

RADIO SPECTRUM AND TECHNICAL STANDARDS ADVISORY COMMITTEE

Update on 802.11ac Wireless Local Area Network Standard

Purpose

This paper briefs Member on the development of 802.11ac wireless local area network (WLAN) standard.

Background

2. 802.11 is a set of WLAN standards developed by the Institute of Electrical and Electronics Engineers (IEEE). 802.11 family of standards are widely adopted internationally and their popularity is boosted by the Wi-Fi Alliance, which is an industry association that promotes WLAN technology and certifies products conforming to 802.11 standards. The [Wi-Fi Alliance](#) defines Wi-Fi as any “WLAN products that are based on the IEEE 802.11 standards”.

Evolution of WLAN Standards

3. The first popular WLAN standard, named 802.11b, employs direct sequence spread spectrum to achieve a maximum data rate of 11 Mbps in a 20 MHz channel in the 2.4 GHz band. With the maturity of orthogonal frequency division multiplexing (OFDM), 802.11a in the 5GHz band and 802.11g in the 2.4 GHz band have been developed to increase the throughput of WLAN to 54 Mbps using 64 QAM scheme in a 20 MHz channel bandwidth.

4. The most recent and popular WLAN standard today is 802.11n which is a further improvement over 802.11a and 802.11g. It uses 40 MHz channel bandwidth and multiple-input multiple-output (MIMO) to boost higher throughputs. MIMO is a technique of using multiple receivers, transmitters, and antennas to achieve spatial division multiplexing which enables the data rate to be multiplied by a factor roughly equal to the number of data streams. 802.11n supports up to four transmit and four receive channels (4x4) although 2x2 and 3x3 versions are more widely used. Using the common 3x3 configuration in conjunction with 64 QAM in a 40 MHz channel, the maximum

throughput can be up to 450 Mbps.

802.11ac Standard

5. 802.11ac is the next WLAN standard built upon 802.11n technologies. The primary changes over 802.11n are the use of 256 QAM, 80 MHz and optional 160 MHz continuous or non-contiguous channels, beamforming and Multi-user MIMO. Due to the limited bandwidth in the 2.4 GHz band¹, 802.11ac can only operate in the 5GHz bands². To provide backward compatibility with 802.11a and 802.11n devices operating in the 5 GHz bands, 802.11ac shall support optional 20 MHz and 40 MHz channel bandwidths.

6. Beamforming is part of the 802.11ac specification to extend range and improve link reliability. With beamforming, the transmitted signal will intelligently direct toward a device instead of radiating in an omni-directional pattern.

7. An access point utilizing 802.11n can transmit multiple spatial streams, but only directed to a single client at any given time. In 802.11ac, Multi-User MIMO is introduced whereby an access point is able to transmit to different clients simultaneously.

8. In 802.ac, using a common 3x3 configuration, the maximum throughput can be boosted to 1.3 Gbps with the use of 80 MHz channel bandwidth and 256 QAM scheme. In short, 802.11ac will be the first WLAN standard that breaks the gigabit barrier of WLAN connections.

Timeline

9. According to its official timeline, IEEE expects to ratify the 802.11ac standard by the end of 2013. In the meantime, pre-802.11ac products including Wi-Fi access points and client devices are now available in the market.

Spectrum Management Issue

10. In accordance with the Telecommunications (Telecommunications Apparatus) (Exemption from Licensing) Order, the use of WLAN equipment in

¹ 2400 – 2483.5 MHz

² 5150 – 5350 MHz, 5470 – 5725 MHz and 5725 – 5850 MHz

the 2.400 – 2.4835 GHz, 5.150 – 5.350 GHz, 5.470 – 5.725 GHz and 5.725 – 5.850 GHz frequency bands are exempted from licensing. In order to control radio interference to other services, WLAN equipment operating in the 5.150 – 5.350 GHz band are restricted to indoor use only whereas WLAN equipment operating in the 5.470 – 5.725 GHz band are subject to the technical requirement of employing dynamic frequency selection as prescribed in ITU-R Recommendation M.1652³. Since 802.11ac shall operate in the existing 5 GHz bands outlined in the Telecommunications (Telecommunications Apparatus) (Exemption from Licensing) Order, there is no need to allocate new frequency band for the use of 802.11ac equipment in Hong Kong.

Certification Requirement

11. WLAN equipment are certified under the Voluntary Certification Scheme of the Hong Kong Telecommunications Equipment Evaluation and Certification Scheme. At present, HKCA 1039⁴ covers the conformance specification of WLAN equipment in the 2.4 GHz and 5 GHz bands. According to the latest information, the operating frequency bands and transmitted power levels of 802.11ac are the same as other existing 802.11 standards in the 5 GHz bands. Under this circumstance, HKCA 1039 will be applicable to certification of 802.11ac equipment. OFCA shall continue monitoring the development of the 802.11ac standards with a view to considering the need to formulate new HKCA specification to facilitate the use of 802.11ac WLAN equipment in Hong Kong.

Advice Sought

12. Members are invited to note the content of this paper.

Office of the Communications Authority
January 2013

³ ITU-R Recommendation M.1652 entitles “Dynamic frequency selection (DFS) in wireless access systems including radio local networks for the purpose of protecting the radiodetermination service in the 5 GHz band.”

⁴ [HKCA 1039](#) – Performance specification for radiocommunications apparatus operating in the 2.4 GHz or 5 GHz band employing frequency hopping or digital modulation