**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. Wi-Fi OFDMA allows for a more efficient use of the spectrum, 20/40/80MHz channelization 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.

**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.

**MODULATION & NET BIT RATE (PER STREAM)**

<table>
<thead>
<tr>
<th>MCS INDEX</th>
<th>MODULATION</th>
<th>CODING</th>
<th>2.0 MHz</th>
<th>4.1 MHz</th>
<th>8.3 MHz</th>
<th>16.6 MHz</th>
<th>17.6 MHz</th>
<th>38.7 MHz</th>
<th>77.8 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>BPSK</td>
<td>1/2</td>
<td>0.9</td>
<td>1.8</td>
<td>3.8</td>
<td>8.6</td>
<td>17.2</td>
<td>36.0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>QPSK</td>
<td>1/2</td>
<td>1.8</td>
<td>3.5</td>
<td>7.5</td>
<td>17.2</td>
<td>34.4</td>
<td>72.1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>QPSK</td>
<td>3/4</td>
<td>2.6</td>
<td>5.3</td>
<td>11.3</td>
<td>25.8</td>
<td>51.6</td>
<td>108.1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>16-QAM</td>
<td>1/2</td>
<td>3.5</td>
<td>7.1</td>
<td>15.0</td>
<td>34.4</td>
<td>68.8</td>
<td>144.1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>16-QAM</td>
<td>3/4</td>
<td>5.3</td>
<td>10.6</td>
<td>22.5</td>
<td>51.6</td>
<td>103.2</td>
<td>212.6</td>
<td></td>
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<tr>
<td>5</td>
<td>64-QAM</td>
<td>2/3</td>
<td>7.1</td>
<td>14.1</td>
<td>30.0</td>
<td>68.8</td>
<td>137.6</td>
<td>288.2</td>
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<tr>
<td>6</td>
<td>64-QAM</td>
<td>3/4</td>
<td>7.9</td>
<td>15.9</td>
<td>33.8</td>
<td>77.4</td>
<td>154.9</td>
<td>324.3</td>
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</tr>
<tr>
<td>7</td>
<td>64-QAM</td>
<td>5/6</td>
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<td>17.6</td>
<td>37.5</td>
<td>86.0</td>
<td>172.1</td>
<td>360.3</td>
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</tr>
<tr>
<td>8</td>
<td>256-QAM</td>
<td>3/4</td>
<td>14.6</td>
<td>29.4</td>
<td>62.5</td>
<td>134.3</td>
<td>286.8</td>
<td>600.4</td>
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</tr>
<tr>
<td>9</td>
<td>256-QAM</td>
<td>5/6</td>
<td>11.8</td>
<td>23.5</td>
<td>50.0</td>
<td>114.7</td>
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<tr>
<td>10</td>
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<td>3/4</td>
<td>13.2</td>
<td>26.5</td>
<td>56.3</td>
<td>129.0</td>
<td>258.1</td>
<td>540.4</td>
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<tr>
<td>11</td>
<td>1024-QAM</td>
<td>5/6</td>
<td>14.7</td>
<td>29.4</td>
<td>62.5</td>
<td>134.3</td>
<td>286.8</td>
<td>600.4</td>
<td></td>
</tr>
</tbody>
</table>

* Data rate may vary depending on client availability.

**INCREASE IN DATA RATE WITH 1024 QAM**

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

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

<table>
<thead>
<tr>
<th>8µs</th>
<th>8µs</th>
<th>4µs</th>
<th>4µs</th>
<th>4µs</th>
<th>4µs</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-STF</td>
<td>L-LTF</td>
<td>L-SIG</td>
<td>RL-SIG</td>
<td>HE-SIG-A</td>
<td>HE-STF</td>
</tr>
</tbody>
</table>

**HE MU PPDU FORMAT**

<table>
<thead>
<tr>
<th>8µs</th>
<th>8µs</th>
<th>4µs</th>
<th>4µs</th>
<th>4µs</th>
<th>4µs</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-STF</td>
<td>L-LTF</td>
<td>L-SIG</td>
<td>RL-SIG</td>
<td>HE-SIG-A</td>
<td>HE-STF</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>8µs</th>
<th>8µs</th>
<th>4µs</th>
<th>4µs</th>
<th>4µs</th>
<th>4µs</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-STF</td>
<td>L-LTF</td>
<td>L-SIG</td>
<td>RL-SIG</td>
<td>HE-SIG-A</td>
<td>HE-STF</td>
</tr>
</tbody>
</table>

**SUPERB PERFORMANCE - EVEN IN CROWDED AREAS**

5GHz Channel Allocation (North America)

- **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**

- **20 MHz 802.11n (2.4 GHz)**
- **20 MHz 802.11ac (5 GHz)**
- **20 MHz 802.11ax (2.4/5 GHz)**
- **40 MHz 802.11n (2.4 GHz)**
- **40 MHz 802.11ac (5 GHz)**
- **40 MHz 802.11ax (2.4/5 GHz)**
- **80 MHz 802.11ac (5 GHz)**
- **80 MHz 802.11ax (5 GHz)**
- **160 MHz 802.11ac (5 GHz)**
- **160 MHz 802.11ax (5 GHz)**

* Data rate may vary depending on client availability.

**INCREASE IN DATA RATE WITH 1024 QAM**

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

**AMPLITUDE +1**

**QUADRATURE +1**

**AMPLITUDE -1**

**QUADRATURE -1**
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.

**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.