lamaPLC Communication: Zigbee

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a low-power, low-data-rate, and close proximity *(i.e., personal area)* wireless ad hoc network.

The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi (or Li-Fi). Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking. *(Zigbee networks are secured by 128-bit symmetric encryption keys.)* Zigbee has a defined rate of up to 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

Zigbee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive.

Zigbee is a low-power wireless mesh network standard targeted at battery-powered devices in wireless control and monitoring applications. Zigbee delivers low-latency communication. Zigbee chips are typically integrated with radios and with microcontrollers.

Zigbee operates in the industrial, scientific and medical ISM radio bands. With the 2.4 GHz band being primarily used for lighting and home automation devices in most jurisdictions worldwide. While devices for commercial utility metering and medical device data collection often use sub-GHz frequencies, *(902-928 MHz in North America, Australia, and Israel, 868-870 MHz in Europe, 779-787 MHz in China, even those regions and countries still using the 2.4 GHz for most globally sold Zigbee devices meant for home use. With data rates varying from around 20 kbit/s for sub-GHz bands to around 250 kbit/s for channels on the 2.4 GHz band range).*

Zigbee builds on the physical layer and media access control defined in IEEE standard 802.15.4 for low-rate wireless personal area networks (**WPAN**s). The specification includes four additional key components: network layer, application layer, Zigbee Device Objects (**ZDO**s) and manufacturer-defined application objects. ZDOs are responsible for some tasks, including keeping track of device roles, managing requests to join a network, and discovering and securing devices.

The Zigbee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of Zigbee routers to extend communication at the network level. Another defining feature of Zigbee is facilities for carrying out secure communications, protecting the establishment and transport of cryptographic keys, ciphering frames, and controlling devices. It builds on the basic security framework defined in IEEE 802.15.4.

Zigbee Pro

Zigbee Pro, also known as Zigbee 2007, was finalized in 2007. A Zigbee Pro device may join and operate on a legacy Zigbee network and vice versa. Due to differences in routing options, a Zigbee Pro device must become a non-routing *Zigbee End Device* (**ZED**) on a legacy Zigbee network, and a legacy Zigbee device must become a ZED on a Zigbee Pro network. It operates using the 2.4 GHz ISM band, and adds a sub-GHz band.

Application profiles

The first Zigbee application profile, Home Automation, was announced November 2, 2007. Additional application profiles have since been published.

The **Zigbee Smart Energy 2.0** specifications define an Internet Protocol-based communication protocol to monitor, control, inform, and automate the delivery and use of energy and water. It is an enhancement of the Zigbee Smart Energy version 1 specifications. It adds services for plug-in electric vehicle charging, installation, configuration and firmware download, prepay services, user information and messaging, load control, demand response and common information and application profile interfaces for wired and wireless networks. It is being developed by partners including:

- HomeGrid Forum responsible for marketing and certifying ITU-T G.hn technology and products
- HomePlug Powerline Alliance
- International Society of Automotive Engineers SAE International
- IPSO Alliance
- SunSpec Alliance
- Wi-Fi Alliance
- Zigbee Smart Energy relies on Zigbee IP, a network layer that routes standard IPv6 traffic over IEEE 802.15.4 using 6LoWPAN header compression.

In 2009, the Radio Frequency for Consumer Electronics Consortium (RF4CE) and *Connectivity Standards Alliance (formerly Zigbee Alliance)* agreed to deliver jointly a standard for radio frequency remote controls. Zigbee RF4CE is designed for a broad range of consumer electronics products, such as TVs and set-top boxes. It promised many advantages over existing remote control solutions, including richer communication and increased reliability, enhanced features and flexibility, interoperability, and no line-of-sight barrier. The Zigbee RF4CE specification uses a subset of Zigbee functionality allowing to run on smaller memory configurations in lower-cost devices, such as remote control of consumer electronics.

Device types and operating modes

There are three classes of Zigbee devices:

- *Zigbee coordinator* (**ZC**): The most capable device, the coordinator forms the root of the network tree and may bridge to other networks. There is precisely one Zigbee coordinator in

each network since it is the device that started the network originally *(the Zigbee LightLink specification also allows operation without a Zigbee coordinator, making it more usable for off-the-shelf home products)*. It stores information about the network, including acting as the trust center and repository for security keys.

- *Zigbee router* (**ZR**): As well as running an application function, router devices can act as intermediate routers, passing data on to other devices. These types of Zigbee products are typically mains-powered so they are always available on the network. Zigbee Router devices are sometimes called Zigbee repeaters or Zigbee range extenders.
- *Zigbee end device* (**ZED**): Contains just enough functionality to talk to the parent node *(either the coordinator or a router)*; it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. These types of Zigbee device products are often battery-powered. A ZED requires the least amount of memory and thus can be less expensive to manufacture than a ZR or ZC

Sources

Wikipedia (here)

Zigbee topics on lamaPLC

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communication, ethernet, bus, ip, Zigbee, WPAN, Bluetooth, Wi-Fi, ISM, IEEE 802.15.4, ZDO, Zigbee Pro, ZC, ZR, ZED, smart energy, HomeGrid, HomePlug, Powerline, IPSO, SunSpec, Wi-Fi, 6LoWPAN, IPv6, RF4CE