T11. Gigabit Wireless LAN: IEEE 802.11ac

Abstract:

Among the wireless technologies for 2.4GHz and 5GHz unlicensed bands, WiFi has significantly transformed our networking culture at home, office, and public places to the extent that its presence has become a necessity. On the other hand, such presence has transformed adjacent technologies like cellular communications and smart grid by its off-loading capacity and low-power capability respectively. To fulfill the new demands, IEEE and the WiFi industry are delivering the 802.11ac that has astonishing maximum raw data rate of 6.9Gbps with the fairest techniques to coexist with other users of the unlicensed band. This tutorial offers a deep dive analysis of 802.11ac and its techniques.

The IEEE 802.11ac uses channel bonding, denser modulation, and more advanced MIMO and multi-user techniques along with efficient aggregation in MAC layer to deliver its promise of multi-gigabit rates and efficient transmission for high-density environments. Channel bonding is taken to its new limits of 80MHz, 160MHz and even non-adjacent 80+80MHz. While channel bonding may seem trivial in licensed bands, it is a challenge in unlicensed bands to bond multiple channels and to be fair to others transmitters including legacy and non-WiFi devices, and 802.11ac achieves this by new delicate mechanisms in PHY and MAC layers. On the multiple-antenna front, 802.11ac offers MIMO techniques with up to eight spatial streams and a unique and industry-wide accepted channel sounding mechanism. Moreover, for the first time in any WLAN standard, the new and advanced multi-user MIMO technique makes an accesspoint capable of transmitting multiple frames to different clients, all at the same time and over the same frequency spectrum. This is a transformation from wireless hub (e.g. in previous 802.11 standards) to a wireless switch on the downlink. Considering the contentious-based MAC layer, MU-MIMO is a challenging technique that takes WLAN to a new limits.

Since 802.11ac is a 5GHz-only standard, this tutorial also addresses the worldwide state of the unlicensed 5GHz spectrum and the techniques that need to be implemented to respect the activity of various radars which are the primary users of a subset of this spectrum. IEEE 802.11ac has also influenced other upcoming amendments in IEEE 802.11. We will give overview of IEEE 802.11ah and 802.11af where the former is being designed for sub 1GHz bands with sensory and smart-grid applications in mind, and the latter is being designed for TV white spaces. Both of these amendments are expected to extend the role of WiFi further in new directions and both have benefited from the techniques that have been developed in 802.11ac.

Speaker’s Biography:

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Ahmadreza Hedayat received B.S. and M.S. in electrical engineering from University of Tehran, Iran and his Ph.D. in the field of wireless communications from University of Texas at Dallas. He was with Navini Networks, Richardson, TX, and throughout its acquisition by Cisco Systems, working on WiMax technology designing algorithms for base stations and CPEs. In past three years

he has been working on next generation of WiFi standards and products, and actively contributing to IEEE Task Groups including 802.11ac. Dr. Hedayat has published over 25 IEEE journal articles and conference papers, and holds over 40 granted and filed U.S. patents. His interests are in the general area of wireless communications including multiple-antenna techniques, multiuser transmission, signal processing techniques, 802.11ac and 802.11ad, and 60GHz WLAN.