Zigbee

Introduction

- Zigbee is a standards-based wireless technology developed to enable low-cost, low-power wireless machine-to-machine (M2M) and internet of things (IoT) networks.
- Zigbee is for low-data rate, low-power applications and is an open standard.
- Zigbee is primarily developed to focus on home and building automation and controls, consumer electronics, PC peripherals, medical monitoring, and toys
- Primary drivers in Zigbee popularity are simplicity, long battery life, networking capabilities, reliability, and cost.
- Zigbee Alliance provides interoperability and certification testing

ZigBee Alliance

Zigbee Alliance

Origin of Zigbee Name

Honey Bee Biology/Sociology:

Using a communication system, whereby a bee dances in a zig-zag pattern, worker bees are able to share information such as the distance and direction of a newly discovered food source to fellow colony members.

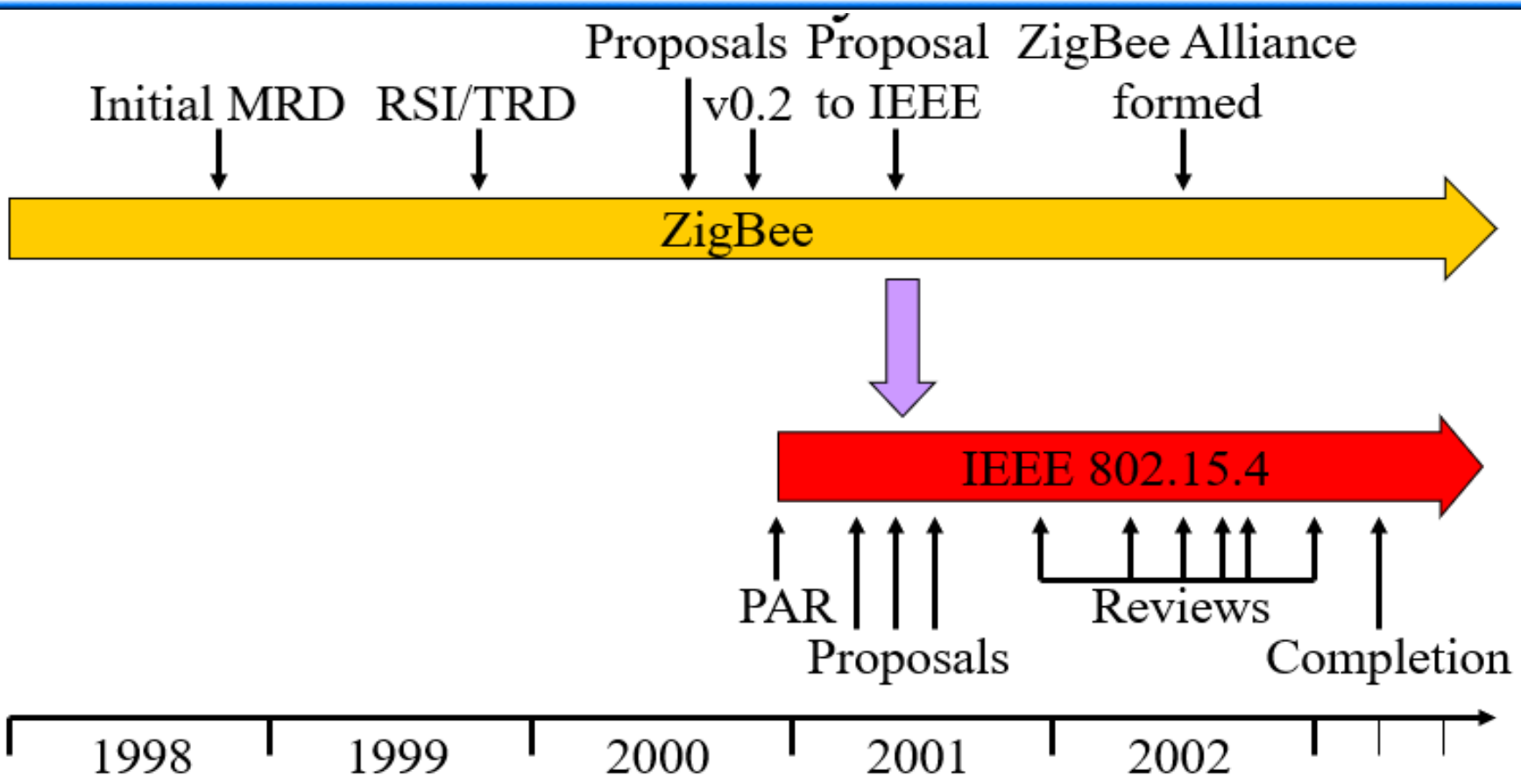
Zigbee Features

- Zigbee is based on the Institute of Electrical and Electronics Engineers (IEEE) Standards Association's 802.15 specification.
- Zigbee is built for control and sensor networks on the IEEE 802.15.4 wireless standard for wireless personal area networks (WPANs).
- The Zigbee WPANs operate on 2.4 GHz, 900 MHz and 868 MHz frequencies.
- The Zigbee specifications, which are maintained and updated by the Zigbee Alliance, boost the IEEE 802.15.4 standard by adding network and security layers in addition to an application framework.
- The standards created by the alliance can be used to create multivendor interoperable offerings.
- Manufacturers that are developing custom applications that don't need to operate with the applications of other manufacturers can create their own specific variations and extensions.

Zigbee Features

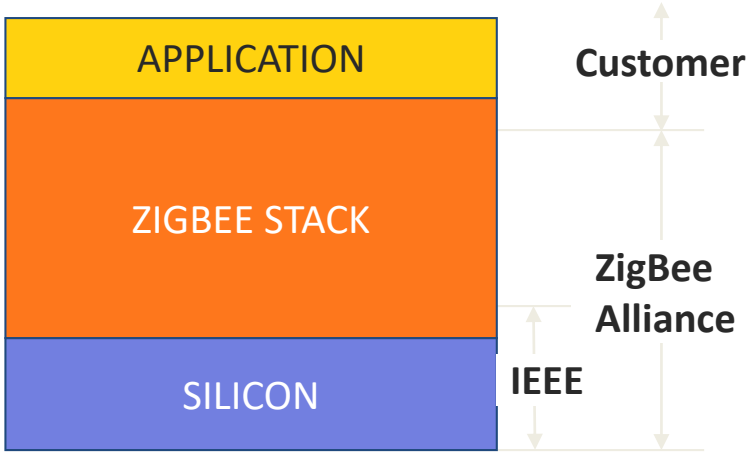
- As of today, there are three Zigbee specifications: Zigbee PRO, Zigbee RF4CE and Zigbee IP.
- Zigbee PRO aims to provide the foundation for IoT with features to support low-cost, highly reliable networks for device-to-device communication.
- Zigbee PRO also offers Green Power, a new feature that supports energy harvesting or self-powered devices that don't require batteries or AC power supply.
- Zigbee RF4CE is designed for simple, two-way device-to-device control applications that don't need the full-featured mesh networking functionalities offered by the Zigbee specification.
- Zigbee IP optimizes the standard for IPv6-based full wireless mesh networks, offering internet connections to control low-power, low-cost devices.

