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# Advanced digital communications

## Finalità

The course goal is to present the principles, the techniques and some applications of multicarrier modulations based on orthogonal frequency division multiplexing (OFDM) and orthogonal frequency division multiple access (OFDMA).

## Programma

Direct implementations of OFDM systems by modulators and filters' banks. Implementation of OFDM systems by discrete Fourier transform (OFDM). Guard interval and cyclic prefix. Equalization in the frequency domain. Power spectra of OFDM signals. Symbol and frequency synchronization errors and their effects. Optimal resource allocation through adaptive coding and modulation (ACM). Waterfilling principle. Coded OFDM (COFDM) with optimal and uniform resource allocation. Trellis coded modulation (TCM) coding and decoding in the frequency domain. Time and frequency diversity. Bit-interleaved coded modulation (BICM). Modulation and access: OFDMA. Overview on OFDM-based wireless networks. Introduction to the concept of "cross-layer" design. Medium access control (MAC) multiple access protocols and OFDMA. Multiuser diversity and relative gain with OFDMA and ACM. Multi-carrier multi-user multiple-input multiple-output (MIMO)-OFDMA systems. Suboptimal resource allocation criteria in MIMO-OFDMA systems. Examples of wireless systems: WiFi (IEEE 802.11g) and WiMAX (IEEE 802.16e).

## Attività d'esercitazione

Lab exercises, with simulations of WiFi and WiMAX systems.

## Modalità d'esame

Oral exam upon appointment.

## Propedeuticità

None.

## Testi consigliati

- \* Notes from the instructors.
- \* Hui Liu and Guoqing Li, OFDM-Based Broadband Wireless Networks: Design and Optimization, John Wiley and Sons, 2005.
- \* H. Schulze, C. Lueders, Theory and Applications of OFDM and CDMA: Wideband Wireless Communications, John Wiley and Sons, 2005.