

ZIGBEE

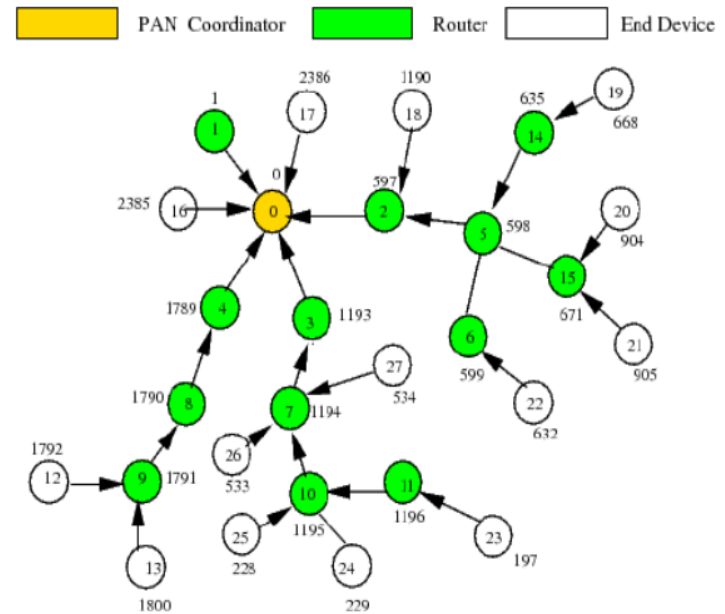
IEEE 802.15.4

**ECE 525E – WIRELESS & MOBILE
COMMUNICATIONS**

Tuesday, April 14, 2026

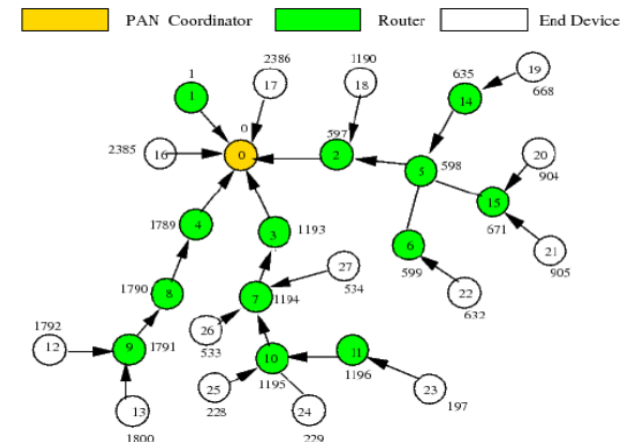
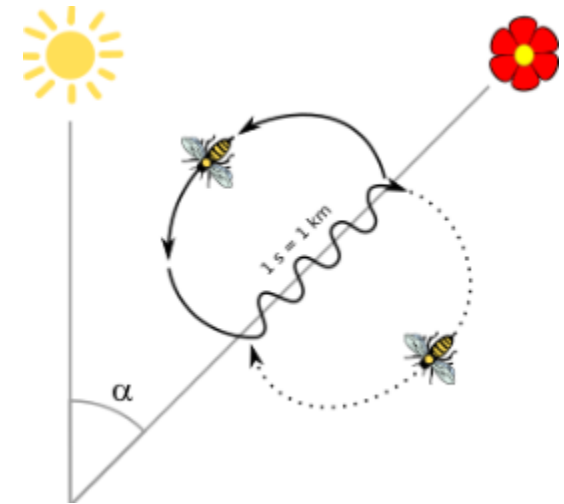
WHAT IS ZIGBEE?

1. **ZigBee** is a technological standard, based on IEEE 802.15.4 standard, which was created specifically for control and sensor networks.
2. ZigBee operates at low-data rate of up to 250kbps.
3. Zigbee operates in 2.4 GHz (Global) , 868 MHz (Europe) and 915 MHz (N. America) Band.
4. It has low in cost, complexity and lower power consumption as compared to competing technologies.



ORIGIN OF NAME ZIGBEE

1. Bees live in a hive that contains a queen, a few male drones, and thousands of worker bees.
2. The survival, success, and future of the colony is dependent upon continuous communication of vital information between every member of the colony.
3. The technique that honeybees use to communicate new-found food sources to other members of the colony is referred to as the **ZigBee Principle**.
4. Using Zigbee, a bee dances in a zig-zag pattern and is able to share information such as the location, distance, and direction of a newly discovered food source to her fellow colony members. Instinctively implementing the ZigBee Principle.



