ZigBee/IEEE 802.15.4

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Outline

- Introduction
- PHY Layer Technology
- MAC Layer Technology
- Evolution of IEEE 802.15.4

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Motivation

The cellular network

(GSM,IS 136,IS 95)

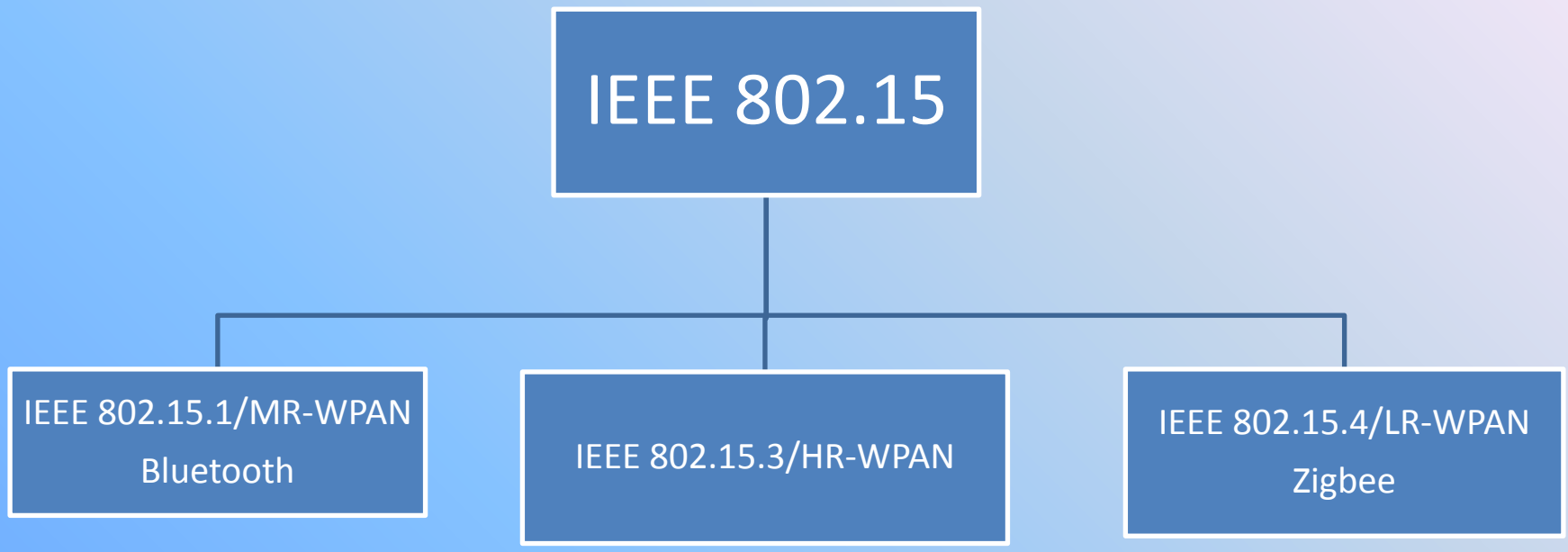
voice communications throughout a metropolitan area

Mid 1980s

IEEE 802.11 WLAN

IEEE 802.15 WPAN

an even smaller coverage area is needed for higher user densities and the emergent data traffic



