

# Analysis and optimization of wireless relay-assisted networks

## Mots clés :

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- **Co-encadrant(s)** :
- **Unité de recherche** : Laboratoire de recherche d'EURECOM
- **Ecole doctorale** : École Doctorale Informatique, Télécommunications, Électronique de Paris
- **Domaine scientifique principal**: Divers

## Résumé du projet de recherche (Langue 1)

New generation wireless networks go beyond the classical paradigms of cellular networks and are based on complex interactions and distributed functionalities. In this context, a fundamental role is played by relays. The potentials of wireless relays go far beyond the possibility of supporting communications between nodes otherwise not connected. By a proper coordination of different spatially distributed wireless relays, the relay nodes can effectively synthesize a virtual antenna array and emulates the operation of a multi-antenna transceiver (better known as MIMO systems). In this distributed environment, the impact of the information shared among communication nodes and the effect of the coordination on the complexity of the system on both performance and complexity are key aspects not yet understood. This project will investigate these aspects starting from two complementary points of view. The first point of view is more industrial: relaying can involve only the physical layer, both physical and data-link layers, or finally from the physical to the networking layer. The involvement of several functionalities has an obvious direct impact on the cost and complexity of the devices. The second point of view is more theoretical and relates complexity and performance to the amount of information available at each node and the corresponding necessary feedbacks. Aim of this doctoral project is to propose eventually novel cooperative protocols for relay networks with different level of complexity, analyze and compare them, and, eventually optimize them by a wise allocation of the available resources. In proposing new cooperative protocols and resource allocation strategies, the project will focus on wireless systems based on novel standards such as WiMax and LTE (Long Term Evolution. The introduction of relaying in the above mentioned standards has just started). Furthermore, it will consider complex networks with a large number of sources and relays. This will imply a large system analysis of the network and the utilization of advanced analytical tools for asymptotic analysis. Therefore, besides deep understanding of communications and information theory, the doctoral candidate will acquire strong skills in powerful analytical tools like random matrix theory, replica methods, optimization, and game theory.

## Résumé du projet de recherche (Langue 2)

New generation wireless networks go beyond the classical paradigms of cellular networks and are based on complex interactions and distributed functionalities. In this context, a fundamental role is played by relays. The potentials of wireless relays go far beyond the possibility of supporting communications between nodes otherwise not connected. By a proper coordination of different spatially distributed wireless relays, the relay nodes can effectively synthesize a virtual antenna array and emulates the operation of a multi-antenna transceiver (better known as MIMO systems). In this distributed environment, the impact of the information shared among communication nodes and the effect of the coordination on the complexity of the system on both performance and complexity are key aspects not yet understood. This project will investigate these aspects starting from two complementary points of view. The first point of view is more industrial: relaying can involve only the physical layer, both physical and data-link layers, or finally from the physical to the networking layer. The involvement of several functionalities has an obvious direct impact on the cost and complexity of the devices. The second point of view is more theoretical and relates complexity and performance to the amount of information available at each node and the corresponding necessary feedbacks. Aim of this doctoral project is to propose eventually novel cooperative protocols for relay networks with different level of complexity, analyze and compare them, and, eventually optimize them by a wise allocation of the available resources. In proposing new cooperative protocols and resource allocation strategies, the project will focus on wireless systems based on novel standards such as WiMax and LTE (Long Term Evolution. The introduction of relaying in the above mentioned standards has just started). Furthermore, it will consider complex networks with a large number of sources and relays. This will imply a large system analysis of the network and the utilization of advanced analytical tools for asymptotic analysis. Therefore, besides deep understanding of communications and information theory, the doctoral candidate will acquire strong skills in powerful analytical tools like random matrix theory, replica methods, optimization, and game theory.