IOT devices via APIs or cloud services

IEEE802.15.4 :-

IEEE 802.15.4 is a low cost, low-data-rate wireless access technology for devices that are operated or work on batteries. This describes how low-rate wireless personal area-networks (LR-WPANs) function.

IEEE 802.15.4e :-

802.15.4e for industrial applications and 802.15.4g for the smart utility networks (SUN).
The 802.15.4e improves the old standard by introducing mechanisms such as time slotted access, multichannel communication and channel hopping.

- IEE 802.15.4e introduces the following general functional enhancements :-

1) Low Energy (LE) :- This mechanism is intended for applications that can trade latency for energy efficiency. It allows a node to operate with a very low duty cycle.

2) Information Elements (IE) It is an extensible mechanism to exchange information at the MAC sublayer.

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3) Enhanced Beacons (EB): Enhanced Beacons are an extension of the 802.15.4 beacon frames and provide a greater flexibility. They allow to create application-specific frames.

4) Multipurpose Frame: This mechanism provides a flexible frame format that can address a number of MAC operations. It is based on IEs.

5) MAC Performance Metric: It is a mechanism to provide appropriate feedback on the channel quality to the networking and upper layers, so that appropriate decision can be taken.

6) Fast Association (Fast A): The 802.15.4 association procedure introduce a significant delay in order to save energy. For time-critical application latency has priority over energy efficiency.

- IEE 802.15.4e defines few new MAC behavior modes.

1) Time Slotted Channel Hopping (TSCH):-
It targets application domains such as industrial automation and process control, providing support for multi-hop and multichannel communications, through a TDMA approach.

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2) Deterministic and Synchronous Multichannel Extension (DSME):-
It is aimed to support both industrial and commercial applications.

3) Low latency Deterministic Network (LLDN):-
Designed for single-hop and single channel networks.

4) Radio Frequency Identification Blink (BLINK):-
It is intended for application domains such as item/people identification, location and tracking

5) Asynchronous multi-channel adaption (AMCA):-
It is targeted to application domains where large deployments are required, such as smart utility networks, infrastructure monitoring networks and process control networks.

o Properties:-

1) Standardization and alliances:- It specifies low-data rate PHY and MAC layer requirements for wireless personal area networks (WPAN). IEEE 802.15. Protocol Stacks include:

- ZigBee:- ZigBee is a Personal Area Network task group with a low rate task group 4. It is a technology of home networking. ZigBee is a technological standard created for controlling and sensing the network. As we know

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that ZigBee is the Personal Area Network of task group 4 so it is based on IEEE 802.15.4 and is created by ZigBee Alliance.

- 6LOWPAN:- The 6LoWPAN system is used for a variety of applications including wireless sensor networks. This form of wireless sensor network sends data as packets and uses IPv6- providing the basis for the name- IPv6 over Low power Wireless Personal Area Networks.

- ZigBee IP:- ZigBee is a standards-based wireless technology that was developed for low-cost and low-power wireless machine-to-machine (M2M) and internet of things (IOT) networks.

- ISA100.11a:- It is a mesh network that provid secure wireless communication to process control.

- Wireless HART:- It is also a wireless sensor network technology, that makes use of time-synchronized and self-organizing architecture.

- Thread:- Thread is an IPv6-based networking protocol for low-power Internet of Things devices in IEEE 802.15.4-2006 wireless mesh network. Thread is independent.

2) Physical Layer:- This standard enables a wide range of PHY options in ISM bands, ranging from 2.4 GHz to sub-GHz frequencies.

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IEEE 802.15.4 enables data transmission speeds of 20 kilobits per second, 40 kilobits per second, 100 kilobits per second, and 250 kilobits per second. The fundamental structure assumes a 10-meter range and a data rate of 250 kilobits per second. To further reduce power usage, even lower data rates are possible. IEEE 802.15.4 regulates the RF transceiver and channel selection and even some energy and signal management features, at the physical layer. Based on the frequency range and data performance needed, there are now six PHYs specified. Four of them employ frequency hopping techniques known as Direct Sequence Spread Spectrum (DSSS). Both PHY data service and management service share a single packet structure so that they can maintain a common simple in interface with MAC.

3) MAC layer:- The MAC layer provides links to the PHY channel by determining that devices in the same region will share the assigned frequencies. The scheduling and routing of data packets are also managed at this layer. The 802.15.4 MAC layer is responsible for a number of functions like:-

- Beaconing for devices that operate as controllers in a network.
- used to associate and dissociate PANs with the help of devices.

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- The safety of the device
- Consistent communication between two MAC devices that are in a peer-to-peer relationship.

