Advanced PHY/MAC Design for Infrastructure-less Networks

The main goal of the project was to investigate if the theoretical capacity of Infrastructure-Less Wireless Networks could be achieved by practical communication systems and evaluate how far an optimized solution is from the theoretical capacity bound. It was an intention of the project to propose an architecture for each node based on a cross-layering design between the physical and the MAC sub-layer.

GENERAL MOTIVATION AND OBJECTIVES

It is well known that the capacity of Infrastructure-Less Wireless Networks (ILWNs) can be surprising low, namely for the case of multi-pair unicasts. However, several innovative radio technologies developed in the last years, including Multi-Packet Reception (MPR), Interference Cancellation (IC), PHY cooperation, Retransmission Diversity (CRD) and Adaptive Modulation (AM) were shown to increase ILWN capacity. While this observation was already validated by several works, none of the works had adopted a physical layer integration of MPR, IC, CRD, and AM. Moreover, these works did not study the impacts of the techniques used in the physical layer at the MAC layer and vice-versa.

The main goal of the project was to investigate if the theoretical capacity of ILWNs could be achieved by practical communication systems, or at least, evaluate how far from an optimized solution, such as the one proposed in the project, is from the theoretical capacity bound. It was an intention of the project to propose an architecture for each node based on a cross-layering design between the physical and the MAC sub-layer. The PHY-MAC architecture design should be defined in order to coordinate and optimize the different radio technologies and node’s medium access in a decentralized way.

CHALLENGE

This project aimed to integrate MPR, IC, CRD, and AM technologies into a single architecture, particularly tailored for Infrastructure-Less Wireless Networks (ILWNs), which is itself a challenging task due to the lack of a central coordinator and to the spatial distribution of the nodes.

The IT research team combined physical layer and data link layer researchers to address both issues in an integrated, cross-layered approach. The physical layer team was responsible for the design of the architecture and the modeling of the physical systems. The data link layer team was responsible for the design of the proposed PHY-MAC architecture. The project involved a substantial interaction between all team members since the MAC layer ran on top of the MPR physical layer.

PROJECT WEBPAGE URL
https://www.it.pt/Projects/Index/1845