SNS COLLEGE OF ENGINEERING

Kurumbapalayam(Po), Coimbatore – 641 107

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Department of Information Technology

Course Name – 19IT503 Internet of Things

III Year / V Semester

Unit 3 – EVOLVING IoT STANDARDS & PROTOCOLS

Topic 8 - Zigbee

ZigBee

ZigBee
ZigBee is similar to Bluetooth and is majorly used in industrial settings.

It has some significant advantages in complex systems offering low-power operation, high security, robustness suitable for sensor networks in IoT applications.
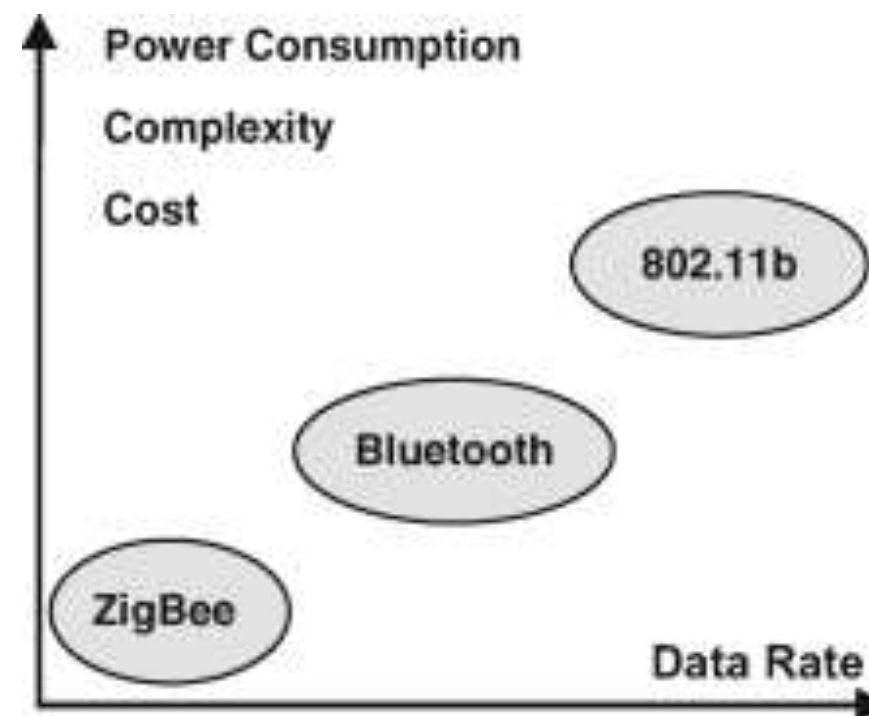
The latest version of ZigBee is the recently launched 3.0, which is essentially the unification of the various ZigBee wireless standards into a single standard.

