ASSIGNMENT 6

CSCI 6704 – Advanced Topics in Network

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Wireless Technology: ZigBee

Overview:

ZigBee, similar to Bluetooth, is a Wireless Personal Area Network (WPAN) developed on IEEE standard 802.15.4. It is a packet-based protocol used to establish well grounded channel between portable devices for communicating wirelessly. Zigbee allows devices between 10 meters to 100 meters of range to connect and communicate with each other. Zigbee offers a dependable, more secure, and economical networking among mobile devices. Generally, devices operating on the ZigBee standard consume less power coupled with low data rate, offers connection among devices within a short range, supports networks with limited capabilities, and are comparatively cheaper to implement as compared to other networking standards such as Cellular networks, WiFi networks, and so on [1].

Categorizing ZigBee devices:

The ZigBee architecture primarily consists of three different components such as ZigBee Coordinator, Router, and End device. The functions of each of these components are:

1. ZigBee Coordinator: There should be mandatorily one coordinator to manage information being transmitted and received. The received information is stored.
2. Router: Routers are intermediary devices that support data transfer to and from them.
3. End devices: These have bounded responsibilities to talk to the parent nodes to reduce the battery consumption [2].

Architecture of ZigBee:

The protocol architecture stack consists of layers such as Physical, Medium Access Control (MAC), Network, and Application layers. Figure 1 displays the architecture of ZigBee technology [3].
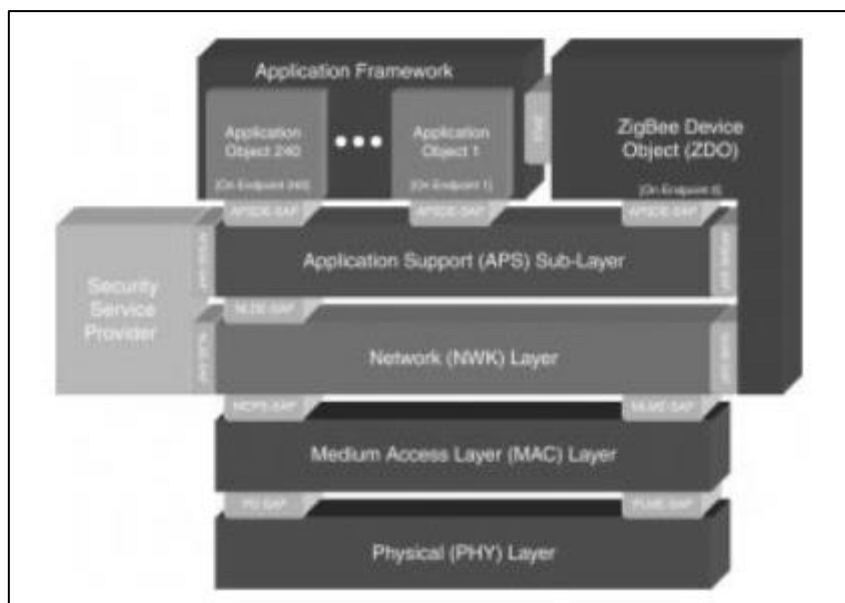

Figure 1: ZigBee architecture [3]

Each of these layers perform dedicated tasks as follows:
1. Physical Layer: The physical layer is responsible for performing the modulation during the transmission of data and demodulation during the reception of data.
2. MAC Layer: The Medium Access Control Layer is tasked to transfer the data in a secure and reliable manner using the network protocol known as Carrier Sense Multiple Access Collision Avoidances (CSMA CA).
3. Network Layer: This layer is responsible for handling tasks dealing with networking such as establishing a secure connection with devices, disconnecting an established connection post operation, routing data packets, configuring devices to an accurate precision, and so on.
4. Application Layer: This layer is responsible for helping the ZigBee device objects interconnect with the application objects for managing data for a ZigBee network. This layer helps two devices to connect to each other according to their needs.
5. Application Framework: The application framework offers two distinct types of services to structure incoming data. The first type is the key-value pair and second type is the generic message service. The primary function of the application framework is to identify, open, and tie other devices to the network.

ZigBee application examples:
1. Medicine Technology: ZigBee devices are used to record patient information such as tracks pulses of a patient, blood pressure, ultrasonic devices to record the movements inside the body.
2. Automation system at Home: This example is a multitude of applications such as usage of Smart TV, Smart refrigerator, Smart alert systems at home.
3. Wireless networks to sense weather conditions: This application example helps to collect weather information such as quality of air, obstructions, and so on.

Advantages of ZigBee technology [4]**:**
ZigBee is a highly efficient wireless technology that helps devices to connect to each other for easy communication. Some of the advantages of the ZigBee technology are as follows:
1. ZigBee technology is a reliable wireless standard.
2. The design of ZigBee is less complex than Bluetooth.
3. The installation of ZigBee technology in any device can be done smoothly.
4. The ZigBee technology is less expensive.
5. From a user's perspective, ZigBee is a very easy to use standard.

Disadvantages of ZigBee technology [4]**:**
ZigBee technology has some cons associated with its design configurations and operations. The disadvantages are listed below:
1. ZigBee technology works on shorter distances with a range of 10-100 meters.
2. The design configurations of the ZigBee technology have certain restrictions in the memory, speed of operation, and many more
3. The security of a ZigBee device is lesser as compared to a WiFi-based device.

ZigBee vs Bluetooth [3]**:**
Although Bluetooth and ZigBee are both wireless technologies, there are some key differences between the two of them. ZigBee uses Gaussian Frequency Shift Keying (GFSK) modulation technique whereas Bluetooth uses Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK), and GFSK. Bluetooth restricts the radio signals to a range of 10 meters whereas ZigBee covers a range of 100 meters. The size of the architectural stack of Bluetooth is 250 KB whereas that of ZigBee is 28KB.

ZigBee vs Bluetooth [3]**:**

References

[1] Wikipedia, "Zigbee," Wikipedia, [Online]. Available: https://en.wikipedia.org/wiki/Zigbee. [Accessed 16 December 2021].

[2] G. f. Geeks, "Introduction of ZigBee," Geeks for Geeks, [Online]. Available: https://www.geeksforgeeks.org/introduction-of-zigbee/. [Accessed 16 December 2021].

[3] ELPROCUS, "ZigBee Technology Architecture and Its Applications," ELPROCUS, [Online]. Available: https://www.elprocus.com/what-is-zigbee-technology-architecture-and-its-applications/. [Accessed 16 December 2021].

[4] E. Fundablog, "What is ZIGBEE Technology in IoT – Architecture, Network Topologies, Applications," Electrical Fundablog, [Online]. Available: https://electricalfundablog.com/zigbee-technology-architecture/. [Accessed 16 December 2021].