Milestones of Development of Zigbee

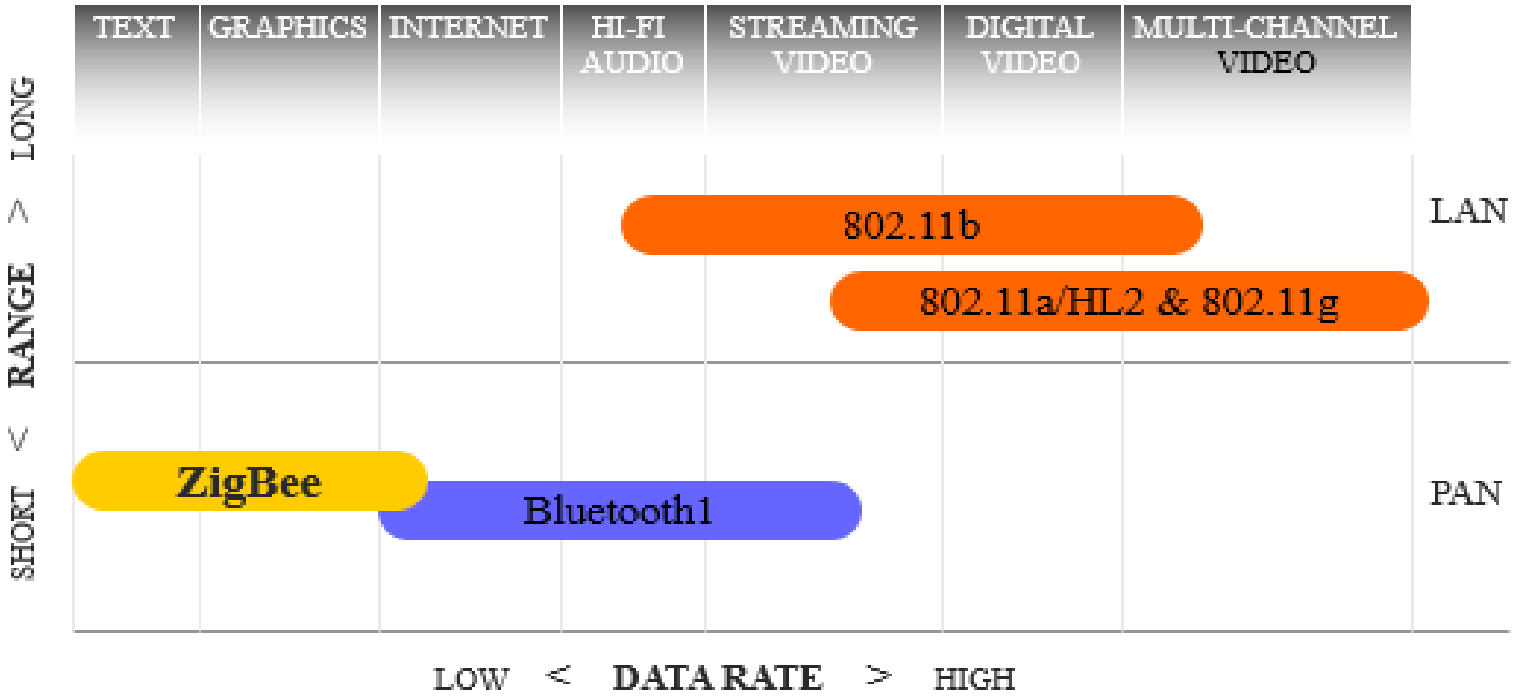


Development of the Standard

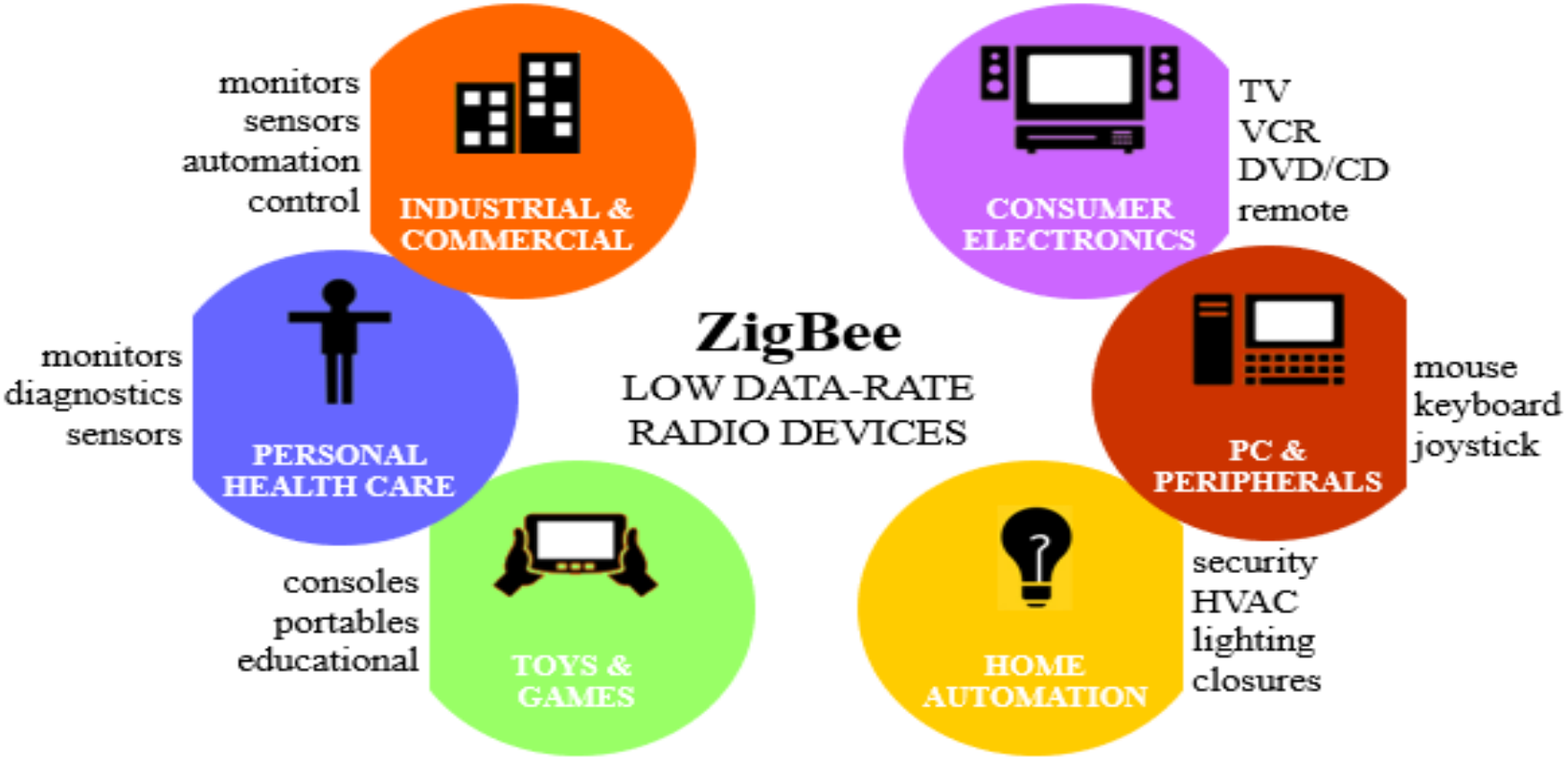
- IEEE 802.15.4 Working Group
  - Defining lower layers of protocol stack: MAC and PHY
  - Available today
- ZigBee Alliance
  - 50+ companies: semiconductor mfrs, IP providers, OEMs, etc.
  - Defining upper layers of protocol stack: from network to application, including application profiles
  - Initial draft available mid 2003



