



Extending LTE into the Unlicensed Spectrum: Regulatory and Technological Challenges

Mina Labib⁽¹⁾, Vuk Marojevic⁽¹⁾, Anthony Martone⁽²⁾, Jeffrey H. Reed⁽¹⁾, and Amir I. Zaghoul^(1, 2)
(1) Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA, USA
(2) US Army Research Laboratory, Adelphi, MD, USA

1. Extended Abstract

Since the introduction of smartphones, the demand on mobile data traffic has been continuously growing. At that time, the Long-Term Evolution (LTE) has been in the process of being standardized by the 3rd Generation Partnership Project (3GPP) to become the primary standard for 4G cellular technology. Cellular network operators thus directed their attention towards LTE as the enabling technology to meet the data demand, which has led to the deployment of LTE networks and handsets that dominate the wireless communications world today. LTE has been able to keep pace with the growing demand in data traffic through several added features such as using Multiple-Input Multiple-Output (MIMO) systems, higher order modulation, and carrier aggregation (CA). CA is one of the dominant features of LTE-Advanced (LTE-A). It allows mobile operators to bond several standard channels together achieving bandwidths of up to 100 MHz. Currently there are more than 400 commercial LTE networks in more than 140 countries. LTE/LTE-A is unarguably the primary standard for 4G cellular and is expected to play a big role in the development of 5G technology.

The commercial success of LTE, along with its wide deployment, significantly contributed to the growth in data traffic. Because of the natural scarcity of the RF spectrum below 6 GHz, cellular network operators strove for new and innovative technologies to develop scalable solutions to keep pace with the steadily growing service demand. One promising solution is LTE-Unlicensed, which has been recently proposed to allow cellular network operators to use unlicensed band to offload some of their data traffic to increase capacity [1]. Making effective use of spectrum, including unlicensed and shared spectrum, is the key to success for years to come. Unlicensed bands are particularly interesting as they can spur innovation by allowing neutral hosts to deploy LTE-like services and enter the wireless market without the burden of spectrum acquisition. LTE-Unlicensed has been proposed to operate in the 5 GHz band, but the core technology should be as frequency independent as possible. The 5 GHz band, known as the U-NII (Unlicensed National Information Infrastructure) band in the United States, is currently used by various radar systems, in addition to Wireless Local Area Networks (WLAN), or Wi-Fi.

This paper explains the current regulations and allocations in different parts of the world, and provides a comprehensive overview of the recent progress in technology for extending the LTE service into the unlicensed band. We discuss the several versions proposed for LTE-Unlicensed, along with the recent trends in industry prospective towards these versions, and we survey the mechanisms for a safe coexistence of technologies in the unlicensed spectrum.

2. References

1. R. Zhang, M. Wang, L. Cai, Z. Zheng, and X. Shen, "LTE-unlicensed: the future of spectrum aggregation for cellular networks," *IEEE Wireless Communications*, vol. 22, no. 3, pp. 150–159, June 2015, doi: 10.1109/MWC.2015.7143339.