ZIGBEE GENERAL CHARACTERISTICS

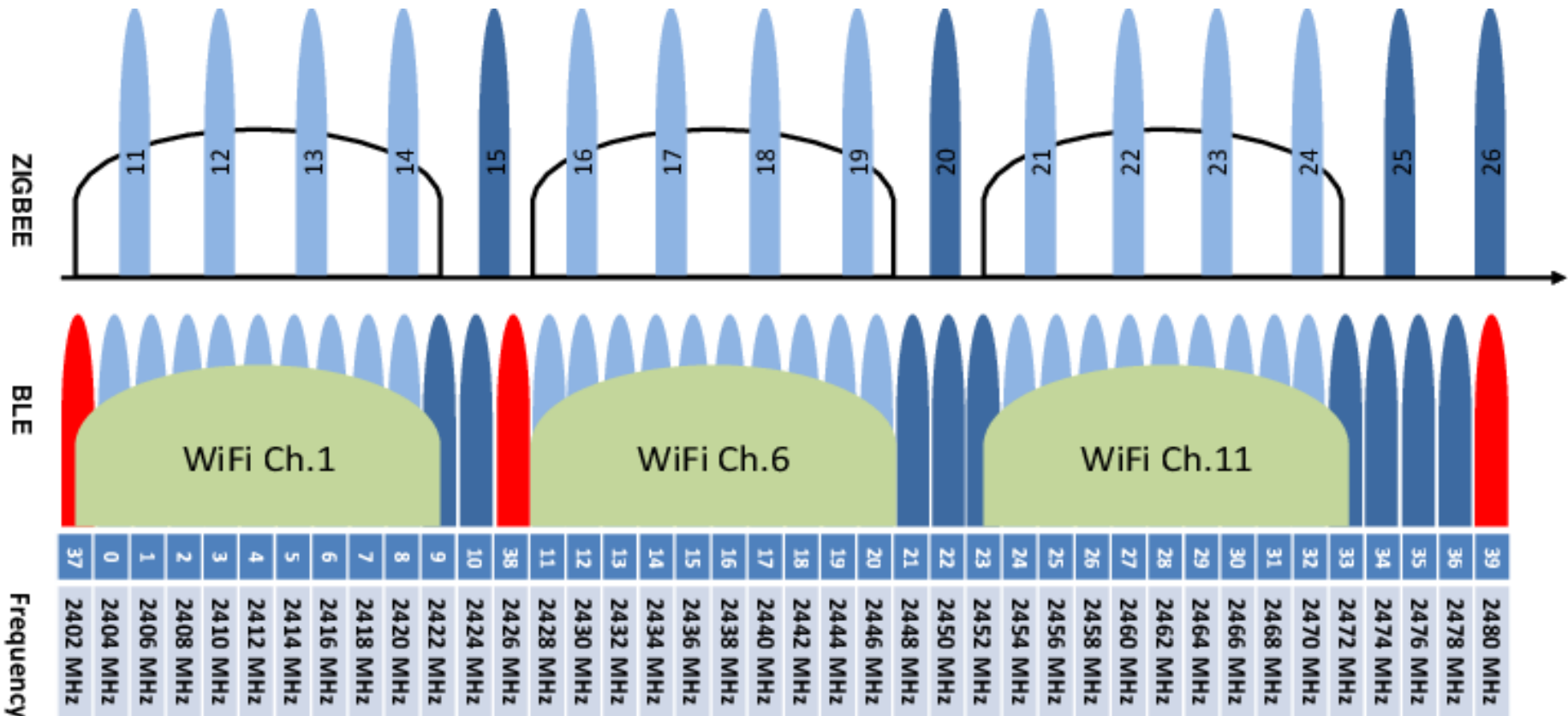
1. Data rates of 20 kbps and up to 250 kbps
2. Star or Peer-to-Peer network topologies
3. Support for Low Latency Devices
4. CSMA-CA Channel Access
5. Handshaking
6. Low Power Usage consumption
7. 3 Frequencies bands with 27 channels
8. Extremely low duty-cycle (<0.1%)

ZIGBEE FREQUENCY BANDS

1. **2.4 - 2.4835 GHz** (ISM band) worldwide (16 channels)
2. **902 - 928 MHz** (915 MHz Band) Band (13 channels) in North America
3. **868 - 868.6 MHz** (868 MHz band) (1 channel) in Europe.