The Wireless Market



Applications



Zigbee Features

- Global, license free ISM band operation
- Unrestricted geographic use
- RF penetration through walls & ceilings
- Automatic/semi-automatic installation
- Ability to add or remove devices
- Cost advantageous
- 10k-115.2kbps data throughput
- 10-75m coverage range
- Up to 65k slave nodes per network
- Up to 100 co-located networks
- Up to 2 years of battery life on standard Alkaline batteries

Frequencies and Data Rates

BAND	COVERAGE	DATA RATE	CHANNEL(S)
2.4 GHz	ISM Worldwide	250 kbps	11-26
868 MHz	Europe	20 kbps	0
915 MHz	ISM Americas	40 kbps	1-10

Stack Reference Model

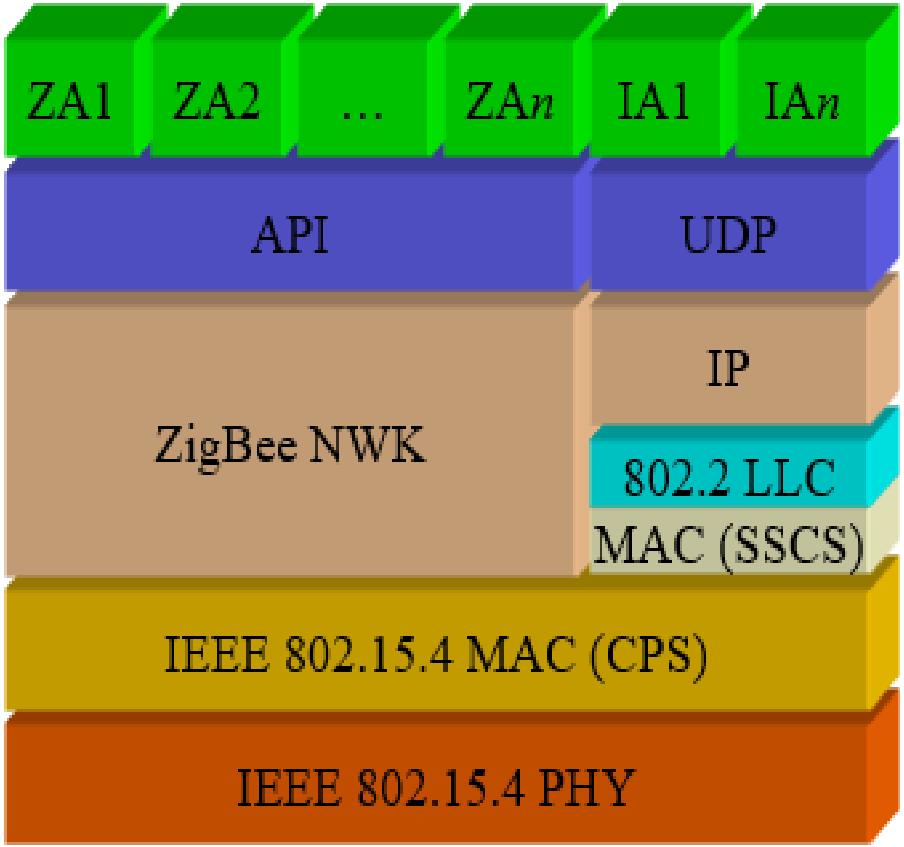
End developer applications, designed using application profiles

