An overview of Zigbee technology

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Abstract: **Zigbee is self-organizing ad hoc digital radio networks was developed in 1990s. It is belonging to wireless ad hoc network (WANET) or mobile ad hoc network (MANET). Which is a decentralized type of wireless network. The network is ad hoc because it does not depend on a pre-existing infrastructure, such as routers in wired networks or access points in wireless network.**

Zigbee is a standards-based wireless technology, which use low-cost, low-power wireless machine-to-machine (M2M) and internet of things (IoT) networks. Zigbee is provides for low-data rate, to build low-power applications. Zigbee is an open standard. It is based on international standard IEEE 802.15.4 and is developed connectivity standard alliance (CSA), formerly known as Zigbee Alliance.

Its low power consumption limits transmission distances to 10–100 meters by line-of-sight, depend on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh topology. 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, which use in same key for both encryption n decryption in cryptography. The data rate of Zigbee protocol is250 kbit/s, and it is best suited for data transmissions from a sensor or input device.

Keywords: **Zigbee, WANET, MANET, M2M, IoT, IEEE, CSA, protocol, sensor, WPAN, symmetric encryption keys, wireless network., Wi-Fi.**

INTRODUCTION

In today's world of www and internet, data communication, Zigbee is a new and efficient way of wireless network communication. ZigBee is a standard that needed for very low-cost implementation and Low power devices with Low data rates for short-range wireless communications. ZigBee is a Personal Area Network task group with low-rate task group 4. It is a technology of home networking. ZigBee is a technological standard created for controlling and sensing the network.

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. Physical range of Zigbee protocol is 10-100 m.

The technology defined by the Zigbee alliance specification is very simple and less expensive than any other wireless personal area networks (WPANs), such as Bluetooth or more general wireless network such as Wi-Fi. Zigbee protocol use for wireless light switches, home energy monitors, traffic management systems, and consumer electronic devices like washing machine ,refrigerators, TV, VCR. Zigbee also uses in industrial equipment movement of raw material that requires short-range low-rate wireless data transfer.

Types of ZigBee Devices:
There are 3 types of ZigBee Devices.They are as follows:
1.Zigbee Coordinator Device: It communicates with networking device routers. This device is used for connecting the various devices.
2.**Zigbee Router**: It is used for passing the data between connected devices.
3.**Zigbee End Device**: It is the device that is to be controlled.

Fig.1 ZigBee Devices
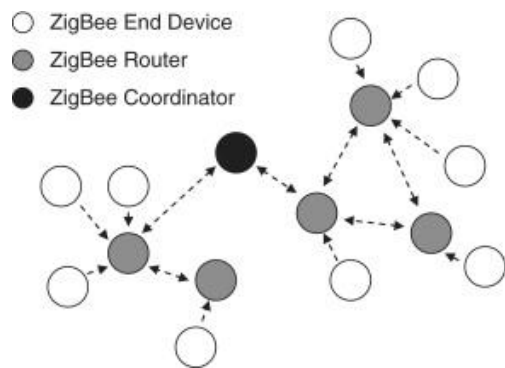
Characteristics of Zigbee protocol:
The following are the Characteristics of Zigbee protocol
- ❖ **Low Data Rate :** Zigbee provides date range : 20- 250 kbps
- ❖ **Short-Range:** Zigbee provides (75-100 meters)
- ❖ **Network Join Time :** Zigbee provides network connection time ~ 30 msec
- ❖ **Support Small and Large Networks**: Zigbee Theorotically connects up to 65000 devices for and Practically 240 devices .
- ❖ Low Cost of Products and Cheap Implementation because its Open Source Protocol.

       Zigbee provides 3 frequency bands with 27 channels from Channel 0 to Channel 26 shown as below.
- ❖ **Operating Frequency Bands** (Only one channel will use for a network)
- ❖ **Channel 0**: 868 MHz (Europe)
- ❖ **Channel 1-10**: 915 MHz (the US and Australia)
- ❖ **Channel 11-26**: 2.4 GHz (Across the World)

Zigbee Network Topologies:
- **Star Topology :** Star topology Consists of a coordinator and several end devices, end devices communicate only with the center hub.
- **Mesh Topology** : Mesh topology consists of one coordinator, several routers, and end devices.
- **Tree Topology**: In this topology, the network consists of a central node which is a coordinator, several routers, and end devices. the function of the router is to extend the network coverage.

