Zigbee: A Review

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Abstract- *Past several years have witnessed a rapid development in the wireless network area. So far wireless networking has been focused on high-speed and long range applications. However, there are many wireless monitoring and control applications for industrial and home environments which require longer battery life, lower data rates and less complexity than those from existing standards. For such wireless applications a new standard called ZigBee has been developed by the ZigBee Alliance. ZigBee is a technological standard created for Control and sensor networks. It is based on the IEEE 802.15.4 standard. The IEEE 802.15.4 standard specifies the PHY Layer and MAC Layer for low data rate wireless PANs. This paper includes ZigBee Alliance, IEEE*

Keywords- ZigBee, IEEE 802.15.4, Networks,Control, Sensor.

I. INTRODUCTION

ZigBee is a technological standard created for control and sensor networks based in IEEE 802.15.4. ZigBee is a specification for a suite of high level communication protocols using small, low- power digital radios based on an IEEE 802.15.4 standard for personal area networks [1]. Applications include wireless light switches, electrical meters with in-home-displays, consumer and industrial equipment that requires short-range wireless transfer of data at relatively low rates. It is the most promising communication protocol for WPAN. IEEE -> IEEE802 -> IEEE802.15 -> IEEE802.15.4 -> ZIGBEE

1. The IEEE 802 standard gives specifications for the Local Area Networks (LAN).
2. The IEEE802.15 standard is a working group for WPAN.
3. The IEEE 802.15.4 standard specifies the PHY Layer and MAC Layer for low data rate wireless PANs. It was completed in May 2003.
4. The ZigBee specifications were approved on 14 December 2004.
5. The ZigBee Alliance announced public availability of Specification 1.0 on 13 June 2005.

ZigBee Alliance is a group of companies creating wireless solutions for use in Residential, Commercial and Industrial Applications. The technology used by ZigBee specification is intended to be simpler and less expensive than other Wireless Personal Area Networks such as Bluetooth. ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory.

ZigBee operates in the Industrial, Scientific and Medical (ISM) radio bands; 868 MHzin Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20 to 250 kilobits/second. ZigBee network layer natively supports both star and tree typical networks and generic mesh networks. Every network must have one coordinator device tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both tree and mesh allows the use of ZigBee routers to extend communication at the network level.

II. ZIGBEE ALLIANCE

Zigbee Alliance is an association of companies working together to define an open global standard for making low-power wireless networks. The intended outcome of ZigBee Alliance is to create a specification defining that how to build different network topologies with data security features and interoperable application profiles. The association includes companies from a wide spectrum of categories, from chip manufactures to system integration companies. The number of members in the association is rapidly growing and is currently over 125. Among the members one can find Philips, Samsung, Motorola and LG. Digi is a member of the ZigBee Alliance and has developed a wide range of networking solutions based on the ZigBee protocol. XBee and XBee-PRO modules and other XBee-enabled devices provide an easy-to- implement solution that provides functionality to connect to a wide variety of devices [3]. ZigBee Alliance provided some ZigBee devices which are widely used as follows:-

A. XBee and XBee-PRO ZB

Fig. 1, shows ZigBee modules support the latest ZigBee PRO feature set and allow for interoperability with ZigBee devices from other vendors. With XBee, users can have their ZigBee network up-and-running in a matter of minutes.

Fig. 1: XBee and XBee-PRO ZB

B. XBee and XBee-PRO ZB Adapters

It provides simple ZigBee communication via a variety of connection options including RS-232, RS-485, digital I/O and analog I/O.

Fig. 2: XBee and XBee-PRO ZB Adapters

C. Connect Port X Gateways

This allows you to IP-enable ZigBee networks by aggregating device data and making that information available over an Ethernet, cellular, or Wi-Fi connection. Connect Port X gateways offer programmability and configuration options to most effectively manage devices on a ZigBee network.

Fig. 3: ConnectPort X Gateways

III. THE NAME ZIGBEE

The name ZigBee [3], is come from the domestic honeybee which uses a zig-zag type of dance to communicate important information to other hive members. This communication dance (the "ZigBee Principle") is what engineers are trying to emulate with this protocol a bunch of separate and simple organisms that join together to tackle complex tasks.

