Planning for 802.11ac Adoption with Ekahau Site Survey™ 6.0

Introduction to 802.11ac

The emerging next generation Wi-Fi standard IEEE 802.11ac aims to break the 1Gbps barrier. It builds on developments in the 802.11n standard [5] and further improves spectral efficiency, channel usage and introduces new methods to utilize advanced antenna technology (MIMO). Usage of 802.11ac is limited to 5GHz frequency band due to limited number of available channels in the 2.4GHz band. The standard will be ratified at the end of 2013 [3].

The major 802.11ac feature enhancements are:

1. Wider channels – From 40MHz up to 80MHz or even 160MHz
2. More spatial streams – Up to 8 spatial streams possible
3. Multi-user MIMO for greater client capacity and more efficient spectrum usage
4. Standard based transmit beamforming
5. Higher modulation

The 802.11n standard increased the data rate by bonding two 20MHz channels together into 40MHz channel. The 802.11ac allows bonding up to 8 channels by introducing 80MHz and 160MHz channel bandwidths. This allows 4x rates compared to 802.11n when free bandwidth is available.

MIMO technology was also introduced in 802.11n. It allows transmitting multiple data streams simultaneously between an access point (AP) and client, thus improving the data rate. The 802.11ac includes support for up to 8 spatial streams, whereas in 802.11n the number of streams is limited to 4. It may take some time before we see a client with 8 streams but a high number of streams is needed with another new feature called multi-user MIMO (MU-MIMO). MU-MIMO allows AP to transmit frames to 4 clients simultaneously. This is particularly useful with low end mobile devices having only single antenna. Such devices are limited to receiving only single stream and AP can increase efficiency by simultaneously transmitting streams to multiple clients.

Other improvements include additions to transmit beamforming and longer battery life [2]. The 802.11ac also improves spectral efficiency by introducing QAM256 modulation, which increases the number of data bits transmitted in one symbol.

Not all the new features introduced in 802.11ac will be available with the first generation of devices. First generation (2013) devices will support 80MHz channel bandwidth with up to 3 streams, single user MIMO, and provide maximum of 1.3Gbps data-rates. During the second wave (2014), devices will support 160MHz bandwidths with up to 4 streams. This will increase data-rates to 3.4Gbps. Also MU-MIMO will be introduced later. [1]

Ekahau Site Survey™ ESS 6.0 Introduces Support for IEEE 802.11ac (WLAN) Adoption

A New Standard Requires New Tools

Taking full advantage of the new features requires understanding the 802.11ac technology. This applies both to network planning and analysis. The 802.11ac devices operate in the 5GHz frequency band where signal coverage is smaller than in the 2.4GHz band. The network should be especially designed for 5GHz in mind to ensure adequate coverage. New 802.11ac features such as QAM256 modulation and an increase in the number of spatial streams require high signal levels thus favoring dense network deployments.

Wide 80MHz and 160MHz channels improve throughput but only when full channel bandwidth is free from interfering transmissions. In dense network deployments, careful channel planning is critical to ensure interference-free operation. Channels cannot be selected arbitrarily but primary channels must always be selected so that access points within radio range can fall back to use lower non-overlapping channel for simultaneous transmissions. For example, APs on an 80MHz channel can fall back to use 40MHz or 20MHz channel bandwidths as described in Figure 1.

