



# IEEE 802

- IEEE supports many groups to develop and maintain wireless and wired communication standards.
- The IEEE 802 working group is responsible for developing standards for local area networks (LAN) and metropolitan area networks (MAN).
- The protocols and standards developed by IEEE 802 deals with the physical and data-link layer of the Open Systems Interconnection model (OSI model).
- The IEEE 802 divides the data- link layer into two sublayers: Logical link control (LLC) and MAC layer.

The IEEE 802 is responsible for many widely used standards such as,

**802.3-** Wired Ethernet

**802.11-** for Wireless Local Area Networks(WLANs/WIFI)

**802.15-** group of standards specifies a variety of wireless personal area networks(WPANs) for different applications.

- **802.15.1-** Bluetooth
- **802.15.3-** High data rate category for ultra band technology
- **802.15.6-** Body Area Networks
- **802.15.4-** Largest standard for low data rate WPANs.

## IEEE 802.15.4

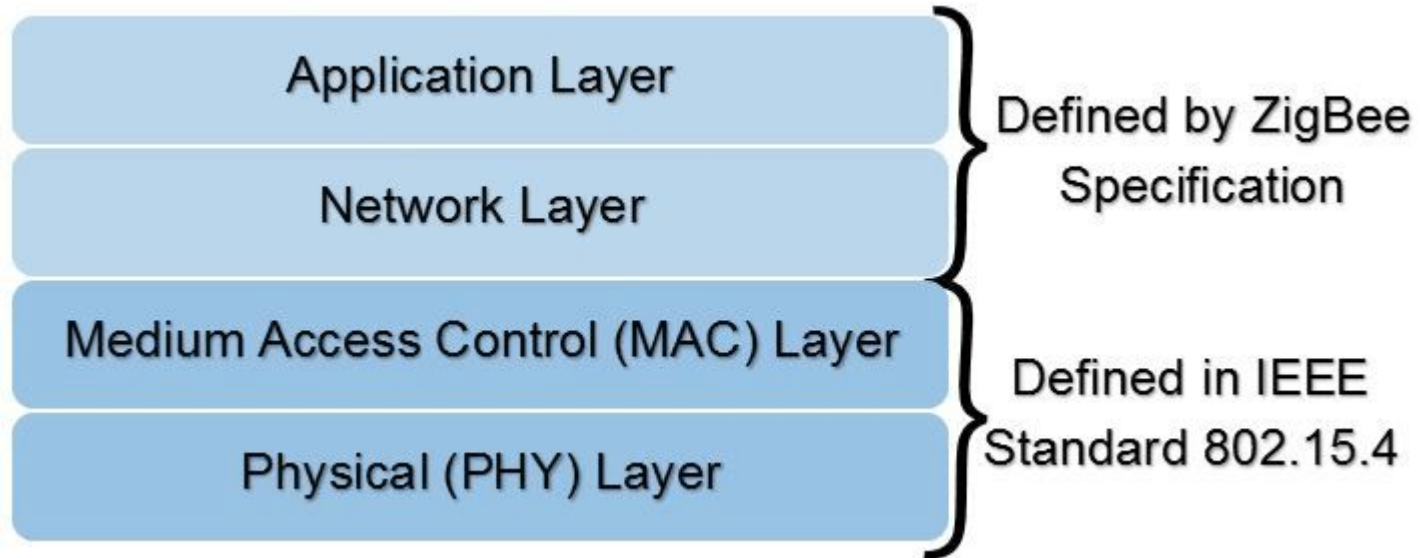
It is a technical standard which **defines the operation of low-rate wireless personal area networks (LR-WPANs)**.

It specifies the physical layer and media access control for LR-WPANs, and is maintained by the IEEE 802.15 working group, which defined the standard in 2003.

IEEE 802.15.4 provides the MAC and PHY layers in the OSI model for low cost, low power wireless connectivity networks.

Low power is one of the key elements of 802.15.4 as it is used in many areas where remote sensors need to operate on battery power

It defines the characteristics of low-data-rate PHY and MAC layers for wireless communication systems that does not require high data rates.



