WiFi Standards

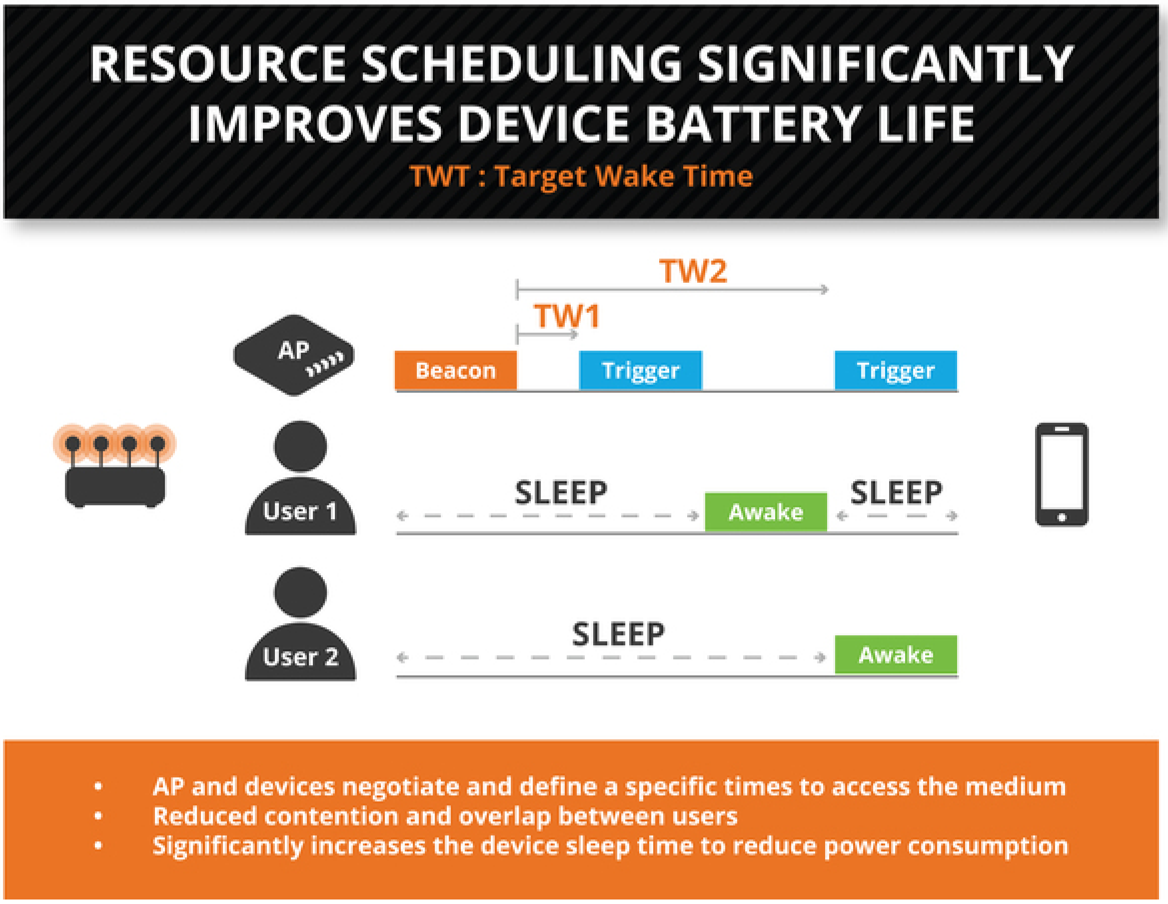
WiFi Standards Comparison

	WiFi 5	WiFi 6	WiFi 6e	WiFi 7
Launch date	2013	2019	2021	2024
Standard name	802.11ac	802.11ax	802.11ax	802.11be
Power and battery life	-	Supports TWT		
Security protocols	WPA, WPA2	WPA, WPA2, **WPA3 (OWE)**		
Modulation	up to 256-QAM	up to 1024-QAM		up to 4096-QAM
Beamforming	up to four antennas	up to eight antennas		
Subcarriers (Resource units)	-	Supports OFDMA	OFDMA	OFDMA
Multi-RU	-	No	No	Yes
MU-MIMO	up to 4x4 downlink unidirectional	up to 8x8 bidirectional	up to 8x8 bidirectional	up to 16×16 bidirectional
Frequency bands	2.4 GHz, 5 GHz	2.4 GHz, 5 GHz	2.4 GHz, 5 GHz, 6 GHz	2.4 GHz, 5 GHz, 6 GHz
Channel width	20, 40, 80, 80+80, 160 MHz	Same	Same	Up to 320 MHz
BSS coloring	-	Yes		
Latency		Reduced if all devices using the network are WiFi 6 and above, due to the above features.		

Target Wake Time (TWT)

[Source]

TWT enables devices to determine when and how frequently they will wake up to send or receive data. Essentially, this allows 802.11ax access points to effectively increase device sleep time and significantly conserve battery life, a feature that is particularly important for the IoT. In addition to saving power on the client device side, Target Wake Time enables wireless access points and devices to negotiate and define specific times to access the medium. This helps optimize spectral efficiency by reducing contention and overlap between users.



The Target Wake Time mechanism first appeared in the IEEE 802.11ah “Wi-Fi HaLow” standard. Published in 2017, the low-power standard is specifically designed to support the large-scale deployment of IoT infrastructure – such as stations and sensors – that intelligently coordinate signal sharing. The TWT feature further evolved with the IEEE 802.11ax standard, as stations and sensors are now only required to wake and communicate with the specific Beacon(s) transmitting instructions for the TWT Broadcast sessions they belong to. This allows the wireless IEEE 802.11ax standard to optimize power saving for many devices, with more reliable, deterministic and LTE-like performance. As Maddalena Nurchis and Boris Bellalta of the Universitat Pompeu Fabra in Barcelona noted in a recent paper, TWT also “opens the door” to fully maximizing new MU capabilities in 