

Achieving Harmony Among Wireless Networks Sharing Radio Resources

The success of several wireless radio technologies is based in part on the availability of frequency bands which do not require a paid government-issued license to be used. These technologies are present in such devices as wireless headphones and cordless telephones. Perhaps the most notable technology based on license-free frequency bands is Wi-Fi (based on the IEEE 802.11 standard) which has observed an explosive growth in recent years: over 3 billion units were sold in 2016 alone. Therefore, Wi-Fi can be considered the incumbent technology in the most popular unlicensed bands. However, entering into these bands are several upcoming disruptive technologies; most notably LTE in its various unlicensed versions. So far, LTE operators have had to pay for frequency bands which they could use exclusively. However, with the decreasing amount of available licensed bands and increasing user requirements (high throughput, low latency), these operators are now looking to move some of their traffic to license-free bands in an opportunity to increase their earnings.

These technological and market-driven developments, along with the proliferation of wireless devices, signify that the license-free frequency bands are becoming “crowded”. This is already observable in areas with multiple Wi-Fi hotspots and many users. The situation will deteriorate once LTE-based solutions become more popular.

Comparing the operation of Wi-Fi and LTE-based technologies in terms of accessing the channel in license-free frequency bands, both aim to grasp as much radio resources as possible while coexisting with other channel users. Each technology has its advantages, however, its operation and performance boundaries are well known only if we have a single network type operating in isolation. In case of several competing technologies, the observed performance is often unexpected and surprising (i.e., different phenomena occur which are hard to predict). This leads to the following general research problem: how can harmony be achieved among wireless networks sharing radio resources? In particular, the interactions between networks using scheduled-based access (such as LTE) and using a combination of scheduled and random access (such as in future Wi-Fi networks based on the upcoming 802.11ax standard) are an important future research topic.

Our goal is to study the interactions between wireless technologies in hopes of gaining new knowledge and answering research questions of a more general nature. Our research will consist of defining and analyzing important use cases, proposing a new method of achieving harmony among wireless networks sharing radio resources, developing theoretical models and simulation scripts, and validating our proposed solutions through analysis of the obtained results. We plan to develop mathematical models, perform simulations and, if possible, perform experimental validation of our solution using. Our goal is to provide solutions that will allow fairness in radio resource sharing while maintaining efficiency in terms of channel utilization. Ultimately, this research will help radio technologies become “good neighbors” in sharing license-free frequency bands so that users can enjoy all the benefits of wireless connectivity.