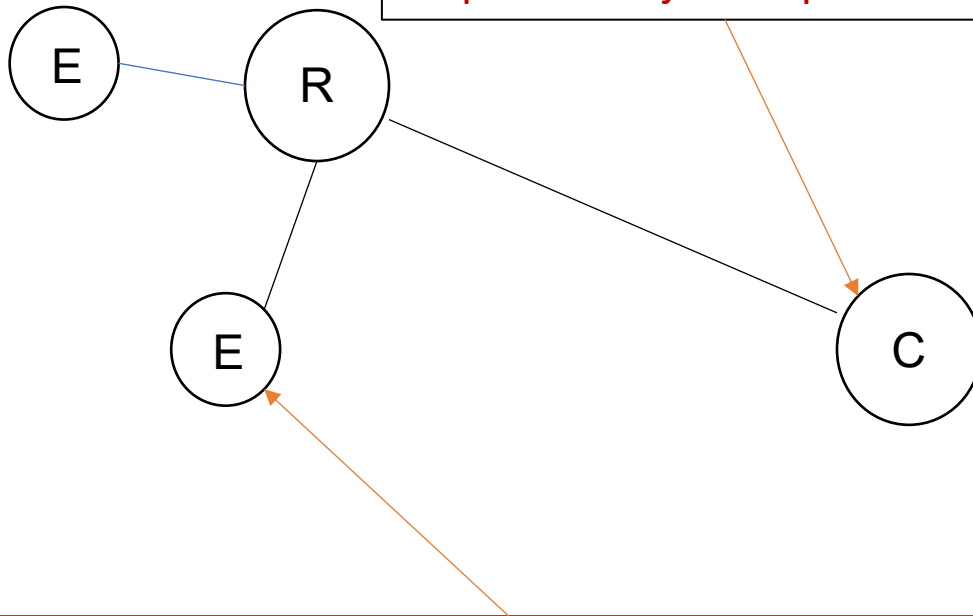
ZIGBEE, BLUETOOTH & WIFI CO-EXISTENCE



ZIGBEE ARCHITECTURE

Coordinator

- A coordinator need to be installed to establish ZigBee network.
- It routes data in the network and processes join requests from R and E

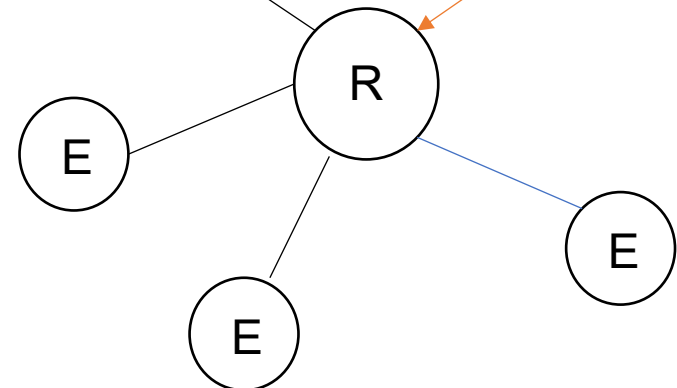


End Device

- **A** battery powered; does not support any child devices.
- May go to sleep hence battery consumption can be minimized to great extent;
- Assists in routing the data through the network.

Router

- At least one router needs to join the WPAN then it can allow other R & E to join.
- It directs/routes data between end devices and does not go to sleep



