Zigbee in Wireless Networking

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ABSTRACT *The ZigBee™ Alliance is an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked monitoring and control products based on an open global standard. The ZigBee alliance specifi es the IEEE 802.15.4 as the physical and MAC layer and is seeking to standardize higher level applications such as lighting control and HVAC monitoring.It also serves as the compliance arm to IEEE802.15.4 much as the Wi-Fi alliance served the IEEE802.11 specifi cation. The ZigBee network specification, ratifi ed in 2004, support both star network and hybrid star mesh networks. The ZigBee alliance encompasses the IEEE802.15.4 specification and expands on the network specification and the application interface*

1.INTRODUCTION .

Long wire bundles represent a significant installation and long term maintenance cost, limiting the number of sensors that may be deployed, and therefore reducing the overall quality of the data reported. Wireless sensing networks can eliminate these costs, easing installation and eliminating connectors. The current list of application profiles either published or in the works are:

- Home Automation
- ZigBee Smart Energy
- Telecommunication Applications
- Personal Home

The goal is "to provide the consumer with ultimate flexibility, mobility, and ease of use by building wireless intelligence and capabilities into every day devices. ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide...
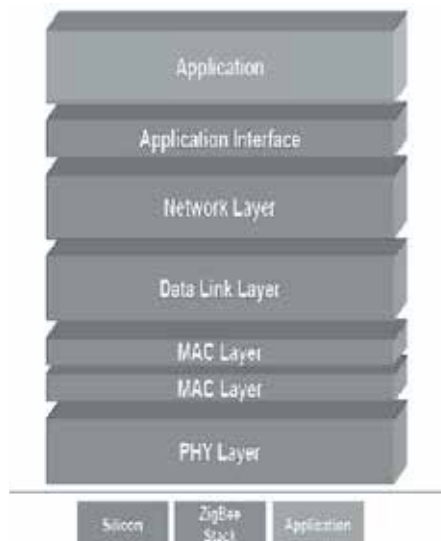

Fig 1 : Zigbee stack

2. ZIGBEE FEATURES

The focus of network applications under the IEEE 802.15.4 / ZigBee standard include the features of low power consumption, needed for only two major modes (Tx/Rx or Sleep), high density of nodes per network, low costs and simple implementation

3. TRAFFIC TYPES

ZigBee/IEEE 802.15.4 addresses three typical traffic types. IEEE 802.15.4 MAC can accommodate all the types.

1. Data is periodic. The application dictates the rate, and the sensor activates, checks for data and deactivates.

2. Data is intermittent. The application, or other stimulus, determines the rate, as in the case of say smoke detectors. The device needs to connect to the network only when communication is necessitated. This type enables optimum saving on energy.

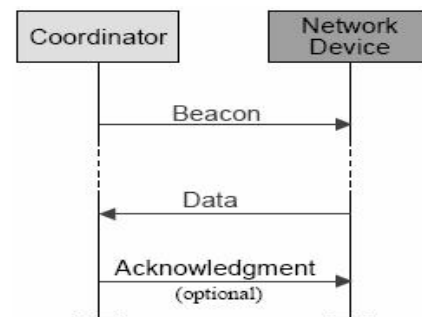3. Data is repetitive, and the rate is fixed a priori.