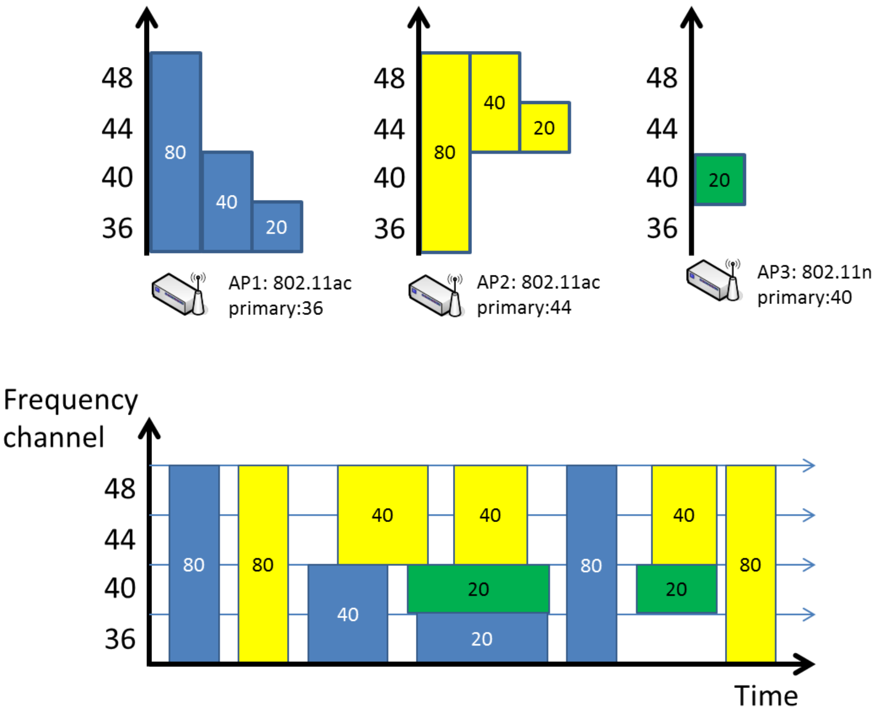

Figure 1. Two 802.11ac APs and one legacy AP. Their channel setups and example transmission schedule [4][1]

The effective throughput of 802.11ac network depends highly on operating parameters such as number of spatial streams, channel bandwidths, and channel assignments. Without understanding and accurate modeling of these parameters, the estimation of the network capacity is difficult. Still, understanding how network capacity behaves with different type of devices and traffic patterns such as first and second generation 802.11ac client devices, is ultimately necessary. With the introduction of bring-your-own-device (BYOD) trend, network traffic evaluations can be especially challenging for a network designer.

In 802.11ac deployment planning, the big question is how much network capacity is increased by simply replacing 5GHz 802.11n radios with 802.11ac. This is not an easy question to answer, but advanced tools can help to find an answer.

Ekahau Site Survey™ Estimates Capacity Requirements

Ekahau Site Survey (ESS) provides advanced tools for network planning, capacity analysis and site survey. The new ESS 6.0 introduces support for 802.11ac devices.

The goal of network analysis is to understand network capacity. The ESS capacity estimation algorithm allows user to accurately estimate the capacity of the planned network with a different set of client devices and traffic patterns. ESS models the key parameters of 802.11ac including the MIMO configurations, channel bandwidths, new QAM256 modulation, and frame aggregation just to name few. To support analysis of your own device, ESS includes predefined templates of AP and client devices and allows estimation of network capacity with a user-configurable set of client devices and their applications. This allows estimation of how network capacity differs, for example, between first and second generation 802.11ac devices.

ESS enables network planning either manually or automatically based on user-defined requirements. The selected AP type automatically provides information on the device's 802.11ac capabilities including MIMO configuration and supported channel bandwidths. Automatic planning ensures adequate coverage for 5GHz band also with multi-radio dual band deployments. The planning algorithm finds the required number of APs to fulfill the traffic profile and automatically selects locations and frequency channels for APs. For 802.11ac, the user can configure the utilized channel bandwidth as well as the allowed channels. The planning algorithm selects frequency channels using the selected bandwidth, including selection of the center channel as well as the primary channel. Channels are selected in such a way, that interference and channel overlap in the network is minimized. The primary channel selection algorithm is optimized for a mixed 802.11ac/802.11n client base and supports parallel non-overlapping 80MHz, 40MHz, and/or 20MHz bandwidth transmissions when full bandwidth is not available.

Measurement of live networks is one of the features provided by ESS--this allows measurement and verification of 802.11ac AP capabilities including the number of supported spatial streams, channel bandwidth and other significant parameters. This information is acquired by analyzing the information elements transmitted by the access points.

Summary

New features in the emerging 802.11ac standard provide significant throughput improvements and also make planning and analyzing of the networks more challenging. Ekahau Site Survey provides advanced tools that can be used to plan, analyze, and measure 802.11ac networks. This allows taking the full benefit of the improved capacity and helps to estimate network capacity to support BYOD. To see yourself how ESS can help you to plan and analyze 802.11ac networks, apply for the free evaluation version at http://www.ekahau.com/try-ess.

References:

[1] Cisco, "802.11ac: The Fifth Generation of Wi-Fi", Technical White Paper, August, 2012

[2] Ruckus, "802.11ac: Very High Throughput", White Paper, February, 2013

[3] IEEE 802.11 Official Working Group Timeline, February 2013, [ONLINE] http://grouper.ieee.org/groups/802/11/Reports/802.11_Timelines.htm

[4] IEEE P802.11ac/D3.0, June 2012

[5] IEEE Std 802.11™-2012