

ML4WiFi2: Machine Learning-based WiFi Optimization

Abstract for the General Public

Wireless networks—especially Wi-Fi—are a vital part of our everyday lives. They connect our phones, laptops, and smart devices to the internet, often using freely available radio frequencies. As the number of connected devices grows and new standards like Wi-Fi 7 emerge, it becomes increasingly important to make these networks smarter and more efficient.

In our previous research, we explored how artificial intelligence, particularly machine learning (ML), can help optimize Wi-Fi performance. Now, we're taking this further by addressing three key challenges that will shape the future of wireless connectivity.

First, we want to ensure that smart, ML-powered Wi-Fi devices can work fairly alongside older, non-ML devices. Today's networks are a mix of new and legacy equipment, and we're studying how ML affects this balance. Our goal is to redesign ML solutions so they improve performance without disrupting older devices—making sure everyone gets a fair share of the network.

Second, we're exploring how generative AI (a powerful branch of machine learning) can enhance Wi-Fi-based sensing and indoor localization. This means using Wi-Fi signals not just for internet access, but also to detect movement, locate devices, and even map indoor spaces. Generative AI can help clean up noisy data, simulate realistic environments, and reduce the need for time-consuming manual measurements—making smart buildings and location-aware services more accurate and accessible.

Third, we're applying generative AI to improve how Wi-Fi networks manage data traffic. This involves smarter scheduling of transmissions, better handling of interference, and adapting to changing conditions in real time. We're building on our earlier work and using advanced models to make Wi-Fi more responsive and reliable, especially in crowded environments.

Together, these efforts aim to make wireless networks more intelligent, fair, and adaptable. Our research could lead to better internet experiences for users, more efficient network management for operators, and new applications in smart homes, offices, and public spaces. By combining cutting-edge AI with practical wireless engineering, we're helping shape the future of connectivity.