

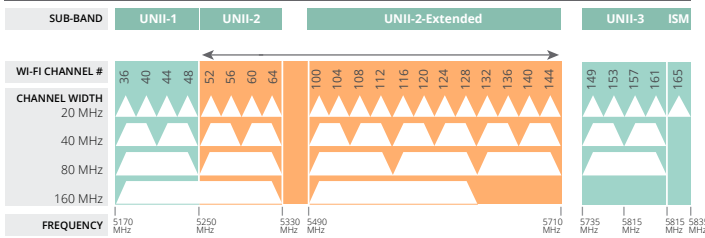
WI-FI 6 REFERENCE

SUPERB PERFORMANCE - EVEN IN CROWDED AREAS

WI-FI 6 (802.11AX) USES THE SAME 5GHZ AND 2.4GHZ CHANNELS AS 802.11N/AC

Wi-Fi 6 supports channel widths of 20, 40, 80 and 160 MHz in the 5GHz band. While OFDMA allows for a more efficient use of the spectrum, 20/40/80MHz channels are recommended for enterprise deployments, while 160MHz is best-suited for environments with low channel utilization. In the 2.4GHz band, 20 and 40 MHz channel widths are supported, but 20 MHz is recommended.

5GHZ CHANNEL ALLOCATION (NORTH AMERICA)



INCREASED DATA RATES

Wi-Fi 6 delivers significantly higher peak data rates than Wi-Fi 5 (802.11ac) in 5GHz and 802.11n in 2.4GHz. Note that support for 8SS was not widely adopted with Wi-Fi 5, but is expected to be more common with Wi-Fi 6.

CHANNEL BANDWIDTH	1 SS	2 SS	3 SS	4 SS	8 SS
20 MHz 802.11n (2.4 GHz)	72 Mbps	144 Mbps	217 Mbps	289 Mbps	N/A
20 MHz 802.11ac (5 GHz)	87 Mbps	173 Mbps	289 Mbps	347 Mbps	693 Mbps
20 MHz 802.11ax (2.4/5 GHz)	143 Mbps	287 Mbps	430 Mbps	574 Mbps	1147 Mbps
40 MHz 802.11n (2.4 GHz)	150 Mbps	300 Mbps	450 Mbps	600 Mbps	N/A
40 MHz 802.11ac (5 GHz)	200 Mbps	400 Mbps	600 Mbps	800 Mbps	1600 Mbps
40 MHz 802.11ax (2.4/5 GHz)	287 Mbps	574 Mbps	860 Mbps	1147 Mbps	2294 Mbps
80 MHz 802.11ac (5 GHz)	433 Mbps	867 Mbps	1300 Mbps	1733 Mbps	2167 Mbps
80 MHz 802.11ax (5 GHz)	600 Mbps	1201 Mbps	1801 Mbps	2402 Mbps	4804 Mbps
160 MHz 802.11ac (5 GHz)	867 Mbps	1733 Mbps	2340 Mbps	3467 Mbps	6933 Mbps
160 MHz 802.11ax (5 GHz)	1201 Mbps	2402 Mbps	3603 Mbps	4804 Mbps	9608 Mbps

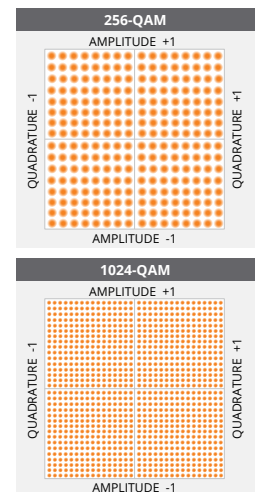
* Data rate may vary depending on client availability.

MODULATION & NET BIT RATE (PER STREAM)

MCS INDEX	MODULATION	CODING	2.0 MHz	4.1 MHz	8.3 MHz	18.9 MHz	37.8 MHz	77.8 MHz
0	BPSK	1/2	0.9	1.8	3.8	8.6	17.2	36.0
1	QPSK	1/2	1.8	3.5	7.5	17.2	34.4	72.1
2	QPSK	3/4	2.6	5.3	11.3	25.8	51.6	108.1
3	16-QAM	1/2	3.5	7.1	15.0	34.4	68.8	144.1
4	16-QAM	3/4	5.3	10.6	22.5	51.6	103.2	216.2
5	64-QAM	2/3	7.1	14.1	30.0	68.8	137.6	288.2
6	64-QAM	3/4	7.9	15.9	33.8	77.4	154.9	324.3
7	64-QAM	5/6	8.8	17.6	37.5	86.0	172.1	360.3
8	256-QAM	3/4	10.6	21.2	45.0	103.2	206.5	432.4
9	256-QAM	5/6	11.8	23.5	50.0	114.7	229.4	480.4
10	1024-QAM	3/4	13.2	26.5	56.3	129.0	258.1	540.4
11	1024-QAM	5/6	14.7	29.4	62.5	143.4	286.8	600.4

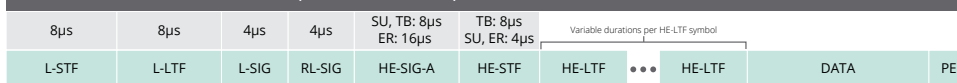
INCREASE IN DATA RATE WITH 1024 QAM

Wi-Fi 6 has 1024 QAM modulation. Each OFDM symbol represents 10bits of data vs 8 for 256QAM in Wi-Fi 5, which is a 25% increase in bits per symbol which translates to 25% decrease in error margin.