Architecture of Zigbee:
Zigbee architecture has 6 layers. They are as follows shown in Fig.2
1. Application Layer
2. Application Interface Layer
3. Security Layer
4. Network Layer
5. Medium Access Control Layer
6. Physical Layer

Fig.2: Architecture of Zigbee
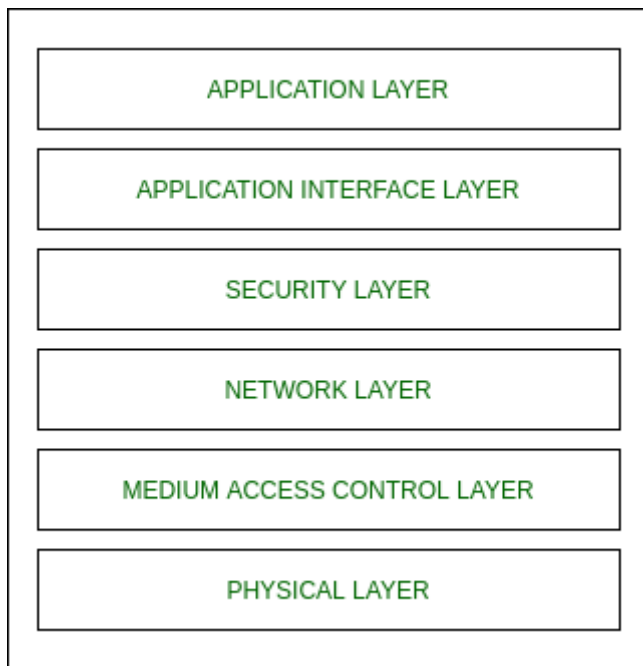
- **Physical layer:** The lowest two layers i.e the physical and the MAC (Medium Access Control) Layer are defined by the IEEE 802.15.4 specifications. The Physical layer is closest to the hardware and directly controls and communicates with the Zigbee radio. The physical layer translates the data packets in the over-the-air bits for transmission and vice-versa during the reception.
- **Medium Access Control layer (MAC layer):** The layer is responsible for the interface between the physical and network layer. The MAC layer is also responsible for providing PAN ID and also network discovery through beacon requests.
- **Network layer:** This layer acts as an interface between the MAC layer and the application layer. It is responsible for mesh networking.
- **Application layer:** The application layer in the Zigbee stack is the highest protocol layer and it consists of the application support sub-layer and Zigbee device object. It contains manufacturer-defined applications.

Channel Access:
1. **Contention Based Method** :CSMA/CD(Carrier-Sense Multiple Access With Collision Avoidance Mechanism)
2. **Contention Free Method** :Coordinator dedicates a specific time slot to each device (Guaranteed Time Slot (GTS))

Zigbee Applications:
There are the numerous applications:-
1. Home Automation
2. Medical Data Collection
3. Industrial Control Systems
4. meter reading system
5. light control system
6. Wireless sensor networks.
7. Industrial control systems.
8. Embedded sensing.
9. Medical data collection.
10. Smoke and intruder warning.
11. Building automation.
12. Remote wireless microphone configuration.

CONCLUSION

Now a days this technology is use for commercial purpose, it promises a great potential in the field of wireless internet. Still most of the peoples unaware of this technology because the problem of lack of radio spectrum, space and low internet connection speed. By deployment of this technology, we can use the various concept of communication networks. The very concept of Zigbee promises to solve issues such as shortage of radiofrequency bandwidth and eliminates the disadvantages of Radio communication technologies. Zigbee is the latest trended and growing technology for various other developing and new inventions/technologies. Therefore Zigbee has almost all the advantages to use in any fields with low cost ,short-range as its most wanted promising features of this technology.

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