ZIGBEE NETWORK ESTABLISHMENT

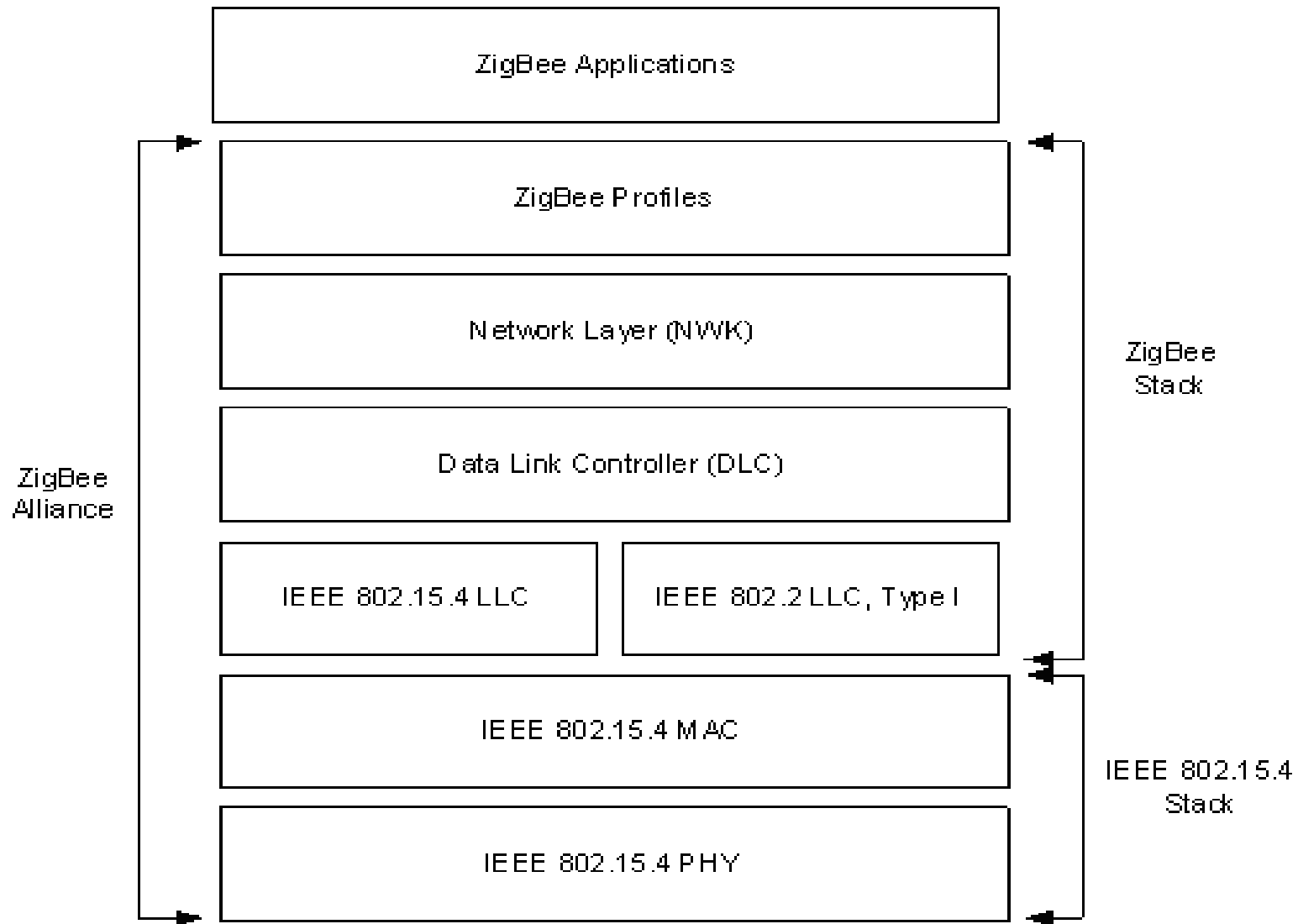
1. Coordinator searches for **suitable RF channel which is usable** and does not interfering with WiFi or Bluetooth channels in use.
2. Coordinator starts the network by assigning a **PAN ID to the network**. Here Coordinator also assigns **network address** to itself.
3. Coordinator sends broadcast beacon request frame on remaining quiet channel. This is also referred as **beacon scan or PAN scan**.
4. Coordinator **receives PAN ID** of routers(R) and End devices(E) present nearby.

ZIGBEE APPLICATIONS

1. Designed for wireless controls and sensors
2. Operates in Personal Area Networks (PAN's) and device-to-device networks
3. Connectivity between small packet devices
4. Control of lights, switches, thermostats, appliances, etc.



ZIGBEE PROTOCOL STACK



DEVELOPMENT OF ZIGBEE STANDARDS

1. IEEE 802.15.4 Working Group

- a) Defining lower layers of protocol stack: MAC and PHY
- b) Available today

2. Connectivity Standards Alliance (formerly ZigBee Alliance)

- a) 50+ companies: semiconductor mfrs, IP providers, OEMs, etc.
- b) Defining upper layers of protocol stack: from network to application, including application profiles
- c) Initial draft available mid 2003



IEEE 802.15 WPAN™ Task Group 4 (TG4)

Sunday, 19 March 2023

search

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The IEEE 802.15 TG4 was chartered to investigate a low data rate solution with multi-month to multi-year battery life and very low complexity. It is operating in an unlicensed, international frequency band. Potential applications are sensors, interactive toys, smart badges, remote controls, and home automation.

IEEE 802.15 TG4 OFFICERS CONTACT INFORMATION

- Chair: [Pat Kinney](#)
- Vice Chair: [Phil Jamieson](#)
- Technical Editor: [Jose Gutierrez](#)
- Secretary: [Marco Naeve](#)

IEEE 802.15 TG4 CURRENT STATUS

The IEEE 802.15.4-2003 standard has been superseded by the publication of IEEE 802.15.4-2006. The new [standard](#) can be purchased from the IEEE store. The TG4 task group put itself into hibernation at the March 2004 meeting after forming a task group (TG4b). The new task group 4b completed its work with the publication of the revision. Additional information can be found on the [TG4b web site](#).

To get more information on TG4 and how to get involved check the [TG4 Expert](#) web site.

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