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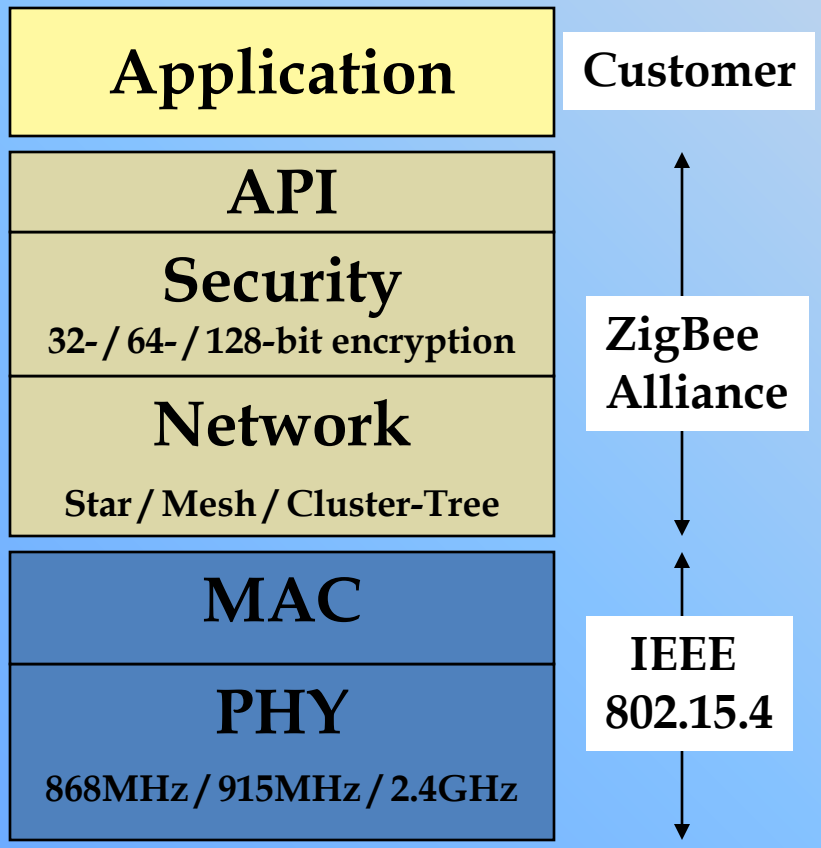
The low rate WPANs(IEEE 802.15.4/LR-WPAN) is intended to serve a set of industrial, residential and medical applications with very low power consumption and cost requirement not considered by the other types of WPANs and with relaxed needs for data rate and QoS. The low data rate enables the LR-WPAN to consume very little power.

