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EION BYTES

The official solution update of EION Wireless

New Technologies behind the Gigabit Wireless OFDMA, 1024 QAM, MU-MIMO, TWT and BSS Coloring

WHAT'S INSIDE THIS ISSUE?

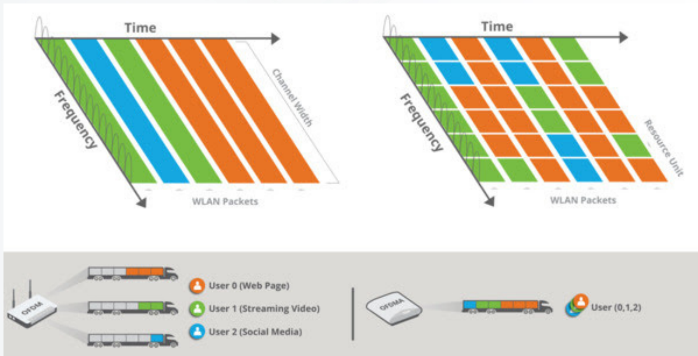
From 802.11b to 802.11ax

The base version of the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard debuted in 1997, with specifications for data rates of 1 and 2 megabits per second (Mbit/s). Since then, the IEEE has ratified five major iterations of the 802.11 WiFi protocol, culminating with 802.11ac in 2013. However, despite a significant increase in speed, many organizations are finding themselves limited by the 802.11ac standard, particularly in high-density venues such as stadiums, convention centers, transportation hubs and auditoriums. To meet the challenges of high-density deployments, the IEEE recently introduced the 802.11ax standard, which is backward compatible with previous generations of WiFi, to deliver faster network performance and connect more devices simultaneously. With an expected four-fold capacity increase over its 802.11ac Wave 2 predecessor, 802.11ax is successfully transitioning WiFi from a 'best-efforts' endeavour to a deterministic wireless technology that is fast becoming the de-facto medium for internet environments will support higher service-level agreements (SLAs) to more concurrently connected users and devices – with more diverse usage profiles. This is made possible by a range of technologies that optimize spectral efficiency, increase throughput and reduce power consumption . These include Orthogonal Frequency-Division Multiple Access (OFDMA), Target Wake Time (TWT), BSS Coloring, 1024-QAM and MU-MIMO.

OFDMA

Current and older iterations of WiFi are client-centric with a randomized, contention-based approach that relegates WiFi to a "free-to-send" first come, first served paradigm which is untenable for modern high-density deployments. In contrast, OFDMA is AP-centric and enables an 802.11ax access point to simultaneously communicate with multiple devices by dividing each WiFi channel into smaller sub-channels known as Resource Units (RU). The access point determines how to allocate the sub-channels, as each individual RU (or sub-channel) can be utilized for different clients that are serviced simultaneously. In other words, an AP can choose to allocate the whole channel (all sub-channels within a channel) to a single user in a given time frame, or it may partition the whole channel to serve multiple devices simultaneously. This technique improves the usable throughput for all devices connected to an AP.

The allocation and scheduling capability supported by OFDMA allows multiple devices to receive more consistent attention. This reduces the use of the contention methodology that preceded 802.11ax and moves WiFi from a contention-based to a scheduled-based service, which is analogous to an unmanaged four-way street intersection finally getting a traffic light. This helps stabilize WiFi performance, especially in higher-density environments such as stadiums, convention centers, transportation hubs, and auditoriums.



1024 QAM

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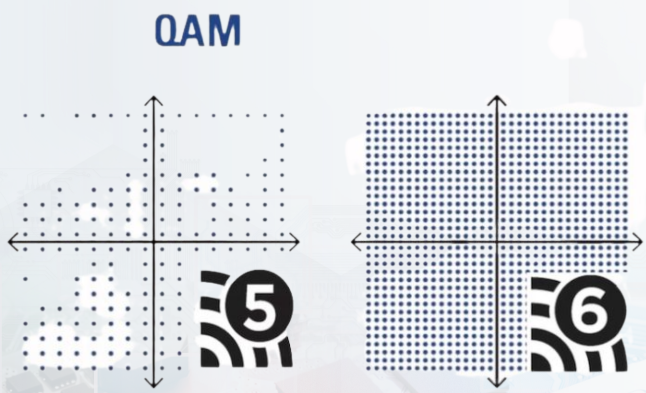

QAM is a modulation scheme that transmits data by changing the amplitude, or power level, of two signals: first in-phase with the incoming data and the second 90 degrees out of phase. QAM relates to the number of bits of information encoded in each time period. For example, eight bits defines the number of combinations that are possible for those two signals (in phase and 90 degrees out of phase). If there are 256 combinations possible for those eight bits, then it is referred to as 256 QAM. Using a single time period to convey 10 bits would be 1024 QAM.