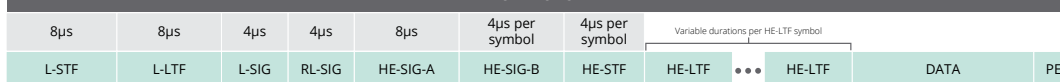


WI-FI 6 (802.11AX) PHYSICAL LAYER FRAME FORMAT

HE SU, EXTENDED RANGE SU, AND TRIGGER-BASED PPDU FORMATS



HE MU PPDU FORMAT



HIGHLIGHTS

WI-FI 5

- Multi-User MIMO (downlink)
- 4 Spatial Streams (4SS)
- 20/40/80/160 MHz channel
- 256-QAM modulation and coding
- Explicit transmit beamforming

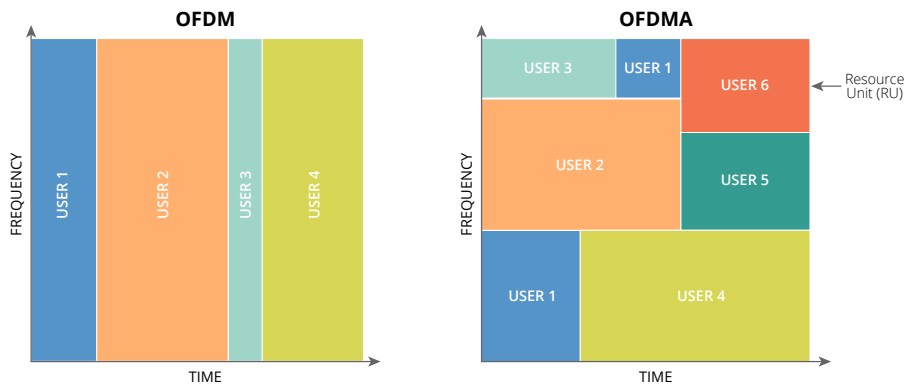
WI-FI 6

- 4x Average throughput per station in 2.4 & 5 GHz bands
- Multi-User MIMO (uplink and downlink)
- OFDMA uplink and downlink
- Higher rates (1024-QAM)
- Wait to Wake (Target Wake Time)
- Enhanced outdoor long-range performance

ENHANCED USER EXPERIENCE

ORTHOGONAL FREQUENCY DIVISION MULTIPLE ACCESS (OFDMA)

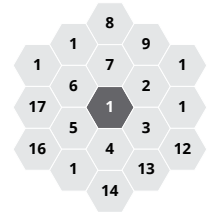
OFDMA improves transmission efficiency in high density environments and where short packets are transmitted by combining users. The resulting benefit is a 4x improvement in average throughput per client in a dense deployment scenario as well as efficiently serving IOT type devices with standard enterprise clients.



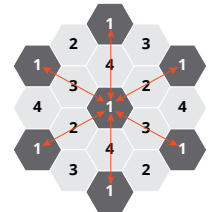
INCREASE NETWORK CAPACITY WITH BSS COLORING

New channel access behavior is introduced in Wi-Fi 6 by assigning a different "color" per BSS and allowing more simultaneous transmissions in same channels with different BSS colors. The resulting benefit is greater frequency reuse between BSS's with increase in network capacity.

LOW FREQUENCY REUSE (W/ 20 MHZ CHANNELS)



INCREASED FREQUENCY REUSE (W/ 80 MHZ CHANNELS) ALL SAME-CHANNEL BSS BLOCKING

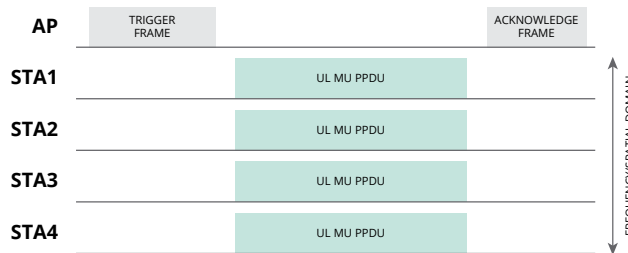


SAME-CHANNEL BSS ONLY BLOCKED ON COLOR MATCH



UPLINK ENHANCEMENTS

802.11ac introduced downlink MU-MIMO from AP to multiple users to improve downlink efficiency. 802.11ax enhances uplink transmission efficiency from multiple clients to AP in both OFDMA and MU-MIMO. The resulting benefit is faster uplink response times experienced by clients, which is required given that most traffic patterns now are symmetrical in nature.



POWER SAVING ENHANCEMENTS

Mechanisms such as Target Wake Time (TWT) negotiated between a client and an AP, Broadcast TWT for clients that have not negotiated pre-scheduled wake times, aggressively focus on improved power efficiency for stations. The resulting benefit is extended battery performance for client devices.

