and OPEX in future wireless networks.

Activitats vinculades:

- 1) Lecture.
- 2) Hands-on wireless project.

Dedicació: 5h

Grup gran/Teoria: 3h

Grup petit/Laboratori: 2h

Digital signal generation and processing strategies

Descripció:

Current and future wireless communication standards and its related technologies (LTE, LTE-Advanced, WiMAX, etc) are being defined with enough flexibility to allow the inclusion in the processing chain concepts or subsystems aimed at improving the radio communication capabilities. Among others, we can analyze the impact of including within the transceiver signal processing strategies to improve both signal’s integrity and the overall system’s efficiency: crest factor reduction techniques to moderate the signal’s PAPR, dynamic supply or dynamic load modulation strategies to improve the transceiver efficiency, steerable antennas to perform beamforming, MIMO, or the incorporation of processing components for coordinated transmission (CoMP) or interference mitigation (ICIC), etc.

Activitats vinculades:

- 1) Lecture.
- 2) Hands-on wireless project.

Dedicació: 6h

Grup gran/Teoria: 4h

Grup petit/Laboratori: 2h



Advanced high-efficient transceiver architectures

Descripció:

Using the classical Cartesian I-Q transceivers to cope with non-constant envelope modulated signals with high peak-to-average power ratios (LTE, LTE-Advanced, WiMAX) clearly results power inefficient. To overcome this power efficiency limitation, the conventional Cartesian transceiver architectures are being modified or adapted to ensure optimal system-level amplification with highly efficient switching mode RF PAs. System level architectures (some including power supply control) with great potential for high-efficiency operation such as: linear amplification with nonlinear components (LINC), $\hat{\alpha}\hat{\beta}\hat{\gamma}$ modulator-based or "all-digital" transmitters, envelope tracking (ET) PAs or polar transmitters (PTs), have been revived thanks to current high-speed digital signal processors (DSP) which substitute their analog counterparts, subjected to tolerances and periodic adjustments.

Activitats vinculades:

- 1) Lecture.
- 2) Hands-on wireless project.

Dedicació: 6h

Grup gran/Teoria: 4h

Grup petit/Laboratori: 2h

Linear and nonlinear characterization and compensation

Descripció:

In the transmitter, linearity levels specified in the communication standards must be met at the antenna side. One of the most significant sources of nonlinear distortion within the transmitter is the power amplifier. Linearization techniques are therefore aimed at compensating for any eventual linear or nonlinear distortion threatening the transmitter's linearity specifications. On the other hand, in the receiver side, digital signal processing techniques have to be carried out (e.g. synchronization, channel estimation and equalization) to cope with communication's channel linear distortion and noise and thus guarantee a certain QoS.

Activitats vinculades:

- 1) Lecture.
- 2) Hands-on wireless project.

Dedicació: 7h

Grup gran/Teoria: 4h

Grup petit/Laboratori: 3h

SISTEMA DE QUALIFICACIÓ

BIBLIOGRAFIA

Bàsica:

- Luo, Fa-Long. Digital front-end in wireless communication and broadcasting : circuits and signal processing. Cambridge [etc.]: Cambridge University Press, 2011. ISBN 9781107002135.
- Kenington, Peter B. High-linearity RF amplifier design. Boston [etc.]: Artech House, cop. 2000. ISBN 1580531431.
- China Mobile Research Institute. "C-RAN: The Road Towards Green RAN". China Mobile Research Institute [en línia]. [Consulta: 16/07/2018]. Disponible a: <https://pdfs.semanticscholar.org/ea3/ca62c9d5653e4f2318aed9ddb8992a505d3c.pdf>. - "Network Functions Virtualisation (NFV)". ETSI [en línia]. [Consulta: 16/07/2018]. Disponible a: https://portal.etsi.org/nfv/nfv_white_paper.pdf. - Nguyen, Duy H. N; Le-Ngoc, Tho. Wireless coordinated multicell systems : architectures and precoding designs. New York: Springer, [2014]. ISBN 9783319063362.

Complementària:

- Wu, Jinsong; Rangan, Sundeep; Zhang, Honggang. Green communications : theoretical fundamentals, algorithms and applications. Boca Raton, FL: CRC Press, cop. 2013. ISBN 9781466501072.



- "Network Functions Virtualisation (use cases)". ETSI [en línia]. [Consulta: 16/07/2018]. Disponible a:
https://www.etsi.org/deliver/etsi_gs/NFV/001_099/001/01.01.01_60/gs_NFV001v010101p.pdf.