Standard- Zigbee 3.0 based on IEEE802.15.4
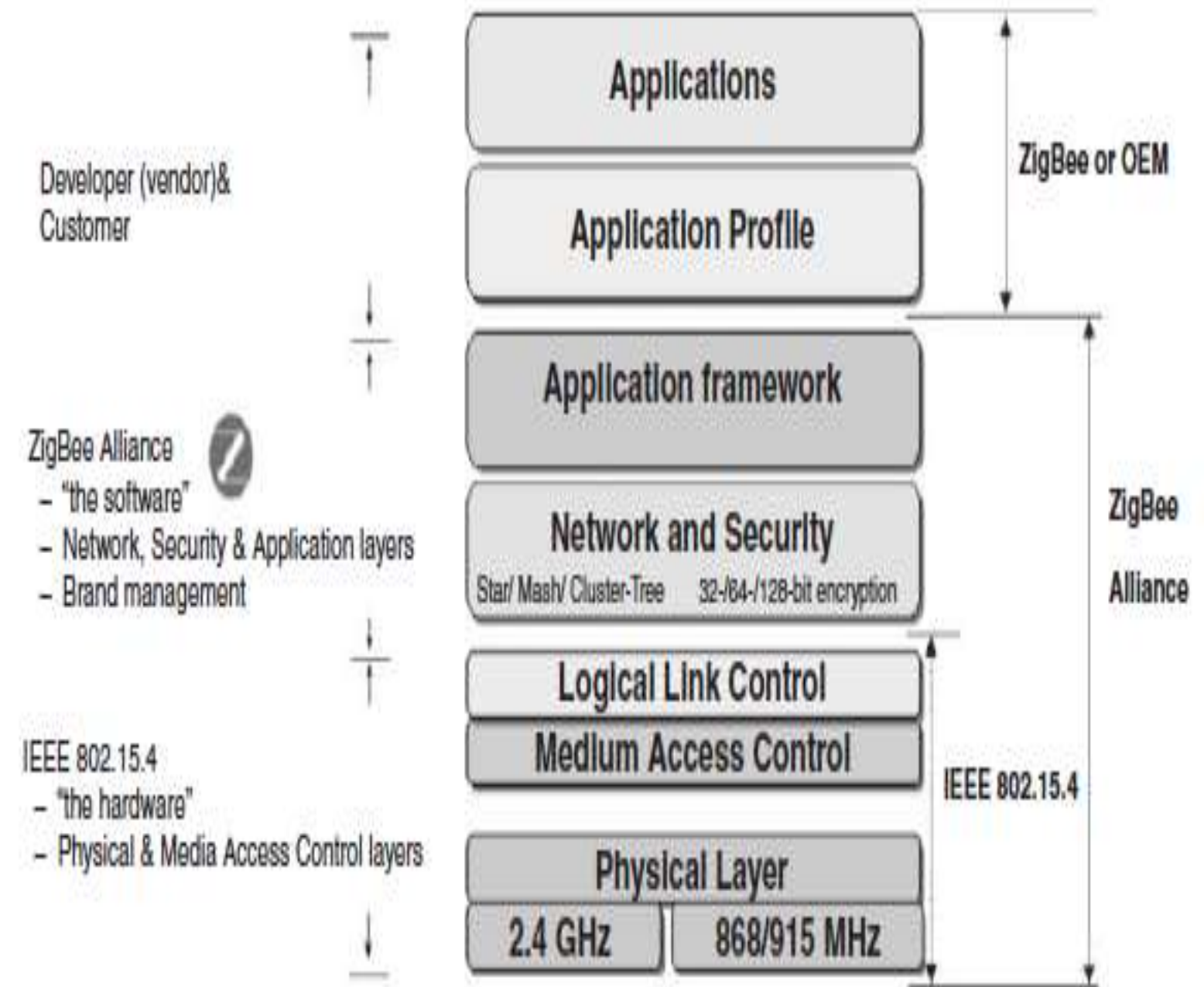Frequencies- 2.4 Ghz
Range- Approx. 10-100m
Data Rates – 250 kbps

	Data Rate	Typical Range	Application Examples
ZigBee	20 to 250 Kbps	10–100 m	Wireless Sensor Networks
Bluetooth	1 to 3 Mbps	2–10 m	Wireless Headset Wireless Mouse
IEEE 802.11b	1 to 11 Mbps	30–100 m	Wireless Internet Connection

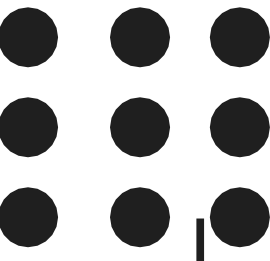**ZigBee/ Internet of Things /IT / SNSCE**

ZigBee

- ZigBee utilizes the globally available, license-free 2.4 GHz industrial, scientific, and medical (ISM) frequency band to provide low data rate wireless applications

- ZigBee networks support star, mesh, and cluster-tree topologies. These capabilities enable a network to have over 65,000 devices on a single wireless network.

- ZigBee offers low-latency communication

- ZigBee can create robust self-forming, self-healing wireless mesh network.

- The ZigBee mesh network connects sensors and controllers without being restricted by distance or range limitations

- It allows participating devices to communicate with one another and act as repeaters transferring data between devices

Developer (vendor)& Customer

ZigBee Alliance
– "the software"
– Network, Security & Application layers
– Brand management

IEEE 802.15.4
– "the hardware"
– Physical & Media Access Control layers

Applications

Application Profile

Application framework

Network and Security
Star/ Mash/ Cluster-Tree   32-/64-/128-bit encryption

Logical Link Control

Medium Access Control

Physical Layer

2.4 GHz   868/915 MHz

ZigBee or OEM

ZigBee Alliance

IEEE 802.15.4

ZigBee

- ZigBee is available as two feature sets, ZigBee PRO and ZigBee.

