ZIGBEE BASED TECHNOLOGY APPLIANCE IN WIRELESS NETWORK

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ABSTRACT

Zigbee communication is specially built for control and sensor networks on IEEE 802.15.4 standard for wireless personal area networks (WPANs), and it is the product from Zigbee alliance. This communication standard defines physical and Media Access Control (MAC) layers to handle many devices at low-data rates. These Zigbee's WPANs operate at 868 MHz, 902-928MHz and 2.4 GHz frequencies. The date rate of 250 kbps is best suited for periodic as well as intermediate two way transmission of data between sensors and controllers. ZigBee operates in the Industrial, Scientific, and Medical (ISM) radio bands and the exact frequency will depend on where you are in the world. It can use the 868 MHz band in much of Europe, 915 MHz in the USA and 2.4 GHz in many other locations. The 2.4 GHz band is very common as many of the available chipsets use it. The speeds available depend on which band you are using, but the maximum is 250 Kbps. This is slower than other popular wireless technologies such as WiFi but is also cheaper and lower cost.

KEYWORD: *transmission lines, ZigBee, mesh network*

1. INTRODUCTION

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 standend created for controlling and sensor the network. As we know that ZigBee is Personal Area network of task group 4 so it is based on IEEE 802.14.4 and it is created by Zigbee Aliance.

- Operates in personal area network.
- It is a device to device network

Zigbee is low-cost and low-powered mesh network widely deployed for controlling and monitoring applications where it covers 10-100 meters within the range. This communication system is less expensive and simpler than the other proprietary short-range wireless sensor networks as Bluetooth and Wi-Fi.

Zigbee supports different network configurations for master to master or master to slave communications. And also, it can be operated in different modes as a result the battery power is conserved. Zigbee networks are extendable with the use of routers and allow many nodes to interconnect with each other for building a wider area network

2. ARCHITECTURE OF ZIGBEE

Zigbee system structure consists of three different types of devices such as Zigbee coordinator, Router and End device. Every Zigbee network must consist of at least one coordinator which acts as a root and bridge of the network. The coordinator is responsible for handling and storing the information while performing receiving and transmitting data operations. Zigbee routers act as intermediary devices that permit data to pass to and fro through them to other devices. End devices have limited functionality to communicate with the parent nodes such that the

battery power is saved as shown in the figure. The number of routers, coordinators and end devices depends on the type of network such as star, tree and mesh networks.

Zigbee protocol architecture consists of a stack of various layers where IEEE 802.15.4 is defined by physical and MAC layers while this protocol is completed by accumulating Zigbee's own network and application layers.

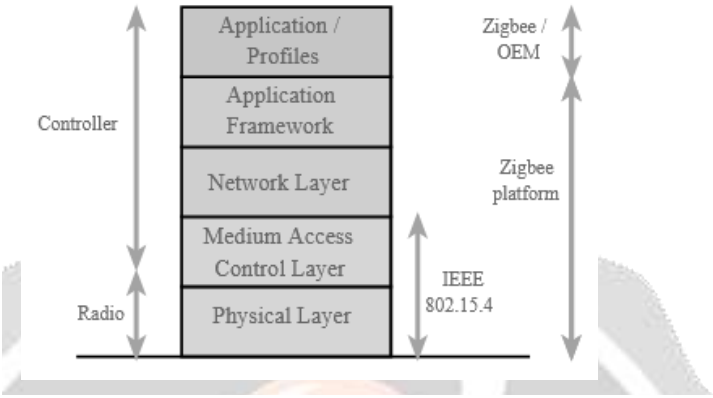

Fig 1.1 Architecture of Zigbee

3. ZIGBEE TOPOLOGIES

Zigbee supports several network topologies; however, the most commonly used configurations are star, mesh and cluster tree topologies. Any topology consists of one or more coordinator. In a star topology, the network consists of one coordinator which is responsible for initiating and managing the devices over the network. All other devices are called end devices that directly communicate with coordinator. This is used in industries where all the end point devices are needed to communicate with the central controller, and this topology is simple and easy to deploy.

In mesh and tree topologies, the Zigbee network is extended with several routers where coordinator is responsible for staring them. These structures allow any device to communicate with any other adjacent node for providing redundancy to the data. If any node fails, the information is routed automatically to other device by these topologies. As the redundancy is the main factor in industries, hence mesh topology is mostly used. In a cluster-tree network, each cluster consists of a coordinator with leaf nodes, and these coordinators are connected to parent coordinator which initiates the entire network.

Due to the advantages of Zigbee technology like low cost and low power operating modes and its topologies, this short range communication technology is best suited for several applications compared to other proprietary communications, such as Bluetooth, Wi-Fi, etc. some of these comparisons such as range of Zigbee, standards, etc., are given below.

4 LITERATURE SURVEY

In order to see the performance of our WSN, we measure the throughput and packet delay as a function of packet size and the baud rate over various distances in point to point link. This experiment is performed to have an insight how the baud rate affects the latency of the communication over the ZigBee protocol. The baud rate is defined as processing data rate in serial communication of Xbee module. The home automation system is designed to be flexible, allowing different devices designed by multiple vendors to be connected. Each device incorporates a dedicated engine, responsible for providing the necessary application functionality and ZigBee network connectivity. Moreover, each device engine may contain dedicated security and safety measures. Critical devices should check all requested operations to ensure that they will not result in an undesirable outcome. Furthermore, collaboration with the virtual home should provide the necessary information to facilitate secure communications.

The ZigBee home automation network consists of a coordinator, routers and several end devices. The coordinator is responsible for starting the ZigBee network. During the network initialisation phase, the coordinator scans the available radio channels to find the most suitable. Normally this will be the channel with the least activity, in order to reduce the level of interference. It is possible to limit the channels scanned, for example excluding those frequencies ranges used by the Wi-Fi network included in the proposed architecture. However, our experiments have shown that the average time taken to scan all the available channels is 9 seconds (to the nearest second). This scan time is relatively small and as the home coordinator is initialised infrequently this is an acceptable delay when contrasted with the performance increase possible through the use of a channel with less interference.

The coordinator is preprogrammed with the PAN ID (Personal Area Network Identifier), although it is possible for the coordinator to dynamically scan for existing network PAN IDs in the same frequency and generate a PAN ID that does not conflict. All home devices connected to the ZigBee home automation network are assigned a fixed 64 bit MAC address. Additionally, each device is assigned a dynamic 16 bit short address that is fixed for the lifetime of the network. At this stage of the network initialisation, the coordinator assigns itself the short address 0x0000. After the coordinator's initialisation phase the coordinator enters "coordinator mode", during this phase it awaits requests from ZigBee devices to join the network. The ZigBee devices developed for the home network, as mentioned, includes a light switch, radiator valve, safety sensor and ZigBee remote control.

A ZigBee end node has been integrated with these devices. As the devices are started, during their respective initialisation stage, the node scans for available channels to identify the network it wishes to join. There may be multiple networks in the same channel, these networks are normally distinguished by their PAN ID. The node selects which network to join based on the PAN ID. The node sends a request to the network coordinator to join the network. The request is sent to the coordinator directly or through a neighbouring router on the desired network with which the node shares the best signal. On receipt of the request the coordinator judges whether the requesting device is permitted to connect to the home automation network. The standard implementation of most ZigBee networks prevents unauthorised devices joining the network by providing a short user defined period where device may join.

This, in our opinion, does not on its own provide sufficient network security. To enhance the systems security the proposed system encrypts all device communications including the requests to join the home network with a private key. Only those devices that are in possession of the correct private key can successfully connect to the home network. The devices that are permitted to join the network are recorded in the device database and stored on the network coordinator.

A partially connected mesh topology was adopted for the ZigBee home automation network. Due to the nature of the home environment where communication interference is constantly fluctuating, the advantage of increased communication routes available through the adoption of a mesh topology outweighs the added routing complexity.

5. METHODOLOGIES

The AP is an artificial intelligence–based companion that will be resident in software and chips embedded in the automobile dashboard. The heart of the system is a conversation planner that holds a profile of you, including details of your interests and profession. When activated, the AP uses the profile to cook up provocative questions such as, ―Who was the first person you dated?‖ via a speech generator and in-car speakers. A microphone picks up your answer and breaks it down into separate words with speech-recognition software. A camera built into the dashboard also tracks your lip movements to improve the accuracy of the speech recognition. A voice analyzer then looks for signs of tiredness by checking to see if the answer matches your profile. Slow responses and a lack of intonation are signs of fatigue.

5.1 APPLICATIONS OF ZIGBEE TECHNOLOGY

Industrial Automation: In manufacturing and production industries, a communication link continually monitors various parameters and critical equipments. Hence Zigbee considerably reduce this communication cost as well as optimizes the control process for greater reliability.

Home Automation: Zigbee is perfectly suited for controlling home appliances remotely as a lighting system control, appliance control, heating and cooling system control, safety equipment operations and control, surveillance, and so on.

Fig 4.2 Application of Zigbee

Smart Metering: Zigbee remote operations in smart metering include energy consumption response, pricing support, security over power theft, etc.

Smart Grid monitoring: Zigbee operations in this smart grid involve remote temperature monitoring, fault locating, reactive power management, and so on.

5. ZIGBEE ROUTING PROTOCOL

The Cluster-Tree algorithm and AODV algorithm are used in ZigBee network to reduce cost and power consumption and improve reliability. But the AODV algorithm of ZigBee is not identical with the classical algorithm. It is a simplified edition of AODV.

A. Cluster-Tree Algotithm

The packet node calculates the next jump according to the node address in Cluster-Tree algorithm. For the routing node whose network address is A and depth is d , if formula(3) is established, the target node whose address is D is its child node.

A D A Cskip (d − 1)

If the target node is descendant of the receive node, the next jump address is N :

N = D

If there is a terminal node,

D >A R_m × Cskip d

Else

N=A+1[D-(A+1)/ Cskip(d)] × Cskip(d)

If the target node is not descendant of the receive node, the packet node is sent to its father node.

6. CONCLUSION

The authors present a smart wireless network for automation of residential and commercial loads that would facilitate their participation in system-wide demand response initiatives. Primary research objectives include: 1) developing a cost-effective and ultra-low power meshed network, 2) developing a learning-based optimization algorithm for load automation, and 3) applying optimization to demand response. To effectively implement demand response, design concepts commonly used in IoT must be applied to components of the power grid. A significant percentage of power consuming devices within a system must have some data acquisition

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