Zigbee Technology

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***Abstract:-*Zigbee is a communication protocol which is based on IEEE 802.15.4 and used for wireless personal area network. IEEE 802.15.4 is a technical standard which explains the operation of low-rates wireless personal area networks (LR-WPANs). It describes physical layer and media access control for LR-WPANs. Zigbee devices have 16-bit short address that means 65536 different devices can be connected to it except to few reserved addresses. This technology is simpler and cheaper than the other WPANs such as Bluetooth and Wi-Fi. Its low power consuming characteristic limits its range to 10-100 meters depending upon the power output. Zigbee chips are integrated typically with radios and microcontrollers. It has major applications in industrial, scientific and medical industries and operates in the bands which include 2.4GHz, 900 and 868 MHz. It's one of the characteristic features is that it provides equipments for carrying out secure communications. Zigbee uses 128-bit keys to implement its security mechanisms. The key can be connected either to network which is used by both Zigbee layer and MAC sub layer or to a link acquired through agreement. Zigbee wireless communication technology offers excellent feature that are best suited for embedded applications, smart asset tracking, home automation and many more at lower cost and lower power consumption.**

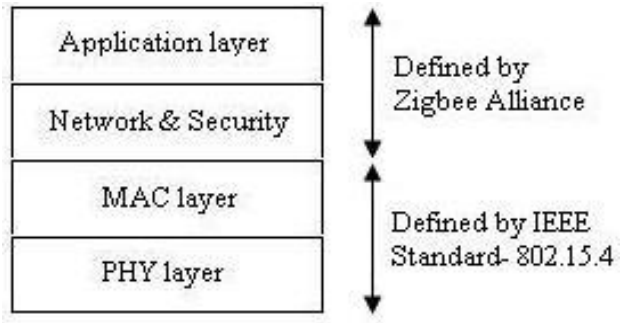
1. INTRODUCTION

The signal strength in the wireless environment which is sent by administrator can be weakened as distance from the administrator increases. The communication with target nodes become difficult and misuse of the wireless resources. Due to the fact it becomes difficult to perform stable and reliable wireless communication with wide range nodes. It is quite complex to use the wireless resources using location data because the coordinator cannot search the locations of some nodes.Zigbee is a rising worldwide standard for Wireless Personal Area Networks (WPAN). Under the foremost goal to provide low-power, cost effective, flexible, reliable and scalable wireless products Zigbee Alliance has been flourishing and standardizing the Zigbee network.

Based on IEEE 802.15.4, Zigbee defines three types of devices which are Zigbee Coordinator, Zigbee Router and Zigbee End device. Zigbee networks support topologies like star, tree and mesh, self-forming and self-healing in addition with more than 65000 address spaces. As a result the network can be easily augmented in terms of size and coverage area. Zigbee built traffic management system have also been executed. The name refers to the waggle dance of honey bees which is a medium of sharing information among them after returning to their beehive. The low cost permits the technology to be widely utilized in wireless control and monitoring applications. Low power-usage legitimates longer life with smaller batteries. Mesh networking renders high reliability and more extensive range. ZigBee chip vendors commonly sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory.

2. NEED OF ZIGBEE

1. There is an assembly of standards that labels mid to high data rates for voice, PC LANs, video and many more. Though, up till now there has not been a wireless network standard that meets the unique needs of sensors and control devices. Sensors and controls do not require high bandwidth but they do need low suspension and very low energy consumption for long battery lives.
2. There are a group of proprietary wireless systems modeled today to solve an assembly of problems that also do not require high data rates but demand low cost and very low current drain.
3. These proprietary systems were invented because there was no calibre that met their requirements. These legacy systems are creating significant serviceable problems with each other and with newer technologies.