- ZigBee PRO, the most widely used specification, is optimized for low-power consumption and to support large networks with thousands of devices

- ZigBee PRO adds some new application profiles such as automatic meter reading, commercial building automation, and home automation.

- ZigBee PRO networks have the ability to aggregate routes through the use of "many-to-one" routing

- The ZigBee 802.15.4 spec defines a maximum packet size of 128 octets; this packet size is optimal for short control messages.

- The ZigBee Alliance is a global ecosystem of 400+ companies in the M2M/IoT space developing standards and producing products for use in commercial building automation, consumer electronics, health care and fitness, home automation, energy management, retail management, and wireless telecommunications.
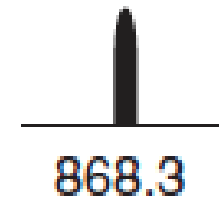
ZigBee
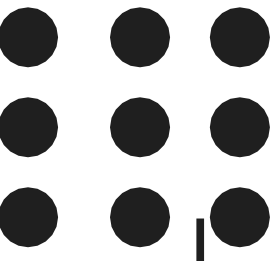
- The PHY layer of the reference model specifies the network interface components, their parameters, and their operation.

- To support the operation of the MAC layer, the PHYlayer includes a variety of features, such as receiver energy detection (RED), link quality indicator (LQI), and clear channel assessment (CCA).

- The MAC layer handles network association and disassociation. It also regulates access to the medium;

- The network layer provides the functionality required to support network routing capabilities, configuration and device discovery, association and disassociation, topology management, MAC layer management, and routing and security management. Three network topologies, namely star, mesh, and cluster tree, are supported.

- The application layer consists of the application support sublayer (APS), the ZigBee device object (ZDO), and the manufacturer-defined application objects. The responsibilitiesof the APS sublayer include maintaining tables for binding devices together,based on their services and their needs, and forwarding messages between bound devices
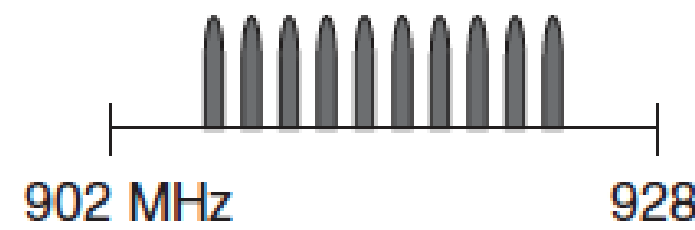
ZigBee

ZigBee

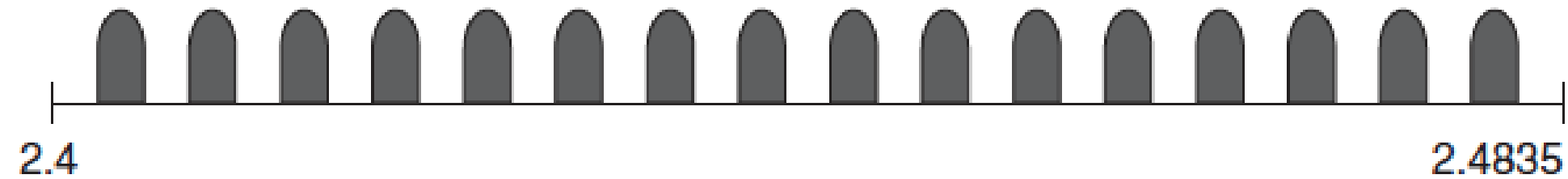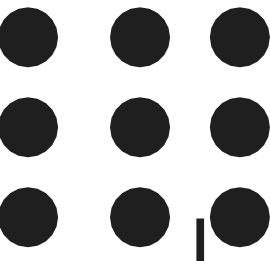The design of the PHY layer is driven by the need for low-cost, power-effective PHY layer for cost sensitive, low data rate monitoring and control applications. Under IEEE 802.15.4, wireless links can operate in three unlicensed frequency bands.

- Direct sequence spread spectrum (DSSS) using binary phase shift keying (BPSK), operating in the 868 MHz at a data rate of 20 Kbps;

- DSSS using BPSK, operating in the 915 MHz at a data rate of 40 Kbps; and

- DSSS using offset quadrature phase shift keying (O-QPSK), operating in the 2.4 GHz at a data rate of 140 Kbps.

IEEE 802.15.4 defines four types of frames: beacon frames, MAC command frames, acknowledgement frames, and data frames

ZigBee

- Network and MAC layer consist of physical devices, namely a full function device (FFD) and a reduced function device (RFD).