IV. IEEE 802.15.4

The goal IEEE had when they specified the IEEE 802.15.4 standard was to provide a standard for ultra-low complexity, ultra-low cost, ultra-low power consumption and low data rate wireless connectivity among inexpensive devices. The raw data rate will be high enough (maximum of 250 kb/s) for applications like sensors, alarms and toys.

A. Components of the IEEE 802.15.4

IEEE 802.15.4 networks use three types of devices [3].

1. **The Network Coordinator**

It maintains overall network knowledge. It is the most sophisticated one of the three types and requires the most memory and computing power.

2. The Full Function Device (FFD) FFD supports all IEEE 802.15.4 functions and features specified by the standard. It can function as a network coordinator. Additional memory and computing power make it ideal for network router functions or it could be used in network-edge devices.

3. The Reduced Function Device (RFD)

RFD carries limited (as specified by the standard) functionality to lower cost and complexity. It is generally found in network- edge devices. The RFD can be used where extremely low power consumption is a necessity.

B. Network Topologies

IEEE 802.15.4 can manage two types of networks, i.e. star topology or the peer-to-peer topology. In ZigBee, these two topologies can be combined to build so-called mesh networks

1. **Star Network Formation**

The first FFD that is activated may establish its own network and become a Personal Area Network (PAN) coordinator.

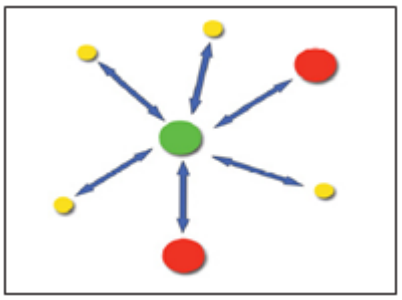

Fig. 4: Star Topology

Then both FFD and RFD devices can connect to the PAN coordinator. All networks within the radio sphere of influence must have a unique PAN identity. All nodes in a PAN must talk to the PAN Coordinator

2. **Peer-to-Peer Network Formation**

In fig. 5, there is also a PAN coordinator, but it differs from the star topology in that any device can communicate with any other device as long as they are in the range of one another.

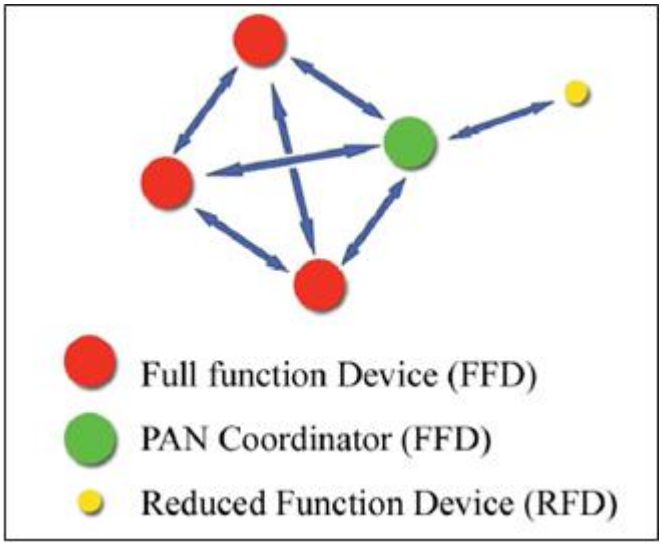

Fig. 5: Peer-to-Peer Topology

t defines the transmitting raw bits. Frequency of operation and data rate as per IEEE Standard.

3. Energy Detection (ED)

Before a signal is transmitted the device goes in the receive The peer-to-peer topology allows more complex network formations to be implemented, such as the mesh topology.in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz. The 802.15.4 specification [4], upon which the ZigBee stack operates gained ratification by the Institute of Electrical and Electronics Engineers (IEEE) in 2003. The specification is a packet-based radio protocol intended for low-cost, battery- operated devices. The protocol allows devices to communicate in a variety of network topologies and can have battery life lasting several years.mode to detect and estimate the signal energy level in the desired channel.