Zigbee Protocol Stack

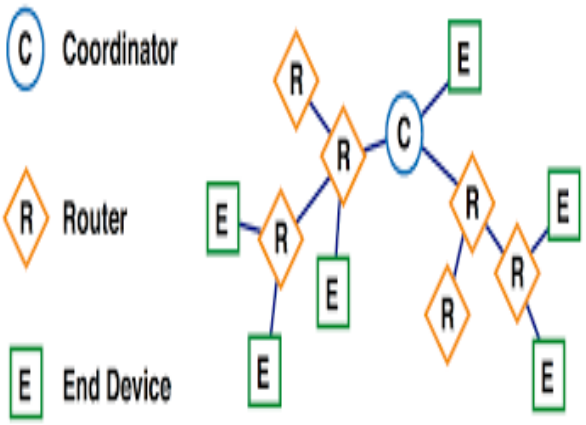
3. ZIGBEE DEVICE TYPES

Zigbee devices are of three types:

1) Zigbee coordinator (ZC): The coordinator that forms the root of the network tree and might bridge to other networks is the most capable device. There is only one Zigbee coordinator in each network since it is the device that initiated the network originally. It accumulates information about the network along with repository for security keys.

2) Zigbee Router (ZR): Besides running an application function, a router can act as an intermediate router, passing on data from one device to other.

3) Zigbee End Device (ZED): It wholly contains ample functionality to talk to the parent node (either the coordinator or a router). It cannot receive data from the other devices. The following relationship permits the node to be asleep a notable amount of the time thereby giving long battery life. A ZED demands the minimal amount of memory, andcan be less expensive to manufacture than ZR or ZC.

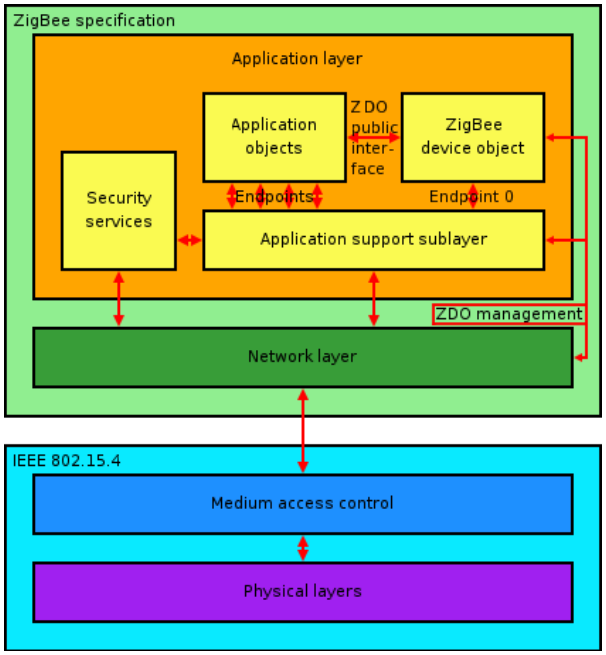


3. General Characteristics:

- Yields high output and low expectancy for low duty cycle devices like sensors.
- Low power (battery life multi-month to years)
- Multiple topologies like star, peer to peer and mesh.
- Addressing space up to 18,450,000,000,000,000,000 devices that is 64 bit IEEE address and 65,535 networks.
- Assured time slot for applications requiring low expectancy.
- Fully hand-shaked protocol for shifting reliability.

4. ZIGBEE NETWORK & ARCHITECTURE

- Search for a Radio Channel-The coordinator first looks for an appropriate radio channel (usually the one which has least activity). This search can be limited to those channels which are known to be functional.
- Assign PAN ID- The coordinator initiates the network, assigning a PAN ID (Personal Area Network identifier) to the network. The PAN ID can be pre-determined, or can be obtained actively by detecting other networks operating in the same frequency channel and choosing a PAN ID that does not dispute with theirs.



5. ZIGBEE SECURITY ARCHITECTURE

Zigbee uses 128-bit keys to execute its security mechanisms. A key can be linked either to a network, being usable by both Zigbee layers and the MAC sub layers gained through pre-installation, or transport. Formation of link keys is based on a master key which controls link key harmony. Eventually, at least the initial master key must be acquired through a secure medium (transport or pre-installation), as the security of the whole network hinged on it. Link and master keys are only viewable to the application layer. Different services use distinctone way variations of the link key in order to avoid leaks and security risks. Key distribution is one of the dominant security functions of the network. A secure network will nominate one special device which other devices belief for the distribution of security keys which is known as the trust center. Preferably, devices will have the trust center address and initial master key preloaded, if a momentary fragility is allowed, it will be sent as mentioned above. Particular applications without special security needs will use a network key provided by the trust center to communicate. Thus, the trust center retains both the network key and provides point to point security. Devices will only accept communications starting from a key provided by the trust center, except for the initial master key. The security construction is dispersed among the network layers as follows:

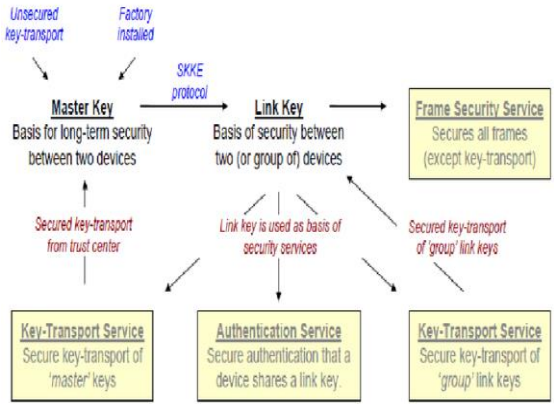
1. The MAC sub layer is competent of single-hop reliable communications. As a rule, the security level it is to use is stated by the upper layers.
2. The network layer manages routing, processing received messages and being capable of broadcasting requests. Outgoing frames will use the adequate link key according to the routing, if it is available; otherwise, the network key will be used to protect the payload from external devices.

3. The application layer presentskey establishment services to both ZDO and its applications. It is also accountable to the propagation across the network of changes in devices present within it. It also directs requests from devices to the trust center. It also routes the network key renewals from the trust center to all devices. Apart from this, the ZDO also maintains the security policies of the device. The safety levels infrastructure is built on CCM, which adds encryption and integrity features to CCM. Zigbee executes two extra security layers on top of the 802.15.4 one is the Network layer and another one is Application security layers.

All the security policies count on the AES 128b encryption algorithm so the hardware architecture earlier used for the MAC layer is still valid. There are three kinds of Keys which are master keys, link keys and network keys.

1) Master Keys: Master keys are pre-installed keys in each node. Their function is to keep intimate Link Keys interchange between two nodes in the Key Establishment Procedure (SKKE).

2) Link Keys: They are distinct between each pair of nodes.



1. APPLICATIONS OF ZIGBEE TECHNOLOGY

- It is not constrained to a certain level but because of being cost effectiveness, low-power battery and wireless connectivity, the Zigbee technology is used in almost every appliance except few.
- Zigbee technology is mapped out in a chip form and is used in many devices to function naturally. By using Zigbee technology we can control and monitor a whole factory unit while sitting in one cabin.
- This centralizes all the units in one place and alsoenables the remote monitoring. In a similar manner, a home can be centralized by augmenting the security aspect. Many small types of equipment which comes with embedded Zigbee technology chips are very useful.
- Zigbee technology is rapidly conquering the market by introducing devices like smoke and heat sensor, medical and scientific equipments and many more.

CONCLUSION

It is likely that Zigbee will progressively play a crucial role in the future of computer technology. It would also be essential in communication technology. In terms of protocol stack size this technology that is Zigbee 32 KB is about one third of the stack size necessary in other wireless technologies. The IEEE 802.15.4 based Zigbee is designed for remote controls and sensors, which are many in numbers, but require only small data packets and, immensely low power consumption for longer life. The Zigbee Alliance selects applications across consumer, commercial, industrial and government markets worldwide. Unwired applications are thoroughly sought after in many networks that are marked by plenteous nodes consuming minimum power and enjoying long battery lives. Zigbee technology is fabricated to best suit these applications, for the reason that it allows lesser costs of development and very rapid market adoption.

REFERENCES:

[1]. ZigBee Alliance, ZigBee Specification. Version 1.0 ZigBee Document 053474r06.
[2]. William Stalling, —Wireless Communication and Networks, Pearson Publication Limited Fourth Edition.
[3]. 802.15.4, Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low Rate Wireless Personal Area Networks (LRWPANs).
[4]. Free scale Semiconductor, ZigBee Implementer's Guide; Document Number: F8W-2004-0007.
[5]. IEEE 802 Part 15.4: Wireless Medium Access Control i.e. MAC and Physical Layer i.e. PHY Specifications for Low Rate Wireless Personal Area Networks, IEEE Computer Society.
[6]. ZigBee Specification and ZigBee Alliance, Tanenbaum & Crispo. It takes sensor networks from the lab to jungle Computers.
[7]. ZigBee routing selection strategy based on data services and energy-balanced ZigBee routing APSCC '06.