

ML-driven Radio Resource Management in Wireless Local Area Networks

Abstract for the general public

Wireless networks have become an important part of our daily lives, but we rarely consider the radio resources required for their operation. While some radio technologies such as LTE use dedicated licensed radio spectrum (bought from regulatory agencies), other technologies operate in frequency bands which do not require a paid government-issued license to be used. The most notable technology operating in unlicensed bands is Wi-Fi, which has sold over 4 billion units in 2020 alone. There are forecasts that by 2022 over half of all Internet traffic will be Wi-Fi and there will be over half a billion Wi-Fi hotspots globally. With this explosive growth of traffic and user devices, it becomes critical to find methods to improve the performance of wireless local area networks operating in unlicensed bands. This performance optimization is becoming increasingly difficult to achieve using available engineering methods. The way to overcome this problem is by augmenting wireless engineering design with artificial intelligence.

In particular, we want to apply machine learning (ML), which is a subset of artificial intelligence, to wireless networks. With ML, algorithms can make decisions based on gathered data without the need to be explicitly programmed beforehand (as is the case with classical computer algorithms). Among the different areas of ML, reinforcement learning (RL) seems to be the solution we need, because it deals with intelligent software agents (installed in network devices) taking actions (choosing parameters) in an environment (wireless radio) with the goal of maximizing a reward (such as user throughput). Since current network devices have high computational capabilities, wireless optimization can now be performed with RL. Additionally, RL can be implemented also in federated settings, which may appear extremely useful in distributed environments.

We have looked at recent developments and the potential of using ML for improving the performance of wireless networks has become apparent. However, we have noticed that there is an under-explored area of research related to radio resource management in wireless networks operating in unlicensed channels. The initial research of both project partners (AGH and TUB) has confirmed the applicability of ML to this problem. In the project, we plan to continue to apply ML methods to improve the performance of wireless local area networks based on upcoming standards such as Wi-Fi 7 (IEEE 802.11be). We want to address problems related to resource allocation and parameter selection. We hope to bring significant results to the research community and, in the future, to cooperate with companies to improve the maturity of the developed solutions. We believe this project is the first step in bringing innovative solutions to the market, with benefits for both users and operators.