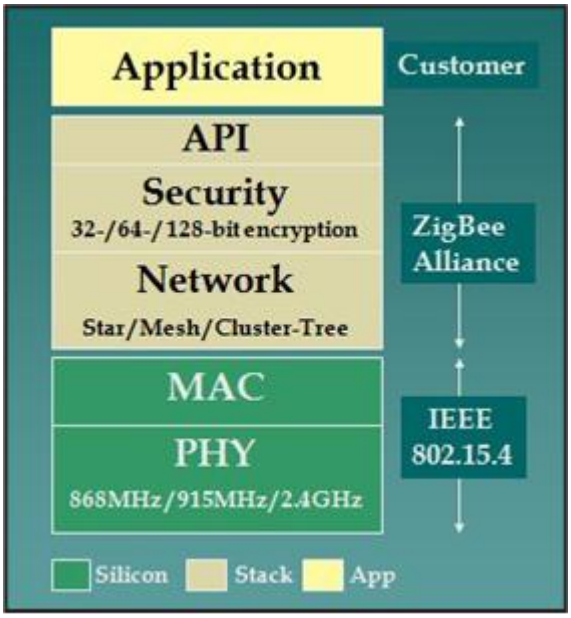

Fig. 6: Layers of IEEE 802.15.4

4. Clear Channel Assessment (CCA)

To ensure that the channel is clear. Not in use by any other device. Zigbee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low- power wireless M2M networks. The ZigBee standard operates on the IEEE 802.15.4 physical radio specification and operates

5. **Link Quality Indication (LQI)**

Measure of quality of packets received at the receiver. Higher the SNR, high is the quality.

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D. Medium Access Control Layer

The Medium Access Control (MAC) layer handles the network association and disassociation and has an optional super frame structure with beacons for time synchronization and a Guaranteed Time Slot (GTS) mechanism for high priority communications.

V. ZIGBEE ADVANTAGES

The ZigBee protocol is designed to communicate data through hostile RF environments that are common in commercial and industrial applications.

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F. Telecommunication Services

It covers information services, Mobile Commerce, also known as M-Commerce or mCommerce, is the ability to conduct commerce using a mobile device, such as a mobile phone, Personal Digital Assistant (PDA), smartphone, or other emerging mobile equipment such as dashtop mobile devices.

G. Industrial Automation

To extend existing manufacturing and process control systems reliability[6]. The interoperable nature of ZigBee means that these applications can work together, providing even greater benefits.

H. Personal Health Care

ZigBee Alliance provided many devices which helps for the fitness of patients such as personal wellness monitoring, Electrocardiograph (ECG), chronic disease monitoring, glucose meter and pulse oximeter.

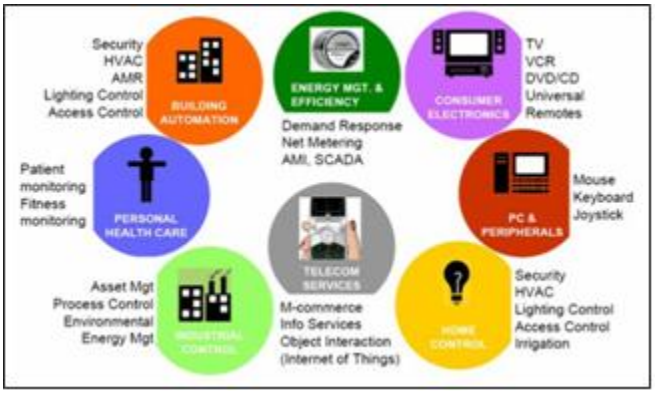

Fig. 7: Applications of ZigBee Technology [5]

VI. FUTURE SCOPE

Chipcon is using ZigBee to produce a road map product that reduces the chip and system costs and increases integration level with low power consumption. Sensors are currently being used in environmental and agricultural applications, but the main target- home automation. ZigBee technology is also being used and tested in applications related to health monitoring.

VIII. CONCLUSIONS

ZigBee is most promising technological standard for low data rate, low power consumption and has a long battery life. ZigBee networks are reliable and self-healing. These networks are easy to deploy which is cheaper as compared to other technologies. Today main issue is its complexity of ZigBee networks. The main problem in this is security because intruders can easily hack ZigBee networks and too much technology makes people lazy.

The evolution of ZigBee technology is a big achievement, which will likely be targeted for use in applications such as road map tracking, medical application, consumer electronics, PC, Personal healthcare, commercial and residential control and many more by applying different actions.

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