IEEE 802.15.4 & ZigBee In Context



ZigBee Alliance

- "the software"
- Network, Security & Application layers
- Brand management

IEEE 802.15.4

- "the hardware"
- Physical & Media Access Control layers

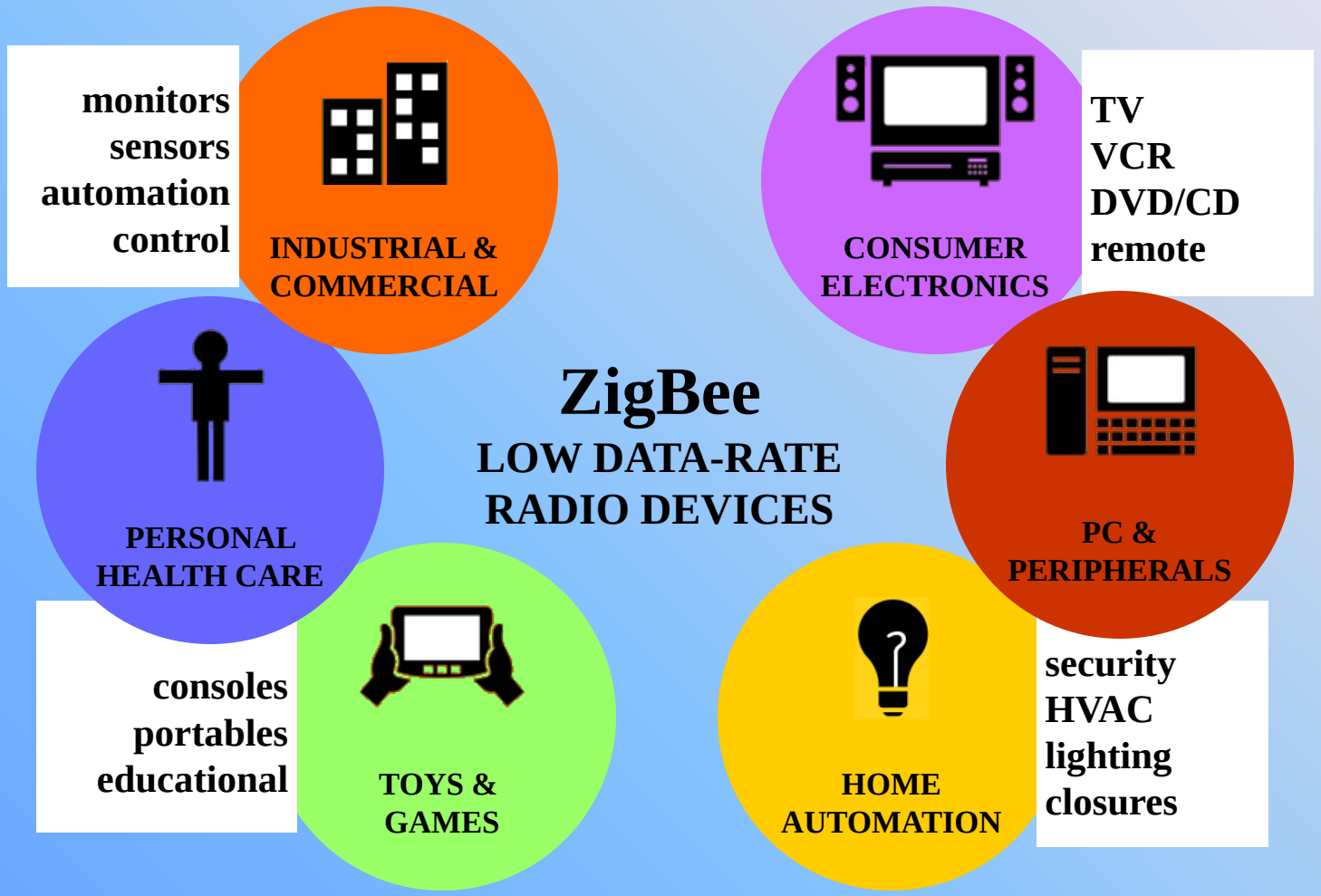
ZigBee Alliance

What is ZigBee

ZigBee is the entire protocol system for LR-WPAN

"ZigBee" originates from the zig-zag waggle dance honeybees use to share critical information, such as the location, distance, and direction of a newly discovered food source, with fellow hive members.

Application Sectors



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BAND	COVERAGE	DATA RATE	CHANNELS
2.4 GHz	ISM Worldwide	250 kbps	16
915 MHz	ISM Americas	40 kbps	10
868 MHz	Europe	20 kbps	1

PHY Layer Key technologies

- The standard offers two PHY options for the frequency band. Both are based on direct sequence spread spectrum (DSSS).

- The data rate is 250kbps at 2.4GHz, 40kbps at 915MHz and 20kbps at 868MHz. The higher data rate at 2.4GHz is attributed to a higher-order modulation scheme(O-QPSK).