Several established frame types are used by the MAC layer to accomplish these functions. In 802.15.4, there are four different types of MAC frames:-

- frame of data
- Frame for a beacon
- Frame of acknowledgement
- Frame for MAC commands.

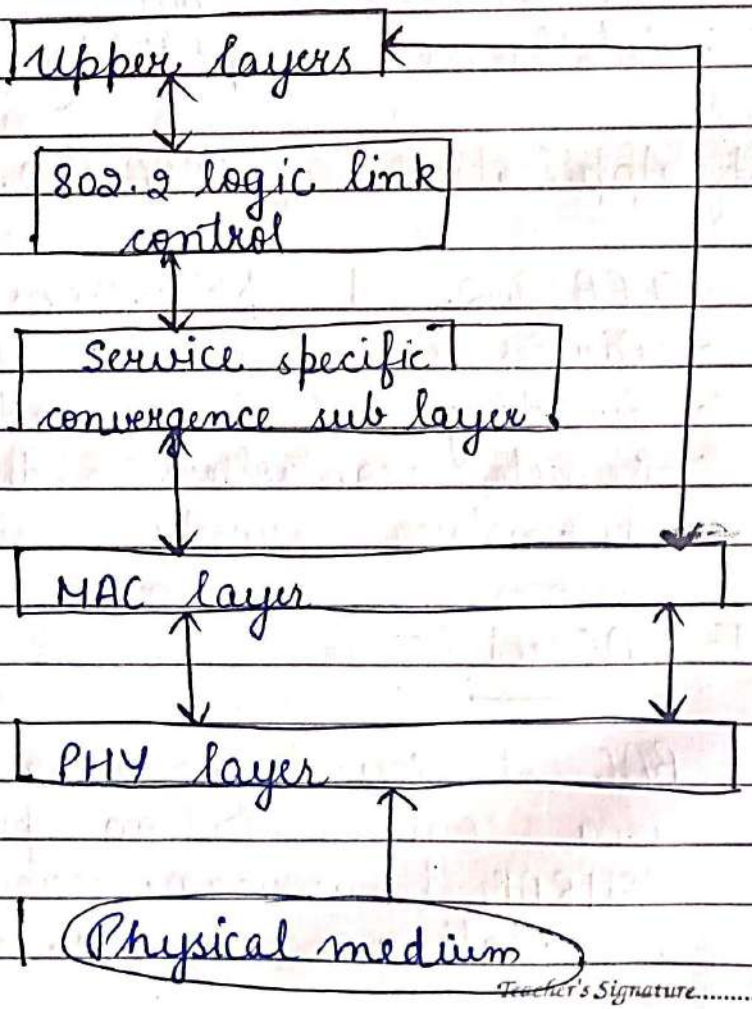
4) Topology:- Networks based on IEEE 802.15.4 can be developed in a star, peer-to-peer, or mesh topology. Mesh networks connect a large numbers of nodes. This enables nodes that would otherwise be out of range to interact with each other to use intermediate nodes to relay data.

5) Security:- For data security, the IEEE 802.15.4 standard employs the Advanced Encryption Standard (AES) with a 128-bit key length as the basic encryption technique. Activating such security measures for 802.15.4 significantly alters the frame format and uses a few of the payloads. The very first phase in activating AES encryption is to use the Security Enabled field in the Frame Control

part of the 802.15.4 header. For safety, this field is a single bit which is assigned to 1. When this bit is set, by taking certain bytes from its Payload field, a field, a field known as the Auxiliary Security Header is formed following the Source Address field.

6) Competitive Technologies:- The IEEE 802.15.4 PHY and MAC layers serve as a basic for a variety of networking profiles that operate in different IOT access scenarios. DASH7 is a competing radio technology with distinct PHY and MAC layers.

The architecture of LR-WPAN Device:-



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Advantages of IEEE 802.15.4 :-

IEEE 802.15.4 has the following advantages:-
- cheap cost
- long battery life
- Quick installation
- simple
- extensible protocol stack.

Disadvantages of IEEE 802.15.4 :-

IEEE 802.15.4's drawbacks include:-
- IEEE 802.15.4 causes interfsence and multipath fadi
- doesnot employ a frequency-hopping approach
- unbounded latency.
- interfsence susceptibility

Applications of IEEE 802.15.4 :-

IEEE 802.15.4 Applications:-
- Wirdess sensor networks in the industry
- Building and home automation.
- Remote controllers and interacting toys.
- Automotive networks.

BACnet :-

BACnet (Building Automation and Control Network) is a communication protocol developed by ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers)

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