Application interface designed using general profile

Topology management, MAC management, routing, discovery protocol, security management

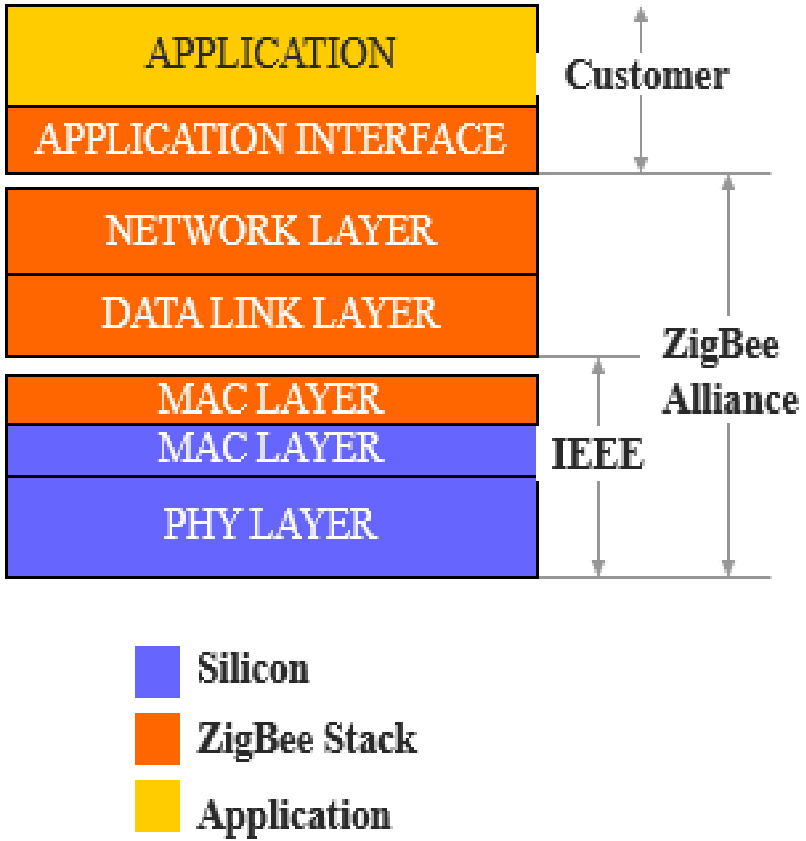
Channel access, PAN maintenance, reliable data transport

