Samsung Wireless Enterprise

# A short guide to the differences between current 802.11n and the new 802.11ac standards

When the 802.11n standard was developed and introduced in September 2009, it was seen by many as bringing a revolution to Wi-Fi connectivity. It changed and added features to the basic communications protocol improving efficiency. 802.11ac by comparison is an evolution, building upon the foundations laid by the 802.11n standard.


As many Wi-Fi networks are using 802.11n Access Points (APs), this short guide will focus on additional benefits the 802.11ac APs will bring to your network.

| 802.11n | 802.11ac |
|---|---|
| Supports 20 and 40 MHz channels | Supports 20, 40, 80 and 160 MHz channels |
| Supports 2.4GHz and 5GHz frequency bands | Supports 5GHz frequency band only |
| Supports BPSK, QPSK, 16-QAM and 64-QAM | Adds 256-QAM |
| Supports many types of explicit beam forming | Only supports null data packet (NDP) explicit beam forming |
| Supports up to 4 spatial streams | Supports up to 8 spatial streams (AP), 4 spatial streams at the client |
| Supports single user transmission | Supports multi user transmission |
| Added significant MAC enhancements (A-MDSU, A-MPDU) to previous standards | Supports similar MAC enhancements with extensions to accommodate higher data rates |

**Let's take a look at the individual changes and what benefits and challenges they bring:**

- Two new channel sizes, 80 and 160 MHz. Each individual channel is 20MHz wide, by combining multiple channels together you will get higher data transmission rates. The spoiler is that the channels need to be contiguous and with the limited spectrum that Wi-Fi uses this can be a problem in areas that have overlapping APs or Wi-Fi networks. The ac standard does however allow for the 160MHz channel to be either eight contiguous channels or 80+80 MHz channels (4 + 4).

- 802.11ac is only supported on the higher 5GHz spectrum, this spectrum has enough bandwidth to support the 80 and 160 MHz channels, the 2.4GHz spectrum cannot support these larger channel sizes as it is limited to four non-overlapping channels in the UK, less in other countries due to local spectrum allocation.

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- Data is a string of binary characters, 1 or 0, on or off. If these characters are transmitted singularly it would be very slow and also very inefficient. On an 802.11n network at the best possible transmission rate they are put together into 6 bit words that are then transmitted as a symbol over the wireless network. The 802.11n standard allows a matrix of 64 (8*8) symbols to be used in one 20MHz channel (also known as a constellation). The 802.11ac standard changes the 6 bit word to an 8 bit word increasing capacity by 30% as well as a 256 symbol matrix (16*16). This increase does come at a cost, to accurately transmit data at this rate the transmission needs to be much cleaner than with 802.11n, another reason for only using the 5GHz spectrum as this has less interference from other sources such as microwave ovens, Bluetooth, zigbee and other devices using the 2.4GHz unlicensed band.

- Beam forming is the ability of the transmitter to direct the transmission energy towards the receiver, this increases the signal to noise ratio allowing less errors in the transmission and therefore a higher data throughput. Explicit beam forming is achieved by the transmitter and client exchanging information about the characteristics of the radio channel they are using, there are several methods of implementing this which was seen as a problem in the 802.11n standard due to different manufacturers implementing different methods so there was limited compatibility between clients and APs. The 802.11ac standard has simplified this to one method. Additionally transmitting beam formed frames requires an antenna array capable of altering its pattern on a frame by frame basis.

- Connecting more devices with higher data throughput is achieved using MU-MIMO. Multiple Input Multiple Output (MIMO) is a technology introduced with the 802.11n standard that allows a suitably equipped client device to set up several connections with the AP simultaneously, thereby increasing the data transmission between the client and AP. With the new 802.11ac standard this has been taken a step further by extending this functionality to Multiple Users (or clients) simultaneously (MU-MIMO). The clients need to be spatially diverse, i.e. not next to each other, so that the AP (Transceiver) can differentiate between the various signals. The benefit of this is that a single AP can then transmit to several clients simultaneously, increasing the conglomerated data rate through the AP, as well as the individual data rate to each device.