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Zigbee Based Wireless Networking on Various Applications

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Abstract:
ZigBee is a wireless communication technology that provides self-organized, multi-hop and reliable networking with long battery lifetime. In this paper the most importantly consists of the architecture of ZigBee protocol and various application of ZigBee technology. IEEE 802.15.4 has developed on low cost of deployment, low complexity and low power consumption and these devices to support for designing the physical and data link layer protocols. ZigBee defines the higher layer communication protocols built on IEEE 802.15.4 standards. This mainly focuses on the widely used transceiver in Wireless Sensor Networks, a ZigBee technology over IEEE 802.15.4 defines specifications for low data rate WPAN (LR-WPAN) to support low power monitoring and controlling devices.
Keywords:- *ZigBee, IEEE 802.15.4, low data rate WPAN LR-WPAN, Wireless Sensor Networks*

INTRODUCTION

ZigBee is a technology for remote monitoring, control and sensor network applications. It was created to address the need for a cost-effective, wireless networking solution that supports low-power consumption, low data-rates, security and reliability. Which support of self-healing mesh networking, ZigBee is a decentralized network topology very similar to the Internet and allows to making robust wireless solution. The ZigBee is a specification that enhances the IEEE 802.15.4 standard by network and security layers, This standard developed an application framework from this foundation Alliance and technically referred to as public application profiles, that can be used to create a multi-vendor interoperable solutions. Where interoperability is not required for the custom application, create their own manufacturer specific profiles [1].

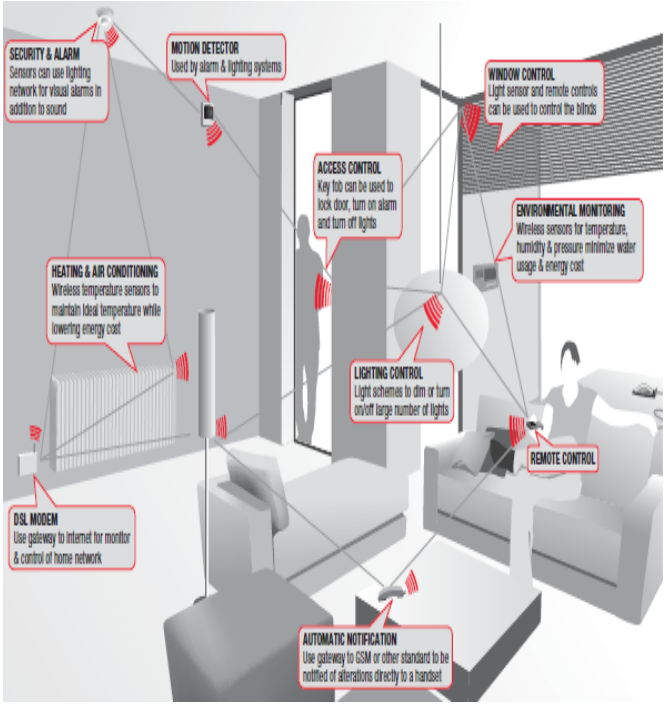

Figure 1: Wireless Networking

A global ecosystem creating a worldwide wireless standard for home, industrial and commercial applications. The global wireless communication is a standard for enabling the development of easily, smart, green, deployable, low-cost, low power monitoring and control products. The innovative standards for energy management, health care, home and commercial automation, retail, telecom and consumer electronics, connecting widest range of devices together work with intelligently[5].

A Wireless Personal area Network(WPN) is a interconnection of several devices around a single person's workspace, which can be connections among devices are wireless and that uses the technology allows communication in the distance of few meters, which is very short distance, Bluetooth is a technologies used for short range distance[3]. The wireless networks provide comfort, security, and safety and that is most popular to support remote monitoring facilities and availability of cheap wireless sensors actuators [4].

ZIGBEE AND IEEE802.11.4 SPECIFICATIONS

ZigBee alliance is an organization was established in 2001and worked together to define an open global standard for making low power wireless network systems.[8] The outcome of ZigBee alliance has to make a description to defines how to build an altered network topologies with features of data security and interpretable application profiles. This organization has more than 150 members out of which seven are the promoter. This offers all wireless networking capable of supporting more than that 64,000 devices on single network system. A big challenge for the ZigBee alliance is to make the interoperability to work among the different products [8]. ZigBee Alliance defined profiles which depend on the category of the product to which it belongs to. For e.g. there is a profile called the home lightning defines how altered brands of home lightning-products should be communicate to each other. The ZigBee specification has the following two key Feature Sets: ZigBee and ZigBee PRO, The ZigBee Feature Set is popular choice of designing to support smaller networks with thousands of devices in a single network. The ZigBee PRO Feature Set is the most popular choice of developers to use for most Alliance developed ZigBee Feature Set and facilitates for ease-of-use and advanced method to support for thousands of devices with larger networks. These can be used to create solutions for multi-vendor interoperable. The range of sample applications include support for the ZigBee Smart Energy, ZigBee Home Automation and ZigBee Light Link Profiles, Over-The Aair download support, Incorporated support for an RF PA/LNA front end which supports up to 22dBm output power and improved receive sensitivity

