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# Advanced digital communications

## Finalità

The course is monographic, focused on topics of current scientific relevance, which can change from year to year. For the academic year 2005/2006, the course will be based on the following topic: ad hoc wireless networks.

## Programma

First Part. Introduction to wireless networks. Characterization of wireless communication channels. Diversity techniques and smart antennas. Comparison between fixed networks and wireless networks. Voice networks (channel access techniques with fixed assignment) and data networks (random channel access techniques). Channel access techniques with fixed assignment (TDMA, FDMA and CDMA) and random techniques (Aloha, CSMA and CSMA evolutions, with particular attention to the IEEE 802.11 standard).

Second part. Conceptual comparison between cellular networks and decentralized or ad hoc networks. Innovative bottom-up approach to the study of ad hoc networks. Bit error rate (BER) at the end of a multi-hop path in an ideal scenario without interference. Connectivity. Minimum spatial energy density. Realistic scenario with interference and examples of medium access control (MAC) protocols. Classification of MAC protocols. Routing protocols: characteristics and classification. Effective transport capacity in ad hoc wireless networks.

Lab activity (networks simulations) based on the use of Opnet.

More information at: <http://www.tlc.unipr.it/ferrari/teaching.html>

## Attività d'esercitazione

Theoric lectures and assignment of technical papers to the students. Lab activity, based on the use of Opnet software, in the first part of the course. In the second part of the course the students will start to work, in small groups, on Opnet projects with a final relation to submit. Analytical projects could also be considered.

## Modalità d'esame

The exam is three-fold:

- 1) written exam (around the beginning/middle of May) relative to the theoretical part of the course;
- 2) group presentations of literature papers assigned by the teacher;
- 3) presentation of a finale relation on a research project based on the use of Opnet, to define with the teacher.

The relative weight of the three components is around 35%, 20% and 45%, respectively.

## Propedeuticità

Math exams, Telecommunication networks, Digital Transmission

## Testi consigliati

\*Handouts from the teacher.

\* O. K. Tonguz and G. Ferrari, "Ad Hoc Wireless Networks: a Communication-Theoretic Perspective," John Wiley & Sons, 2005. ISBN: 0-470-09110-X.

\* E. Aboelela, "Network Simulation Experiments Manual," Morgan Kaufmann, May 2003, ISBN: 0120421712.