While the older WiFi 5 (802.11ac) standard is limited to 256 QAM, the new WiFi 6 (802.11ax) standard incorporates an extremely high optional modulation scheme (1024 QAM), with each symbol (a point on the constellation diagram) encoding a larger number of data bits when using a dense constellation. In real-world terms, 1024-QAM enables a 25% data rate increase (throughput) in WiFi 6 (802.11ax) access points and devices. With over 35 billion connected "things" expected by 2022, higher wireless throughput facilitated by 1024 QAM is critical to ensuring quality of-service (QoS) in high-density locations such as stadiums, convention centers, transportation hubs, and auditoriums.

MU-MIMO - Multi user-MIMO

UL MU-MIMO is a new key feature introduced with WiFi 6 (802.11ax). By leveraging UL MU-MIMO, multiple clients connected to the access point will be able to send acknowledgment responses (ack) simultaneously, thus saving airtime. This ultimately improves network throughput and efficiency.

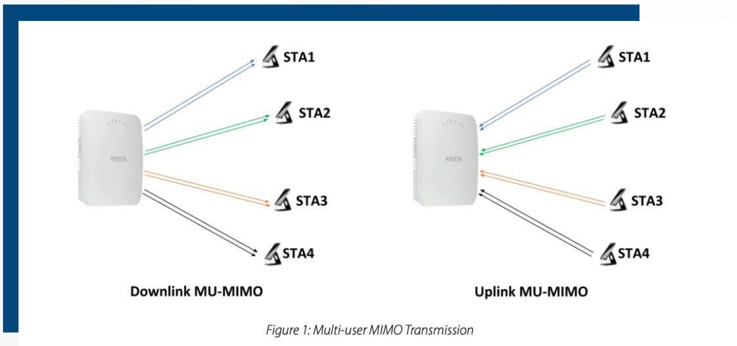

Figure 1: Multi-user MIMO Transmission

TWT - Target Wait Time

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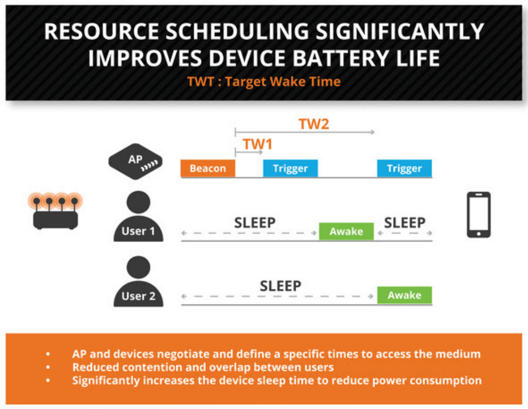
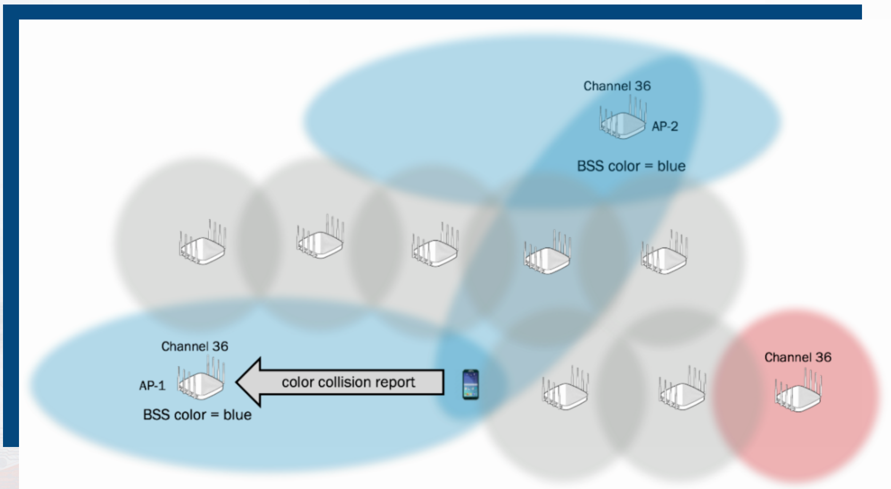


BSS Coloring

Legacy high-density WiFi deployments typically saw multiple access points assigned to the same transmission channels due to a limited amount oF spectrum – an inefficient paradigm that contributed to network congestion and slowdowns. Moreover, legacy IEEE 802.11 devices were unable to effectively communicate and negotiate with each other to maximize channel resources. In contrast, WiFi 6 access points are designed to optimize the efficient reuse of spectrum in dense deployment scenarios using a range of techniques, including BSS Coloring. This mechanism intelligently 'color codes' – or marks – shared frequencies with a number that is included within the PHY header that is passed between the device and the network. In real-world terms, these color codes allow access points to decide if the simultaneous use of spectrum is permissible because the channel is only busy and unavailable to use when the same color is detected. This helps mitigate Overlapping Basic Service Sets (OBSS). In turn, this enables a network to more effectively – and concurrently – transmit data to multiple devices in congested areas. This is achieved by identifying OBSS, negotiating medium contention and determining the most appropriate interference management techniques. Coloring also allows WiFi 6 access points to precisely adjust Clear Channel Assessment (CCA) parameters, including energy (adaptive power) and signal detection (sensitivity thresholds) levels.



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