Transmission & reception on the physical radio channel

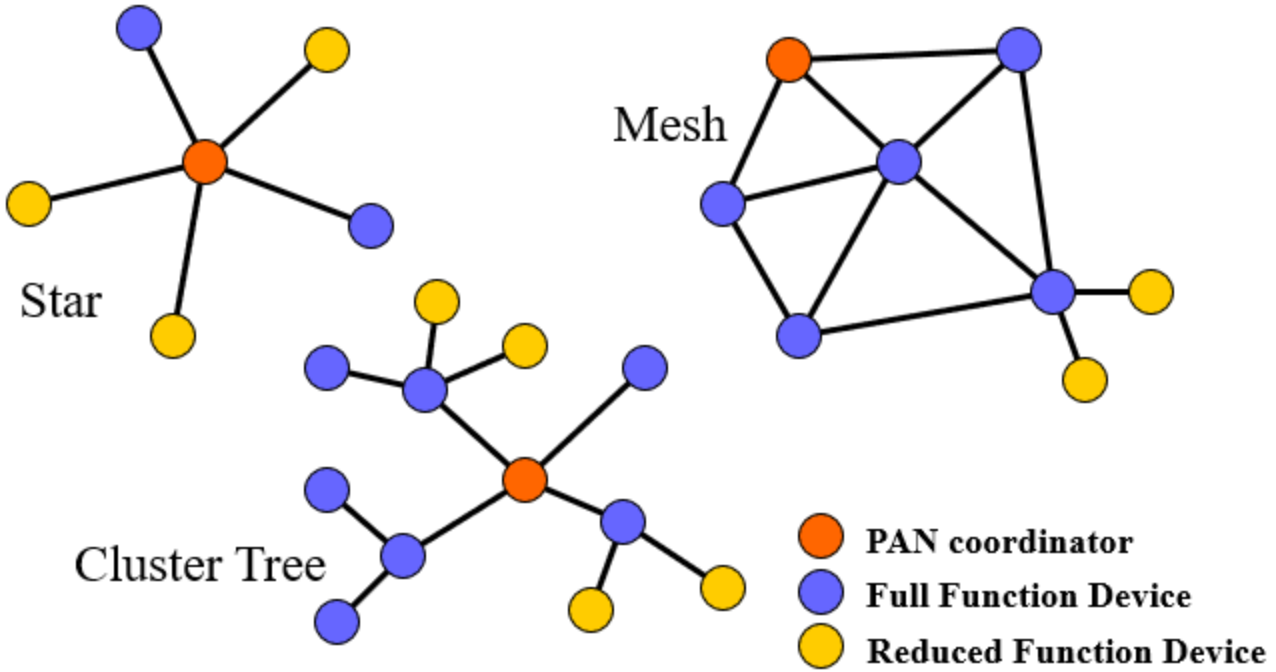


Protocol Stack Features

- 8-bit microcontroller
- Full protocol stack <32 k
- Simple node-only stack ~4k
- Coordinators require extra RAM
  - Node device database
  - Transaction table
  - Pairing table



Topology Models



IEEE 802.15.4 Overview

- Employs 64-bit IEEE & 16-bit short addresses
- One PAN coordinator & multiple RFDs/FFDs
- Optional superframe structure with beacons
- CSMA-CA (Carrier Sense Multiple Access- Collision Avoidance) channel access
- Simple frame structure
- Reliable delivery of data
- Association/disassociation
- GTS (Guaranteed Time Slot) mechanism
- AES-128 security

Zigbee Advantages

- This network has a flexible network structure
- Battery life is good.
- Power consumption is less
- Very simple to fix.
- It supports approximately 6500 nodes.
- Less cost.
- It is self-healing as well as more reliable.
- Network setting is very easy as well as simple.
- Loads are evenly distributed across the network because it doesn’t include a central controller
- Home appliances monitoring as well controlling is extremely simple using remote
- The network is scalable and it is easy to add/remote ZigBee end device to the network.

Zigbee Disadvantages

- It needs the system information to control Zigbee based devices for the owner.
- As compared with WiFi, it is not secure.
- The high replacement cost once any issue happens within Zigbee based home appliances
- The transmission rate of the Zigbee is less
- It does not include several end devices.
- It is so highly risky to be used for official private information.
- It is not used as an outdoor wireless communication system because it has less coverage limit.
- Similar to other types of wireless systems, this ZigBee communication system is prone to bother from unauthorized people.

What Devices use ZigBee?

- The following list of devices supports the ZigBee protocol.
- Belkin WeMo
- Samsung SmartThings
- Yale smart locks
- Philips Hue
- Thermostats from Honeywell
- Ikea Tradfri
- Security Systems from Bosch
- Comcast Xfinity Box from Samsung
- Hive Active Heating & accessories
- Amazon Echo Plus
- Amazon Echo Show

Zigbee in IoT

- Recently, the Zigbee Alliance rolled out "dotdot," a program to extend its interoperability technology beyond Zigbee.
- It is the First Multi-Band IoT Mesh Network Technology for Massive IoT Deployments
- Dotdot, a universal language for the internet of things, lets smart objects work together on any network, unlocking new markets for members and unifying the fragmented IoT.