# Properties:

- **Standardization and alliances**
- **Physical Layer**
- **MAC layer**
- **Topology**
- **Security**
- **Competitive Technologies**

# Standardization and alliances

## IEEE 802.15. Protocol Stacks include –

- ZigBee
- 6LoWPAN
- ZigBee IP
- ISA100.11a
- Wireless HART
- Thread

## IEEE 802.15.4 supports two classes of devices:

- **Fully functional devices (FFD)**, which have full network functionalities and
- **Reduced functional devices (RFD)**, which possess limited functionalities

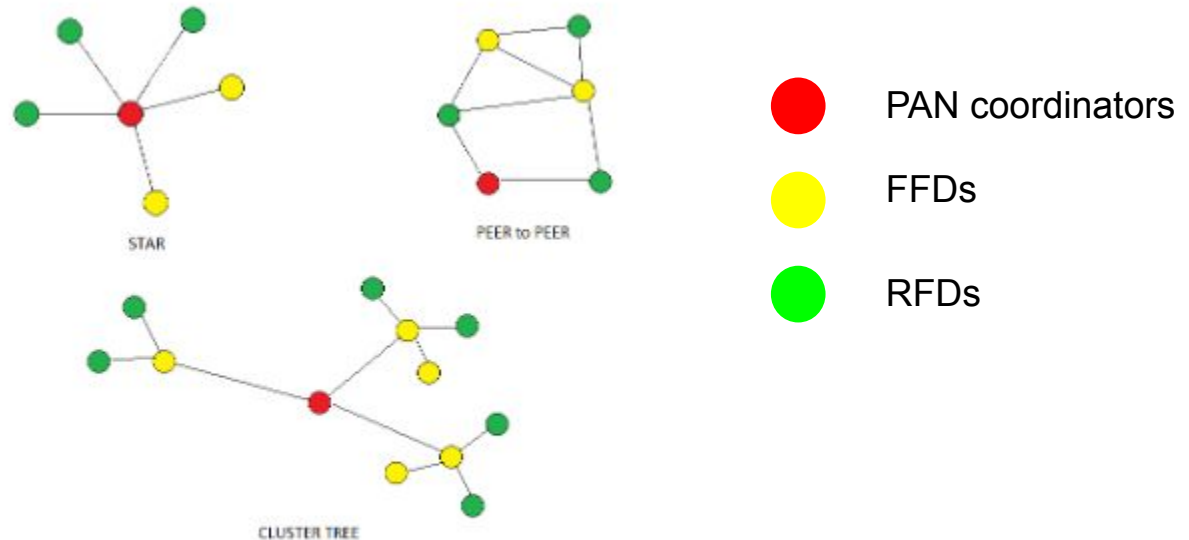


Fig. 1. Network Topologies



# Physical Layer

It adopted a wideband physical layer using Direct Sequence Spread Spectrum technique (DSSS).

It provided **physical layer operations in three frequency bands:**

- 868 MHz band, available in Europe — --- supported 1 channel
- 915 MHz band, available in US,----- 10 channels
- 2.4 GHz ISM band, which is the unlicensed band available worldwide– 16 channels

27 channels were supported across these three bands.

The three bands provide a transmission rate of 20 kb/s, 40 kb/s and 250 kb/s respectively.

## Contd...

The physical layer of the IEEE 802.15.4 is responsible for the following low level functions:

- Data transfer and reception
- Energy detection of current channel
- Link quality indication and clear channel assessment

Preamble	Delimiter	Header	Physical Data Service Unit (PSDU)
4 bytes	1 byte	1 byte	<= 127 bytes

Fig. 2. Physical layer packet structure

Packet sizes for **home applications** are generally about **30-60 bytes** whereas **interactive applications** require **packets of larger sizes**.

# MAC Layer

The MAC layer has the following features:

- Association and dissociation
- Acknowledged frame delivery
- Channel access mechanism
- Frame validation
- Guaranteed time slot management
- Beacon management

Frame control	Sequence number	Dst Address	Src Address	Payload	Frame check sequence
2 bytes	1 byte	0-20 bytes		Variable	2 bytes

Fig. 3. MAC layer frame structure

## Contd...

There are four types of MAC frames: data frames, MAC command frames, acknowledgment frames and beacon frames.

## Topology

Networks based on IEEE 802.15.4 can be developed in a star, peer-to-peer, or mesh topology.

## 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.

# Contd...

## Competitive Technologies

The IEEE 802.15.4 PHY and MAC layers serve as a basis 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.

# ZIGBEE

The ZigBee alliance was established in 2002 to develop a standard protocol stack for low-cost, low-rate, low-power wireless devices.

It uses the IEEE 802.15.4 standard to define its physical and MAC layer.

The ZigBee alliance is a non-profit association of members aiming at the development of the standard and consists of various kinds of organizations including universities, equipment manufacturers, semiconductor companies etc.

## Architecture of the ZigBee stack

