The goal of this PhD is to develop an approach to dynamically select adequate values for the IEEE 802.11 Quality of Service (QoS) in terms of delay, losses or throughput. WLANs are typically based on the IEEE 802.11 standard (commercially known as WiFi). In order to meet the increasing needs of WLAN users, IEEE 802.11 has undergone several amendments, mostly aimed at strengthening its performance and security. Despite newer amendments of IEEE 802.11 and network densification, WLANs may be strained to keep up with the tremendous growth of demand. In particular, WLANs remain prone to performance and management issues such as unfairness and inefficiencies that may especially occur in dense networks. The goal of this PhD is to address part of these issues by making fine adjustments to a key mechanism of IEEE 802.11: Rate Adaptation (RA).

Rate Adaptation (RA) is a mechanism that mostly belongs to the PHY layer. It allows APs and user devices to change their transmission rate with regard to the current quality of the radio channel. In a nutshell, the better the radio channel, the higher the transmission rate. Current approaches to choose the transmission rates are typically based on preset thresholds regarding the Frames Loss Rate or the received Signal-to-Interference-plus-Noise Ratio (SINR) [LAC04,BIA08,SLA12,INT18].

Having preset values for the thresholds of RA is a conservative approach that is likely to lead to suboptimal performance for the WLANs and its users. Said differently, the performance of WLANs can be significantly improved through a fine and dynamic tuning of RA parameters. Unfortunately, as far as we know, there is no such thing as a general rule for how to set their values.

The goal of this PhD is to develop an approach to dynamically select adequate values for the IEEE 802.11 parameters related to the RA mechanism to the WLAN context. The search for an adequate setting for the RA parameters is made complex due to the vast number of parameters (e.g., the used amendment of IEEE 802.11, the channel transmission rate, the number of competing nodes, the Frame Error Rate (FER), the offered load, and the transport protocol to name a few) that may affect a WLAN behavior. This high-dimensionality contributes to hinder the finding of general closed-form expressions [STO17].

The PhD candidate will explore a new approach to determine an adequate setting of the RA parameters using a data-driven approach based on techniques of Machine Learning (ML) in Artificial Intelligence (AI). The approach will consist of three stages. First, building a large dataset of measurements that will serve as the training set. This dataset should include the attained throughput of WLAN devices (output) as well as any WLAN parameters that may significantly affect these values (input) such as transmission rate at the PHY layer, number of neighbors, SNIR, frame loss rate, etc. Second, using ML techniques to discover a function that fits the mapping between the dataset output and the inputs. Lastly, WLAN devices will embed and use this learned function to predict (approximately) what will be their attained throughput under various possible settings of their RA, and then select their best option. Overall, we cast our problem as a Nonlinear Regression problem that we will address using Artificial Neural Networks that can easily handle problems of large dimensions.
Compétences

Technical skills and level required: Background in Machine Learning techniques, Performance evaluation and Computer Networks

Languages: English or French

Other valued appreciated: Skills in wireless networks, computer network simulator, programming, optimization.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération