ZIGBEE Wireless Technology

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Abstract: ZigBee technology is a new standard in wireless personal area after Bluetooth. After an introduction to this technology, a new wireless meter-reading system based on ZigBee protocol has evolved. This system, which is comprised of ZigBee network and database management system. Wireless Sensor Network based on ZigBee technology is a wireless network which is composed of many nodes of ZigBee RF chips, sensors and MCUs, especially suitable for application of the remote monitoring system in flammable and explosive environments.[1]This paper focuses on ZigBee as a technology innovation which would bring about low-cost connectivity, its architecture and applications .[2]

Keywords: Zigbee, Zigbee Architecture, low cost connectivity.

I. INTRODUCTION

ZigBee is a wireless network protocol specifically designed for low data rate sensors and control networks.zigBee is expected to provide low cost and low power connectivity for equipment that needs battery life as long as several months to several years but does not require data transfer rates as high as those enabled by Bluetooth. In addition, ZigBee can be implemented in mesh networks larger than is possible with Bluetooth. It also offers three frequency bands of operation along with a number of network configurations and optional security capability. [6] ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices.[3]

II. APPLICATIONS

Zigbee protocol has been developed with the emphases on low cost battery powered application such as consumer electronics, industrial automation, home and building automation, PC peripherals, medical sensor applications, toys and games. .[6]
Some of the major applications include:

- Remote sensing : Water/sewage level monitoring, Temperature sensing.
- Industrial and commercial : Monitor, control and automation links.
- Building automation : Security, light, thermostat, Air condition control.
- Heath care : Patient monitoring, data logger, remote diagnosis.
- Memory tagging : Automotive service record, maintenance logging,inventory control/tracing.

Description of some of the application is explained below

A. Water Level Sensing:

Zigbee can be installed in remote locations where conventional GSM modems would be out of their network coverage area, such as inside water tanks.Zigbee tranceivers can be hermetically sealed with batteries and co-located with the sensors.Each tranceivers transmits periodically to another unit installed above ground.A GSM modem transmits the data back to base.

B. In-building Control

Zigbee-enabled switches and lights can reduce installation costs in new buildings by eliminating the need to route light control through the walls, and remove the need to call in a qualified electrician when switches need to be relocated. Thermostats and air-conditioning controls can also be placed anywhere free of any wiring constraints.

C. Radio Systems

The freescale solution is one of the first on the market. It comprises an RF data modem IC supporting the 2.4GHz band of the 802.15.4 standard, the world renowned 68HCS08 microcontroller, and software meeting current Zigbee protocols.

III. ZIGBEE PROTOCOL STACK

The ZigBee Standard has evolved standardized sets of solutions, called 'layers'. These layers facilitate the features that make ZigBee very attractive: low cost, easy implementation, reliable data transfer, short-rangeoperations, very low power consumption and adequate security features.[5]
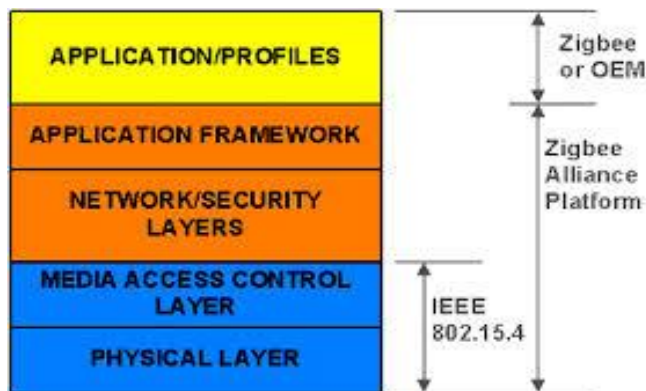
Fig1:- ZigBee protocol stack

A. *Physical layer*

The physical layer of the IEEE802.15.4 standard is the closest layer to the hardware, which control and communicate with the radio transceiver directly. It handles all tasks involving the access to the ZigBee hardware,including initialization of the hardware, channel selection,link quality estimation, energy detection measurement andclear channel assessment to assist the channel selection.Supports three frequency bands.[4]

B. *Media access control (MAC) layer*

This layer provides interface between physical layer and network layer. This provides two services; MAC data services and MAC management service interfacing to the MAC sub Layer Management Entity (MLME) Service Access Point called (MLME-SAP). MAC layer is responsible for generating beacons and synchronizing devices to the beacon signal in a beacon enabled services. It is also performing association and dissociation function. [4]

C. *Network layer*

Network layer interfaces between application layer and MAC Layer. This Layer is responsible for network formation and routing. Routing is the process of selection of path to relay the messages to the destination node. This forms the network involving joining and leaving of nodes, maintaining routing tables (coordinator/router), actual routing and address allocation. ZigBee coordinator or router will perform the route discovery. This layer Provides network wide security and allows low power devices to maximize their battery life. From the basic topologies, the three network topologies considered in IEEE802.15.4 are star, tree Network and mesh.[4]

Star Network

In the star topology, the communication is established between devices and a single central controller ,called the PAN coordinator. The PAN coordinator may be mains powered while the devices will most likely be battery powered. Applications that benefit from this topology include home automation, personal computer (PC) peripherals, toys and games.[6]
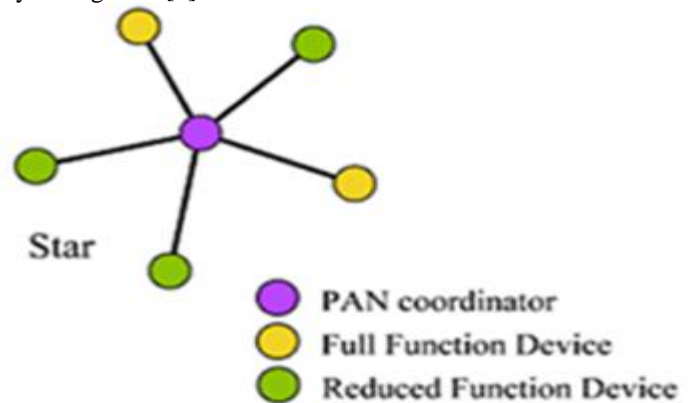

Fig 2 Star Network

Cluster-tree network

Cluster-tree network is a special case of a peer-to-peer network in which most devices are FFDs and an RFD may connect to a cluster-tree network as a leave node at the end of a branch. Any of the FFD can act as a coordinator and provide synchronization services to other devices and coordinators. Only one of these coordinators however is the PAN coordinator.A candidate device receiving a beacon frame may request to join the network at the CLH. If the PAN coordinator permits the device to join, it will add this new device as a child device in its neighbor list. [6]
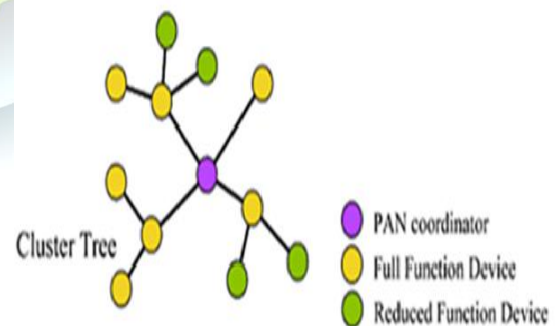

Fig 3 Cluster Tree Network

Mesh network

A mesh network is similar to a cluster tree configuration, except that FFDs can route messages directly to other FFDs instead of following the tree structure. Messages

to RFDs must still go through the RFD's parent. The advantages of this topology are that message latency can be reduced and reliability is increased. [6]
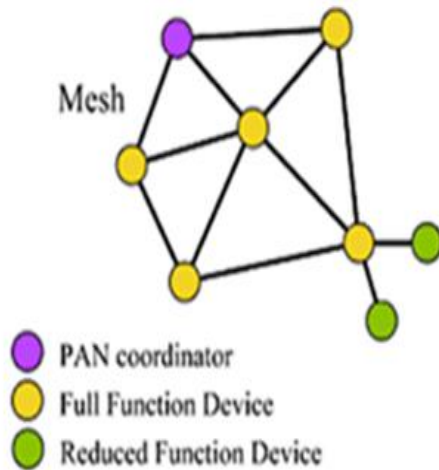

Fig 4 Mesh Network

D. *Application Layer*

The application Layer is the highest protocol layerand it hosts the application objects. ZigBee specification separates the APL layer into three different sub-layers: the Application Support Sub layer, the ZigBee Device Objects, and The application Layer is the highest protocol layer. [4]
The application objects (APO)

Control and manages the protocol layers in ZigBee device. It is a piece of software which controls the hardware.
ZigBee Device Object

The key definition of ZigBee is the ZigBee device object, which addresses three main operations; service discovery, security and binding.
Application support sub layer

The Application Support (APS) sub layer provides an interface between the NWK and the APL layers through a general set of services provided by APS data and management entities.

IV. ADVANTAGES OF ZIGBEE

- Low power consumption, simply implemented.
- Users expect batteries to last many months to years! Consider that a typical single family house has about 6 smoke/CO detectors.
- Bluetooth has many different modes and states depending upon your latency and power requirements such as sniff, park, hold, active, etc.

V. CONCLUSION

It is likely that ZigBee will increasingly play an important role in the future of computer and communication technolog.The IEEE 802.15.4–based ZigBee is designed for remote controls and sensors, which are very many in number, but need only small data packets and, mainly, extremely low power consumption for (long) life. Therefore they are naturally different in their approach to their respective application arenas. ZigBee technology is designed to best suit these applications, for the reason that it enables reduced costs of development and very fast market adoption

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