Modulation schemes in the PHY layer of Wi-Fi standards encode data onto carrier waves to enable wireless transmission, varying signal properties like amplitude, phase, or frequency to represent binary data. The process starts with a baseband signal (data) being modulated onto a high-frequency carrier wave, which the receiver demodulates to retrieve the original information. Different schemes balance speed, range, and robustness against noise.

BPSK (Binary Phase Shift Keying), used in 802.11b, modulates data by shifting the phase of the carrier wave to represent 0 or 1 (two phases), offering a basic data rate of 1 Mbps with DSSS. It's robust but limited in speed.
QPSK (Quadrature Phase Shift Keying), also in 802.11b, uses four phase states to encode 2 bits per symbol, doubling the rate to 2 Mbps, improving efficiency while maintaining decent noise resistance.
CCK (Complementary Code Keying), specific to 802.11b's higher rates (5.5 and 11 Mbps), employs complex codes to encode multiple bits per symbol, enhancing throughput but requiring better signal quality.
OFDM (Orthogonal Frequency Division Multiplexing), introduced in 802.11a/g and evolved in later standards, splits data across multiple subcarriers, each modulated (e.g., with BPSK, QPSK, or higher) to achieve up to 54 Mbps in 802.11a/g. It improves spectral efficiency and resistance to multipath interference.
16-QAM (Quadrature Amplitude Modulation), used in 802.11a/g and beyond, encodes 4 bits per symbol using 16 phase/amplitude combinations, boosting speeds (e.g., 24 Mbps in 802.11a) but needing a stronger signal.
64-QAM, in 802.11a/g and later (e.g., 54 Mbps in 802.11a), encodes 6 bits per symbol with 64 states, offering higher rates but greater susceptibility to noise.
256-QAM and 1024-QAM, introduced in 802.11ac and 802.11ax, encode 8 and 10 bits per symbol respectively, enabling speeds up to 1.3 Gbps (802.11ac) and 9.6 Gbps (802.11ax), but require excellent signal-to-noise ratios.

Performance Comparison:

- BPSK and QPSK in 802.11b provide reliable low-speed connections (1-2 Mbps) over longer ranges but are inefficient for modern needs.

- CCK pushes 802.11b to 11 Mbps, suitable for early networks but limited by interference.

- OFDM, starting with 802.11a/g, offers scalability and efficiency, supporting 54 Mbps with 64-QAM, and its evolution in 802.11n/ac/ax with higher QAM and MIMO boosts throughput significantly, though range decreases with higher modulation due to noise sensitivity.

- 802.11ax's 1024-QAM maximizes speed in dense environments but demands optimal conditions, outperforming earlier standards in capacity and efficiency.