COMP2250 Assignment 2 Research

# 802.11 Standards

## General Information

* “802.11 or 802.11x refers to a family of specifications developed by the IEEE for Wireless LAN (WLAN)” ([src](https://www.webopedia.com/definitions/802-11/))
* Specifies an over-the-air interface between 2 wireless networked devices (client or base station) ([src](https://www.webopedia.com/definitions/802-11/))
* IEEE accepted specifications in 1997
* 802.11 uses the CSMA/CA (Carrier-sense multiple access / Collision avoidance) protocol for standard WLAN ([src](https://brainly.in/question/13790601))
* “Always remember that radio frequency (RF) is a half-duplex medium and that the 802.11 medium contention protocol of **CSMA/CA consumes much of the available bandwidth**” ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))
* As 802.11x protocols utilise radio frequencies to transmit data, and as this technology is half-duplex, there is an inefficiency of transmission
* As more hosts try to transmit data through a single access point, collisions can occur, pausing communication to handle the collisions ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))
* Within laboratory conditions, TCP throughput of 60% - 70% can be achieved with 1 access point and 1 client ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))
* Within real world situations and in a complicated 802.11 wireless network with competing clients, it can be observed that a transmission rate of 50% of the theoretical maximum can be achieved in a best case ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))

## 802.11

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 1997
* Theoretical maximum speed: 2 Mbps
* Frequency Bands: 2.4 (GHz)

## 802.11b “WiFi 1 – Unofficial Name”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 1999
* Theoretical maximum speed: 11 Mbps
* Frequency Bands: 2.4 (GHz)
* *Very quickly superseded by 802.11a*

## 802.11a “WiFi 2 – Unofficial Name”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 1999
* Theoretical maximum speed: 54 Mbps
* Frequency Bands: 5 (GHz)
* “802.11a uses an orthogonal frequency division multiplexing encoding scheme rather than FHSS or DSSS” ([src](https://www.webopedia.com/definitions/802-11/))

## 802.11g “WiFi 3 – Unofficial Name”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 2003
* Theoretical maximum speed: 54 Mbps
* Frequency Bands: 2.4 (GHz)

## 802.11n “WiFi 4”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 2009
* Theoretical maximum speed: 600 Mbps
* Frequency Bands: 2.4/5 (GHz)
* ***Nearly legacy, only supported for older devices like old phones and IOT devices***

## 802.11ac “WiFi 5”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 2013
* Theoretical maximum speed: 1,300 Mbps
* Frequency Bands: 5 (GHz)
* “While technically 802.11ac does NOT support 2.4 GHz bands, in practice most 802.11ac routers are dual-band and can fallback to 802.11n if needed”
* ***Current standard***

## 802.11ax “WiFi 6 & WiFi 6E”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Year published: 2019
* Theoretical maximum speed: 9,600 Mbps
* Frequency Bands: 2.4/5 (GHz) (*also 6 GHz – see below*)
* With the implementation of WiFi 6E (a future development of 802.11ax), a Frequency Band of 6 GHz will be used ([src](https://www.extremenetworks.com/wifi6/what-is-80211ax/))
* “802.11ax is backward compatible with older 802.11x standards”
* Most devices do not support WiFi 6 standards, performance difference between 802.11ac and 802.11ax will be small because of this
* Best for future-proofing
* “802.11ax isn't as widespread or affordable as 802.11ac in general” – More expensive

## 802.11be “WiFi 7”

* ([main source](https://www.cbtnuggets.com/blog/technology/networking/when-to-use-802-11-a-b-g-b-nc-wifi-standards))
* Currently in development (not yet finalised)
* Final draft projected 2021
* Final version projected 2024
* IEEE documents speeds of 40,000 Mbps

# WiFi Frequency Bands and Channel Widths

<https://www.minim.com/blog/wifi-channels-explained-what-is-wifi-channel-width>

## 2.4GHz

* Less expensive
* More devices 2.4GHz capabilities
* Other devices such as microwaves, garage door openers, baby monitors, etc use this frequency band
* Can cause more radio frequency interference with these devices
* Travels further than 5GHz
* Penetrates solid objects better than 5GHz
* Lower data rate
* Spans over 100MHz of range
* Usually used with 20MHz channel width and can fit a total of 14 20MHz channels within this range
* 14 x 20MHz = 180MHz (THIS IS HIGHER THAN THE ALLOWED 100MHz OF 2.4GHZ, THEREFORE THERE IS OVERLAP) ([src](https://www.cbtnuggets.com/blog/certifications/cisco/when-to-use-20mhz-vs-40mhz-vs-80mhz))
* In a 2.4GHz 20MHz environment, only channels 1, 6, 11, and 14 do not overlap
* Some countries have regulations around usable channels (E.G. USA ONLY ALLOWS USE OF 11 OF THE 14 CHANNELS) ([src](https://www.cbtnuggets.com/blog/certifications/cisco/when-to-use-20mhz-vs-40mhz-vs-80mhz))

## 5GHz

* More expensive
* Less existing devices have 5GHz capabilities

## 20 MHz

* Channels of 22MHz width

Diagram

Description automatically generated