Standard-related patent landscape: Wifi 6

Patent Mapping to the Wifi 6 standard in LexisNexis® IPlytics®

General Scope

WiFi 6, also known as 802.11ax, represents the latest generation of wireless networking standards, designed to address the ever-growing demands for faster and more efficient wireless communication. With a focus on enhancing data transfer rates, reducing latency, and improving overall network performance, WiFi 6 introduces advanced technologies to optimize connectivity in crowded environments with numerous connected devices. Operating in both the 2.4 GHz and 5 GHz frequency bands, WiFi 6 is positioned as a transformative technology that significantly improves the wireless experience for a wide range of applications, from smart homes to enterprise networks.

References

- The Institute of Electrical and Electronics Engineers (IEEE) characterizes WiFi 6 (802.11ax) as a groundbreaking standard in wireless networking. The IEEE emphasizes its role in providing "higher data rates, increased capacity, better performance in dense environments, and improved power efficiency," making WiFi 6 a key enabler for the next era of wireless connectivity.
  Source: *ieee.org*

- The WiFi Alliance, a key advocate for WiFi technologies, highlights the significance of WiFi 6 in meeting the connectivity needs of modern society. According to the WiFi Alliance, WiFi 6 "provides a more reliable and efficient wireless experience," offering benefits such as faster speeds, increased network capacity, and improved performance in crowded areas, ultimately shaping the future of wireless communication.
  Source: *wifi.org*

Wi-Fi generations

Generation/IEEE Standard	Maximum link rate	Standards development	Adopted	Frequency
Wi-Fi 7 (802.11be)	N.A.	2019-today	N.A.	2.4/5 and 6 GHz
Wi-Fi 6E (802.11ax)	600 to 9608 Mbit/s	2014-today	2019	6 GHz
Wi-Fi 6 (802.11ax)	600 to 9608 Mbit/s	2014-today	2019	2.4/5 GHz
Wi-Fi 5 (802.11ac)	433 to 6933 Mbit/s	2008-2013	2014	5 GHz
Wi-Fi 4 (802.11n)	72 to 600 Mbit/s	2003-2013	2008	2.4/5 GHz

Wifi 6 standard	Topics (positive concepts)
Relevant concepts	▪ Wi-Fi 6 (also known as 802.11ax) is the new generation of Wi-Fi technology with a new focus on efficiency and performance. ▪ 802.11ax is an IEEE draft amendment that defines modifications to the 802.11physical layer (PHY) and the medium access control (MAC) sublayer for high-efficiency operation in frequency bands between 1 GHz and 6 GHz. The technical term for an 802.11ax is High Efficiency (HE). ▪ Unlike 802.11ac, which operates in 5 GHz only, 802.11ax radios can transmit and receive either the 2.4 GHz or 5 GHz frequency bands. In the future, 802.11ax technology will also be available in the 6 GHz band as part of Wi-Fi 6E. ▪ 802.11ax architecture: PHY Layer (Physical Layer): ▪ The PHY layer is responsible for transmitting and receiving wireless signals. ▪ 802.11ax introduces improved modulation techniques, including higher-order quadrature amplitude modulation (QAM) for increased data rates. ▪ Orthogonal Frequency Division Multiple Access (OFDMA) is a key feature, allowing the simultaneous transmission of multiple data streams to different devices in the same frequency channel. MAC Layer (Medium Access Control): ▪ The MAC layer manages access to the wireless medium and is crucial for coordinating communication between devices. ▪ Enhanced Basic Service Set (BSS) coloring is introduced to improve spatial reuse and reduce interference between neighbouring BSSs. ▪ Target Wake Time (TWT) is a feature that allows devices to schedule when they wake up and communicate with the access point, reducing power consumption and improving efficiency. Spatial Reuse: ▪ Spatial reuse is a key focus in 802.11ax to make more efficient use of the available frequency spectrum. ▪ BSS Coloring helps differentiate between transmissions from different BSSs, enabling devices to distinguish between overlapping networks and reduce interference. MU-MIMO (Multi-User Multiple Input Multiple Output): ▪ 802.11ax supports improved MU-MIMO capabilities, allowing the simultaneous transmission of data to multiple devices in the downlink and uplink directions. ▪ This enhances the network's overall capacity and performance. OFDMA (Orthogonal Frequency Division Multiple Access): ▪ OFDMA divides the available frequency spectrum into smaller sub-channels called Resource Units (RUs). ▪ Each RU can be allocated to different devices or purposes, enabling more efficient use of the spectrum and reducing latency.

Wifi 6 standard	Topics (positive concepts)
Relevant concepts	Beamforming: ▪ Beamforming technology is employed to focus wireless signals in specific directions, improving signal strength and reliability. ▪ This is particularly useful in environments with obstacles or interference. Security Enhancements: ▪ 802.11ax includes improvements in WPA3 (Wi-Fi Protected Access 3) security protocols to enhance the overall security of wireless communications. Backward Compatibility: ▪ 802.11ax is designed to be backward compatible with previous Wi- Fi standards (e.g., 802.11ac, 802.11n), allowing devices of different standards to coexist in the same network.

Wifi 6 standard	Topics (negative concepts)
No relevant concepts	▪ While 802.11ax (Wi-Fi 6) is a comprehensive and advanced standard, there are certain features that it does not have but are found in some other wireless communication standards. Here are a few examples: Cellular Integration: ▪ Some cellular technologies, such as LTE (Long-Term Evolution) and 5G, feature tight integration with cellular networks for seamless handovers between Wi-Fi and cellular connections. While Wi-Fi standards focus on local area wireless communication, cellular standards are designed for broader coverage and mobility. Wide-Area Coverage: ▪ LPWAN (Low Power Wide Area Network) technologies, like LoRaWAN and Sigfox, are designed for low-power, wide-area coverage, making them suitable for IoT applications in environments where Wi-Fi coverage might be limited. Ultra-Low Power Consumption: ▪ Some IoT-focused protocols, such as Zigbee and Z-Wave, are designed with a primary emphasis on ultra-low power consumption. These protocols are often used in battery-operated devices with a focus on extending battery life for years. Mesh Networking: ▪ Standards like Zigbee, Thread, and Bluetooth Mesh support mesh networking, where devices can relay data through a network of interconnected nodes. This can enhance coverage in areas where a direct connection to the central access point may be challenging.

Wifi 6 standard	Topics (negative concepts)
No relevant concepts	Deterministic Communication: ▪ Time-Sensitive Networking (TSN) is a set of standards designed to provide deterministic communication over Ethernet networks. It is often used in industrial applications where precise timing is critical. 802.11ax is designed for high throughput and efficiency but does not prioritize deterministic communication. Satellite Communication: ▪ Satellite communication standards, such as DVB-S2 for satellite broadband, are used for long-distance, global communication. Wi-Fi, including 802.11ax, is designed for local wireless networking and is not intended for global-scale communication. Licensed Spectrum Usage: ▪ Cellular standards like LTE and 5G operate in licensed spectrum bands, providing a level of control and quality of service that unlicensed spectrum technologies like Wi-Fi may not have. Dynamic Spectrum Access: ▪ Cognitive Radio technologies, like those in some versions of IEEE 802.22, enable devices to dynamically adapt and use available spectrum in real- time based on environmental conditions. This is different from traditional Wi-Fi, which operates in designated frequency bands. ▪ **Different wireless standards are developed to cater to diverse requirements and scenarios.**