lamaPLC Communication: Z-Wave

Z-Wave is a wireless communications protocol used primarily for residential and commercial building automation. It is a mesh network using low-energy radio waves to communicate from device to device, allowing for wireless control of smart home devices, such as smart lights, security systems, thermostats, sensors, smart door locks, and garage door openers. The Z-Wave brand and technology are owned by Silicon Labs. Over 300 companies involved in this technology are gathered within the *Z-Wave Alliance*.

Like other protocols and systems aimed at the residential, commercial, MDU and building markets, a Z-Wave system can be controlled from a smart phone, tablet, or computer, and locally through a smart speaker, wireless keyfob, or wall-mounted panel with a Z-Wave gateway or central control device serving as both the hub or controller. Z-Wave provides the application layer interoperability between home control systems of different manufacturers that are a part of its alliance. There is a growing number of interoperable Z-Wave products; over 1,700 in 2017, over 2,600 by 2019, and over 4,000 by 2022.

Interoperability

Z-Wave's interoperability at the application layer ensures that devices can share information and allows all Z-Wave hardware and software to work together. Its wireless mesh networking technology enables any node to talk to adjacent nodes directly or indirectly, controlling any additional nodes. Nodes that are within range communicate directly with one another. If they aren't within range, they can link with another node that is within range of both to access and exchange information.

In September 2016, certain parts of the Z-Wave technology were made publicly available, when then-owner Sigma Designs released a public version of Z-Wave's interoperability layer, with the software added to Z-Wave's open-source library. The Z-Wave MAC/PHY is globally standardized by the International Telecommunication Union as ITU 9959 radio. The open-source availability allows software developers to integrate Z-Wave into devices with fewer restrictions. Z-Wave's S2 security, Z/IP for transporting Z-Wave signals over IP networks, and Z-Wave middleware are all open source as of 2016. In 2020, the Z-Wave Alliance ratified the Z-Wave specification, adding the application to open-source development. The Alliance Technical Working Group manages Z-Wave specification development and maintains a library of standard implementations for Z-Wave compliant products.

Radio frequencies

Z-Wave is designed to provide reliable, low-latency transmission of small data packets at data rates up to 100 kbit/s, and is suitable for control and sensor applications, unlike Wi-Fi and other IEEE 802.11-based wireless LAN systems that are designed primarily for high data rates. Communication distance between two nodes is 200 meters line of sight outdoors and 50 meters line of sight indoors, and with message ability to hop up to four times between nodes, it gives enough coverage for most residential houses. Modulation is frequency-shift keying (FSK) with Manchester encoding, and other supported modulations schemes include GFSK and DSSS-OQPSK.

Z-Wave uses the Part 15 unlicensed industrial, scientific, and medical ISM band, operating on varying frequencies globally. For instance, in Europe it operates at the 868-869 MHz band while in North America the band varies from 908-916 MHz when Z-Wave is operating as a mesh network and 912-920 MHz when Z-Wave is operating with a star topology in Z-Wave LR mode. Z-Wave's mesh network band competes with some cordless telephones and other consumer electronics devices, but avoids interference with Wi-Fi, Bluetooth and other systems that operate on the crowded 2.4 GHz band. The lower layers, MAC and PHY, are described by ITU-T G.9959 and fully backwards compatible. In 2012, the International Telecommunication Union (ITU) included the Z-Wave PHY and MAC layers as an option in its G.9959 standard for wireless devices under 1 GHz. Data rates include 9600 bit/s and 40 kbit/s, with output power at 1 mW or 0 dBm.

Z-Wave has been released to be used frequencies with the following frequency bands in various parts of the world:

Frequency in MHz	Used in
865.2	India
868.4	China, South Africa
868.4, 869.85	Armenia, Bahrain, CEPT Countries (Europe and other countries in region), Egypt, French Guiana, Georgia, Iraq, Jordan, Kazakhstan, Kuwait, Lebanon, Libya, Nigeria, Oman, Philippines, Qatar, Saudi Arabia, South Africa, Turkmenistan, UAE, United Kingdom, Uzbekistan, Yemen
869	Russia
908.4, 916	Argentina, the Bahamas, Barbados, Bermuda, Bolivia, British Virgin Islands, Canada, Cayman Islands, Colombia, Guatemala, Haiti, Honduras, Jamaica, Maldives, Mauritius, Mexico, Moldova, Morocco, Nicaragua, Panama, St Kitts & Nevis, Suriname, Trinidad & Tobago, Turks & Caicos Islands, Uruguay, USA
916	Israel
919.8, 921.4	Australia, Brazil, Chile, Dominican Republic, Ecuador, El Salvador, Indonesia, Malaysia, New Zealand, Paraguay, Peru, Uruguay, Venezuela, Vietnam
920.9, 921.7, 923.1	Macau, Singapore, South Korea, Taiwan, Thailand
922.5, 923.9, 926.3	Costa Rica, Japan

Sources

Wikipedia (here)

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