802.11ax by supporting the scheduling of both MU-DL and MU-UL transmissions. In addition, TWT can be used to collect information from stations, such as channel sounding and buffers occupancy in pre-defined periods. Last, but certainly not least, TWT can potentially help multiple WLANs in dense deployment scenarios reach consensus on non-overlapping schedules to further improve Overlapping Basic Service Set (OBSS) co-existence.

WPA3 Opportunistic Wireless Encryption (OWE)

[Source]

Multi-User, Multiple Input, Multiple Outputs (MU-MIMO)

Orthogonal Frequency-Division Multiple Access (OFDMA)

The Benefits of OFDMA for Wi-Fi 6 - A technology brief highlighting Qualcomm Technologies' competitive advantage

OFDM subdivides the Wi-Fi channel into smaller frequency allocations called resource units. By partitioning the channel, parallel transmissions of smaller frames to multiple users occur simultaneously. For example, a traditional 20 MHz channel might be partitioned into as many as nine smaller channels. Using OFDMA, a Wi-Fi 6 AP could simultaneously transmit smaller frames to nine Wi-Fi 6 clients.

The Wi-Fi Alliance Whitepaper further explains the difference between uplink and downlink OFDMA.

Uplink OFDMA is one of the key features introduced by Wi-Fi 6 and is among the most significant differences relative to 802.11ac. Uplink OFDMA allows data frames to be transmitted simultaneously by
multiple stations. This amortizes preamble overhead and medium contention overhead, which leads to
high aggregated network throughput. Uplink OFDMA can provide additional gains by permitting greater
transmit power level per device, subject to regulatory requirements, and thus signal coverage on the uplink,
since the transmit power of each client device can be concentrated on smaller allocated resource units.

Downlink OFDMA allows multiple data frames to be transmitted in a single data unit to multiple stations,
thus amortizing preamble overhead and medium contention overhead, leading to higher aggregated
network throughput. Downlink OFDMA can further optimize aggregate throughput by balancing the allocation of power between users at high versus low signal-to-noise ratios, subject to total power constraints and regulatory requirements.

Frequency bands

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