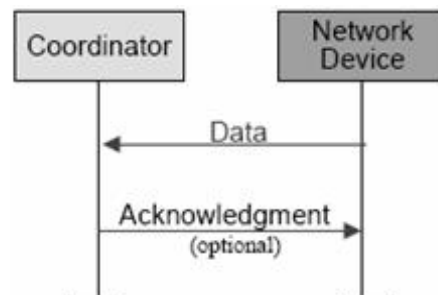

Figure 2: Beacon Network Communication

Figure 3: Non-Beacon Network Communication

The ZigBee Alliance will also serve as the official test and certification group for ZigBee devices. ZigBee is the only standards-based technology that addresses the needs of most remote monitoring and control and sensory network applications.
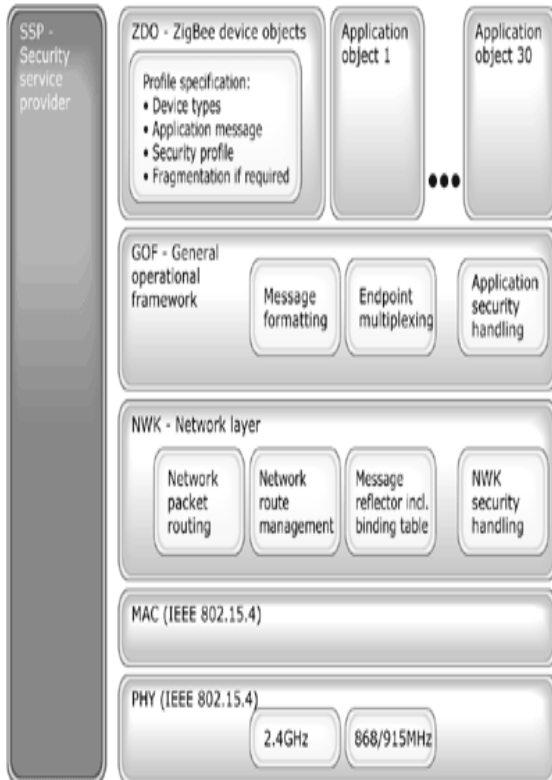
4. ARCHITECTURE

Figure 4: ZigBee stack architecture

It may be helpful to think of IEEE 802.15.4 as the physical radio and ZigBee as the logical network and application software. Following the standard Open Systems Interconnection (OSI) reference model, ZigBee's protocol stack is structured in layers. The first two layers, physical (PHY) and media access (MAC), are defined by the IEEE 802.15.4 standard. The layers above them are defined by the ZigBee Alliance. The IEEE working group passed the first draft of PHY and MAC in 2003.

5. FRAME STRUCTURE

Figure 4 illustrates the four basic frame types defined in 802.15.4: data, ACK, MAC command, and beacon.
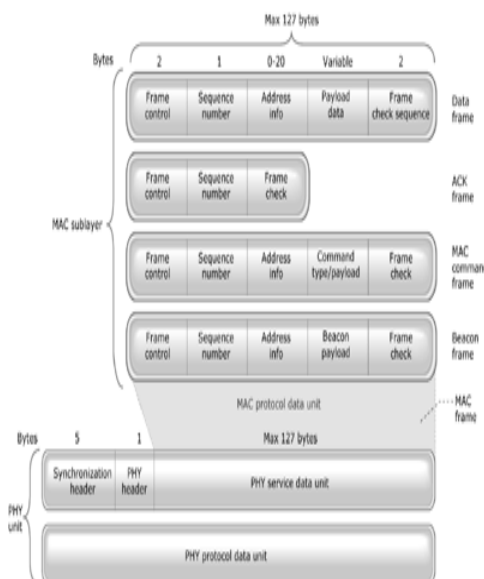

Fig 5 : The Fourbasic frame types defined in 802.15.4 : Data, ACK, MAC command and beacion

6. CHANNEL ACCESS, ADDRESSING

Two channel-access mechanisms are implemented in 802.15.4. For a non"beacon network, a standard ALOHA CSMA-CA (carrier-sense medium-access with collision avoidance) communicates with positive acknowledgement for successfully received packets. In a beacon-enabled network, a superframe structure is used to control channel access

7. DEVICE TYPES

ZigBee networks use three device types:

- The network coordinator maintains overall network knowledge. It's the most sophisticated of the three types and requires the most memory and computing power.
- The full function device (FFD) supports all 802.15.4 functions and features specified by the standard. It can function as a network coordinator. Additional memory and computing power make it ideal for network router functions or it could be used in network-edge devices (where the network touches the real world).
- The reduced function device (RFD) carries limited (as specified by the standard) functionality to lower cost and complexity. It's generally found in network-edge devices.

8. SECURITY

Security and data integrity are key benefits of the ZigBee technology. ZigBee leverages the security model of the IEEE 802.15.4 MAC sublayer which specifies four security services:

- access control—the device maintains a list of trusted devices within the network
- data encryption, which uses symmetric key 128-bit advanced encryption standard
- frame integrity to protect data from being modified by parties without cryptographic keys
- sequential freshness to reject data frames that have been replayed.

9. APPLICATIONS OF WIRELESS SENSORS FOR BETTER HEALTH CARE.

The healthcare domain presents opportunities for a significant number of applications of wireless sensor technology. The following sections focus on three broad health monitoring applications that include Chronic Disease Monitoring, Personal Wellness Monitoring, and Personal Fitness. Within each of these applications, we describe several specific uses of wireless sensor technology.

indicators

Fig 6 : Chronic desease monitoring devices

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