Design: New WiFi 6 Hardware and How it helps improve customer home experience

WiFi 6 is built on the 802.11ax standard. It introduced fundamental changes to WiFi including OFDMA and new subcarrier spacing. The standard differs from its predecessors by focusing on efficiency rather high speed and high throughput. It was designed to maximize efficiency in utilizing the available resources (Bandwidth, Airtime, and Power Consumption, etc..).

WiFi 6 comes with some features that will improve the customer home experience. BSS coloring improves spatial reuse by mitigating CCI (Co-Channel interference). TWT (Target Wait Time) will help save battery life of WiFi IoT devices. OFDMA on DL will help save Airtime and lower channel utilization for video streaming on set-top boxes by combining their traffic in one OFDMA PPDU, rather than TDMA. WiFi 6 introduces new MCS 10, and 11 using 1024-QAM for higher throughput. With 160MHz channel width and 1024-QAM 5/6 LDPC allows a windows PC with 2x2 160 MHz Wireless card (Intel AX200 is a commercially available wireless card with these specs) to have a PHY rate of 2400Mbps for gig speed service.

The only problem with WiFi 6 is that it not here yet. As for all new standards it takes time for the clients to catch up and become the majority on the network. As from the time of writing this, there are only 2 known phones with WiFi 6, the Samsung S10 and the iPhone 11. It will take probably another 1-2 years for STBs (Set top Boxes), IoT devices, and other devices using WiFi to catch up to WiFi 6 so, what will a customer gain from installing a new WiFi 6 AP in their home? To answer this question, we need to look at what makes a new WiFi 6 AP different from a WiFi 5 AP:

- More Packet processing power: WiFi 6 APs are expected to handle more traffic, and take on more and new responsibilities, like scheduling traffic for UL and DL OFDMA, keep tracking of individual wake-up times for each device, and many other new features that will come with WiFi 6. This heavy lifting requires an increase in its packet processing power which is also reflected in handling non WiFi 6 devices.
- Carrier Spacing: Going from 312.5kHz subcarrier spacing in the previous standards to 78.125kHz in WiFi 6 requires oscillators to have lower phase noise. The improved radio improves the performance of all devices.
- 1024-QAM:
    - Requires more linear amplifier having better EVM, improving the performance of all devices.
    - MCS 10, and 11 require the AP to handle 1024-QAM.
- Receiver Specifications:
    - Receiving 1024-QAM at 78.125kHz subcarriers spacing with OFDMA requires an improved NF (Noise Figure).
    - All of this means the 802.11ax APs must have a much lower NF than VHT APs. This lower NF is reflected on the overall performance of the AP as a higher SNR in both Tx and Rx states even when its operating in VHT mode.

To verify these gains an active site survey with iperf was conducted. Both APs used have chipsets from the same vendor except one has an 802.11ax chipset and the other has an 802.11ac chipset. Both APs were set to channel 100 and BW 80MHz in a radio silence environment. The same client was used to conduct the survey for both APs. The client was a 2014 MacBook pro with 3x3 and BW 80MHz.