- There are three categories of logical devices:
- Network coordinator : An FFD device responsible for network establishment and control.

- Router : An FFD device that supports the data routing functionality, including acting as an intermediate device to link different components of the network and forwarding message between remote devices across multihop paths.

- End Devices : An RFD device that contains (just) enough functionality to communicate with its parent node, namely the network coordinator or a router. An end device does not have the capability to relay data messages to other end devices.

- A PAN coordinator is the designated principal controller of the WPAN. Every network has exactly one PAN coordinator.
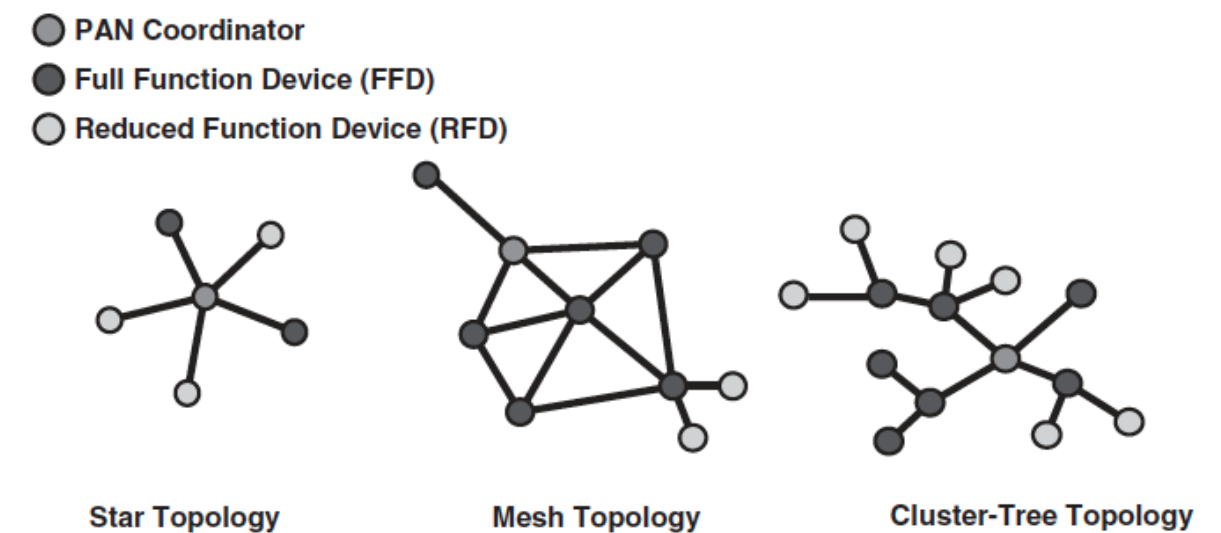
ZigBee

Based on these logical device types, a ZigBee WPAN can be organized into one of three possible topologies, namely a star, a mesh (peer-to-peer), or a cluster tree.

The star network topology supports a single coordinator, with up to 65,536 devices. In this topology configuration, one of the FFD-type devices assumes the role of network coordinator. All other devices act as end devices.

The mesh configuration allows path formation from any source device to any destination device,
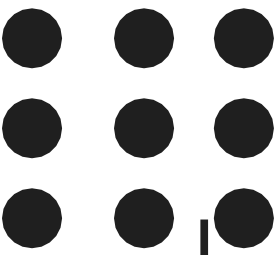using tree- and table-driven routing algorithms.

Cluster-tree networks enable a peer– peer network to be formed with a minimum of routing overhead, using multihop routing.

The cluster can be rather large, comprising up to
255 clusters of up to 254 nodes each, for a
total of 64,770 nodes

Legend:
- PAN Coordinator
- Full Function Device (FFD)
- Reduced Function Device (RFD)

Star Topology   Mesh Topology   Cluster-Tree Topology

ZigBee

Application Standards
- ZigBee Building Automation
- ZigBee Health Care
- ZigBee Home Automation
- ZigBee Input Device
- ZigBee Light Link
- ZigBee network devices (assist and expand ZigBee networks)
- ZigBee Remote Control (used for advanced RCs)
- ZigBee Retail Services (used for smarter shopping)
- ZigBee Smart Energy (SE) (used for home energy savings)
- ZigBee Telecom Services (used for value-added services)

THANK YOU