Some of the characteristics of ZigBee include:

- According to IEEE 802.15.4 is the 2.4GHz frequency band in Global operation.
- Regional operation in 915 MHz (Americas) and 868 MHz (Europe).
- Frequency agile solution operating over 16 channels in 2.4GHz frequency.
- Incorporates power saving mechanisms for all device classes.
- Discovery mechanism with full application confirmation.
- Pairing mechanism with fully application confirmation.
- Multiple star topology and inter-personal area network (PAN) communication.
- Various transmission options including broadcast.
- Security key generation mechanism.
- Utilizes the industry standard AES-128 security scheme.
- Supports Alliance standards (public application profiles) or manufacturer specific profiles.

ZIGBEE PROTOCOL ARCHITECTURE

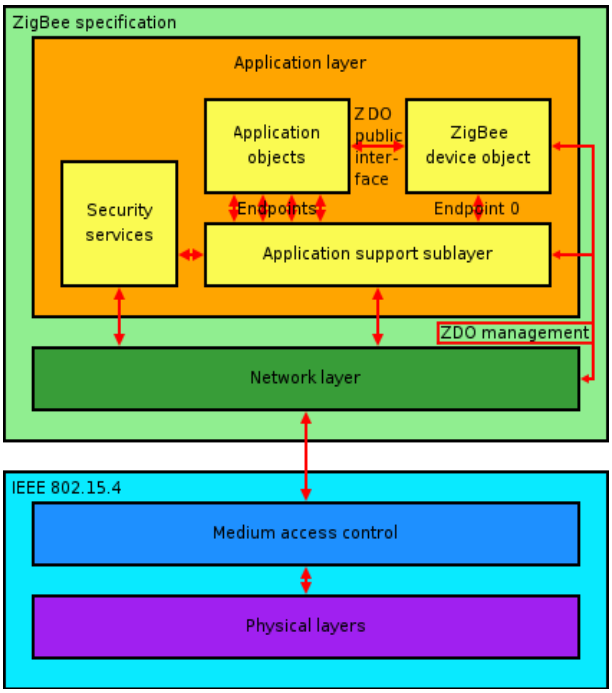

Figure2: Zigbee protocol Architecture

1.1 **The Physical layer** directly controls and communicates with the radio transceiver and handles all tasks involving access to the ZigBee hardware and initialization of the hardware, channel selection, energy detection measurement and link quality estimation and that will clear channel assessment to assist Channel selection. It supports three frequency bands such as 868MHz band using 1 channel, 915MHz band which using 10 channels and 2.45GHz band which using16 channels,. All three using Direct Spread Spectrum Sequencing access mode [2].

1.2 **The MAC layer** is an interface between the physical and the network layer. The main function of this layer is to generate beacons and synchronize devices to the beacon signal in a network, which is beacon that have enabled and performs, connect and disconnect function. MAC layer can be defined four types of frame structures such as beacon frame, data frame, acknowledgment frame and MAC command frame.

1.3 **The Network layer** is an interface between the Application layer and the MAC Layer and the main functions of this layer is the formation of network and routing. It has to help low power devices to increase their battery life, which connects or disconnects devices by using the network coordinator, that implements security and forward frames to their destination. The Network layer of the coordinator starts a new network which assigns an address to newly connected devices.

1.4 **The application Layer** holds the different application objects and it is the top most layer of the protocol stack. ZigBee specification can be split into three different APL sub layer such as: Application support sub layer, ZigBee device objects and Application framework, which contains manufacturer defined objects.

ZigBee is a standards-based technology supported by the following topologies; Star topology, Tree topology and Mesh topology. The Star topology is where a co-coordinator surrounded by a group of end devices or routers. These provide easy way to access for service or reconfiguration of the network devices. This topology used in most existing information networks, that involving data processing or voice communications. All traffic should travel through centre of the star. For the same reason the coordinator will be easily bottleneck to the traffic. The Tree topology is a coordinator initializes the network and is the root of the tree. The shape of the network is that of an inverted tree with the central root branching, sub branching to the extremities of the network and the message can take one path so this type of topology is not reliable topology. The Mesh topology is excellent for long distance networking because it provides extensive back up, rerouting and pass through capabilities. This function is needed in the event of a line failure elsewhere in the network. If one router fails the ZigBee's itself

healing mechanism will allow the network to search for passing an alternative path for the message.

SYSTEM MODEL

The system model of this work is shown in Figure1. The system model of this work can have the following different types of basic components

- Automatic speech recognition system
- control units
- wireless network system
- Application and home appliances.

Automatic speech recognition (ASR) system can be defined as an independent and Computer- driven transcription of spoken language that allows a computer can be identify to spoken words and that should captured from a microphone or telephone then convert into written texts. There are many fundamental components of an ASR are

- a microphone
- speech recognition software
- a computer,
- a sound card.

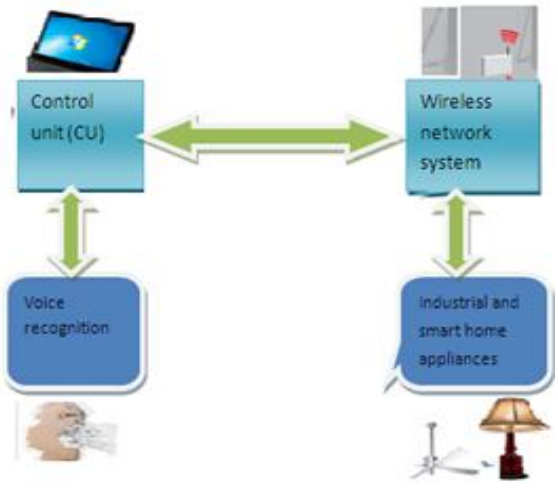

Figure 3: System operation

The main goal of the ASR is to allow a computer to recognize in real-time system and any person can spoken any words, the independent of vocabulary size, noise, speaker features or accents. Through a speech recognition program/ application, the computer is able to process words one says and turn them into text that is displayed on the screen. The main aspects of these research activities on speech recognition system are the accessibility for the deaf and hard of hearing, automation cost reduction and searching text capability.

ZIGBEE DEVICES

ZigBee devices are the combination of application layer like light sensors for lightening control methods. There are three different types of ZigBee devices. ZigBee Coordinator forms the network tree root and that might bridge to other networks. Which exactly one coordinator in each network and also store the information about network security keys. Router can be sensor devices which can connect to an already existent network and also able to accept connections from other devices and re-transmitters to the network. End Device have no routing capability which can be increase power /battery-powered devices and collect various information from sensors and switches. It has sufficient functionality to talk to their parents (either the coordinator or a router) and can't relay data from various devices and reduce their cost, without any chargers.

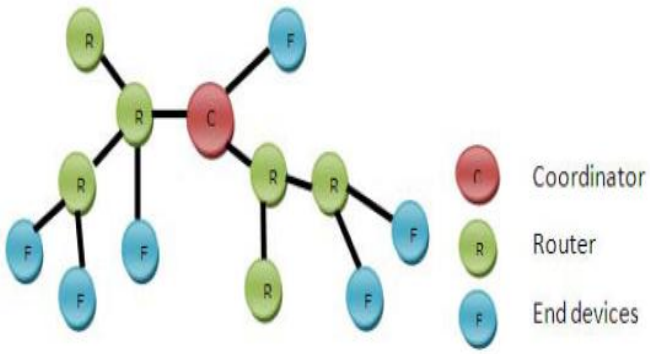

Figure 4: ZigBee Network

APPLICATIONS OF ZIGBEE

ZigBee 802.15.4 can be used in any monitoring and control application that requires a wireless link. The primary target markets are:

- Home, building and industrial automation
- Smart wireless lighting control
- Home control/security
- Medical/patient monitoring
- Logistics and asset tracking
- Sensor networks and active RFID

- Advanced metering/smart energy
- Commercial building automation
- Energy harvesting
- vehicular and entertainment control
- Design of greenhouse monitoring control system based on ZigBee.
- Multilevel parking vacancy monitoring system based on ZigBee.

CONCLUSION

The ZigBee/IEEE 802.15.4 is a specification gives a practical application solution for characteristics of Wireless Sensor Networks provides low data rate, low cost and low power dissipation. This paper mainly concerned on details of the ZigBee technology. This technology is designed by ZigBee alliance, which has offers various characteristics like low power consumption, advanced security services, full mesh networking etc. ZigBee can supports three types of ZigBee devices and also supports three network topologies. This technology gives sufficient details about ZigBee Protocol stack. ZigBee technology has various applications in various fields. The aims are to utilize low power consumption. Wireless smart home automation system implement a voice controlled based Zigbee and that can be implement speech recognition system. Further this technique utilizes bandwidth and also improves reliability and energy efficiency among nodes.

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