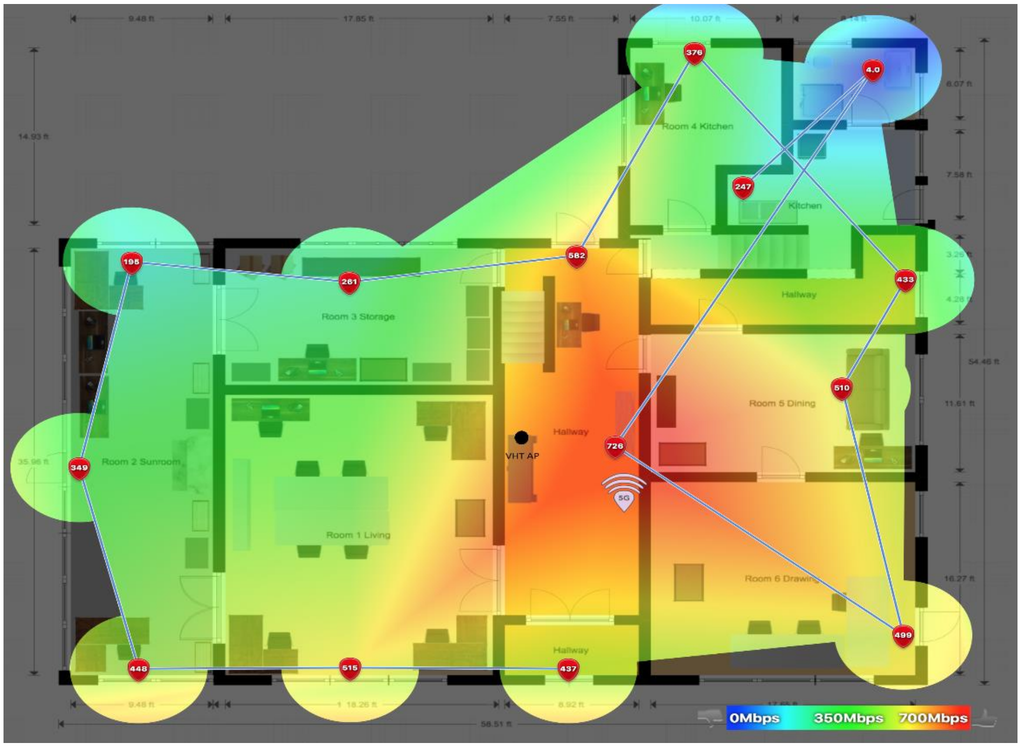

Figure 1: Shows throughput numbers for a VHT AP DL TCP iperf

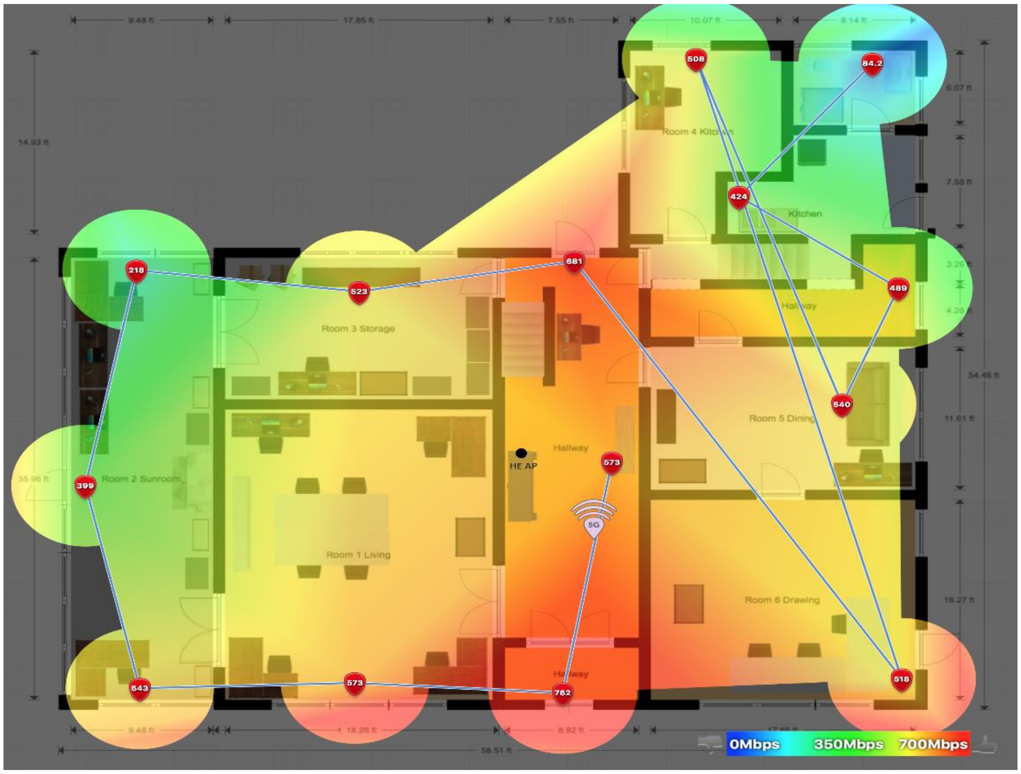

Figure 2: Shows throughput numbers for a HE AP DL TCP iperf

If you take a look at the DL throughput reported on the heat maps in Figure 1 and 2 you can see that at close distance there is not much of a difference in performance between the 802.11ax AP and 802.11ax AP but, at a challenging spot blocked by the tile of a shower (The point is at the far right top corner of the heatmap) the 802.11ac AP measured 4Mbps where the 802.11ax AP measured 84Mbps.

Conclusion, introducing a WiFi 6 AP into a customer's home can improve the customer experience especially at far locations where the better built 802.11ax hardware can improve link quality and provide better VHT throughput.