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Types of PAN

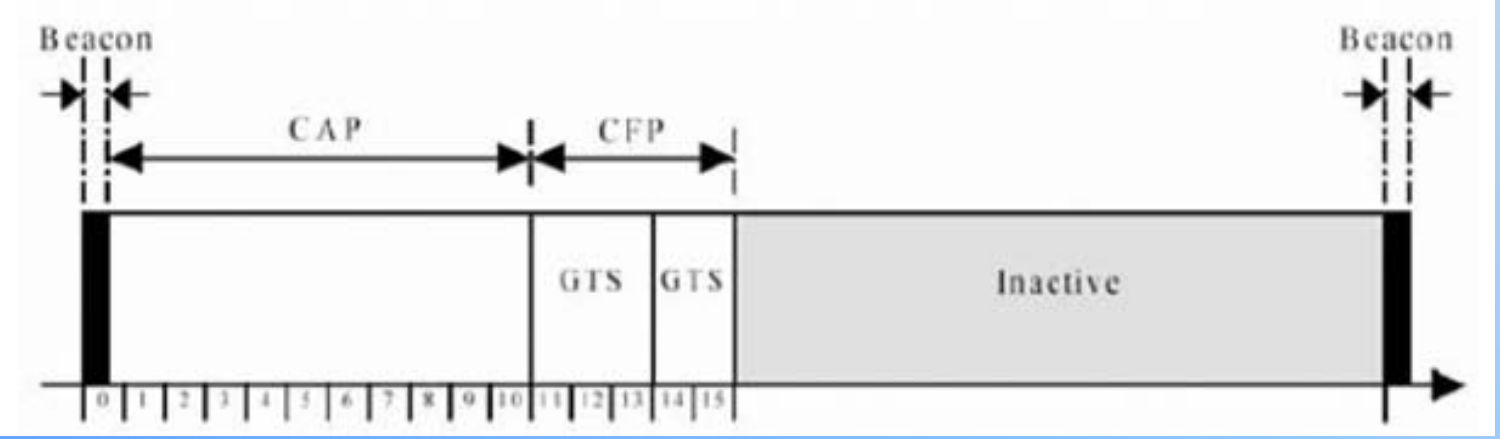
- Beacon Enabled PAN

  Slotted CSMA/CA
- Non-Beacon Enabled PAN

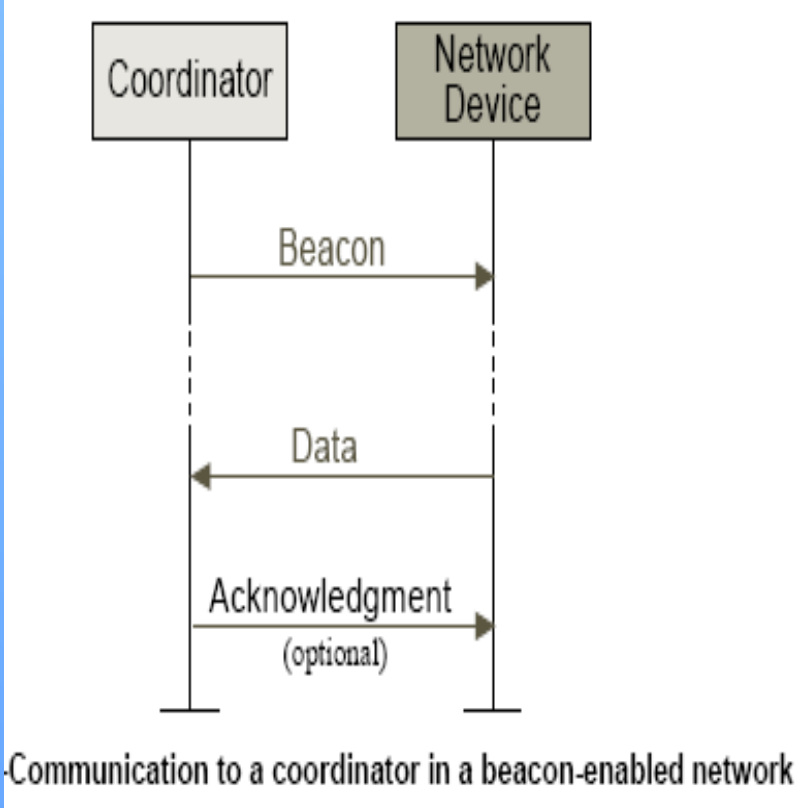
  Un-slotted CSMA/CA

SuperFrame Structure

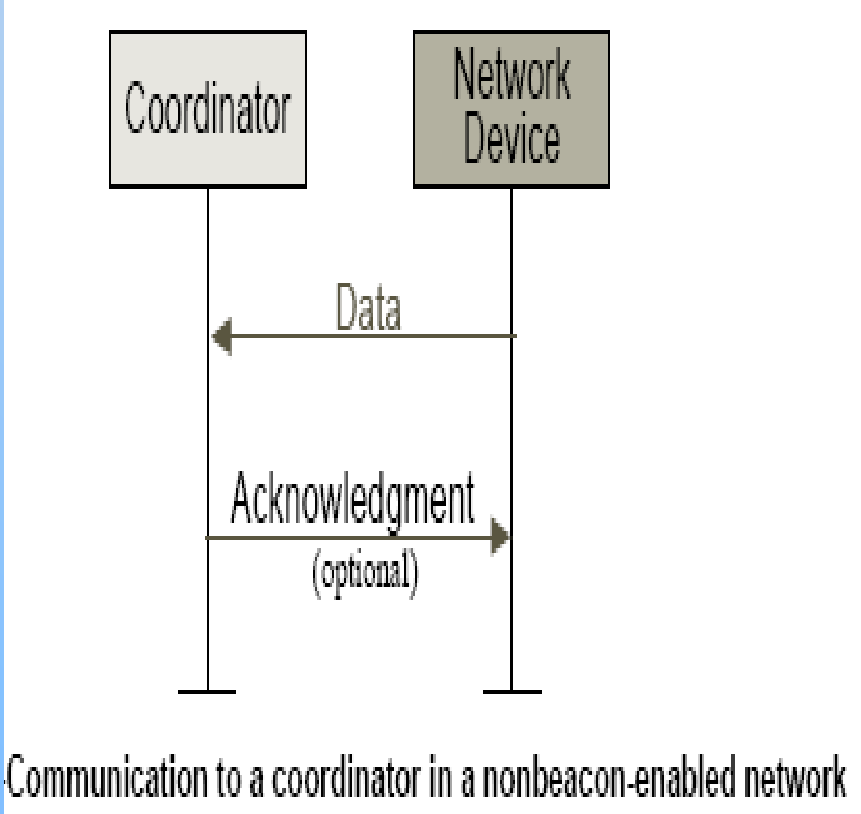
- A superframe is formed by the PAN coordinator to synchronize network reception and transmission.
- The whole frame consists of *active* and *inactive* period
- CAP: *Contention Access Period*
- CFP: *Contention Free Period*
- GTS: *Guaranteed time slots*



Communication Mechanisms-I device-coordinator

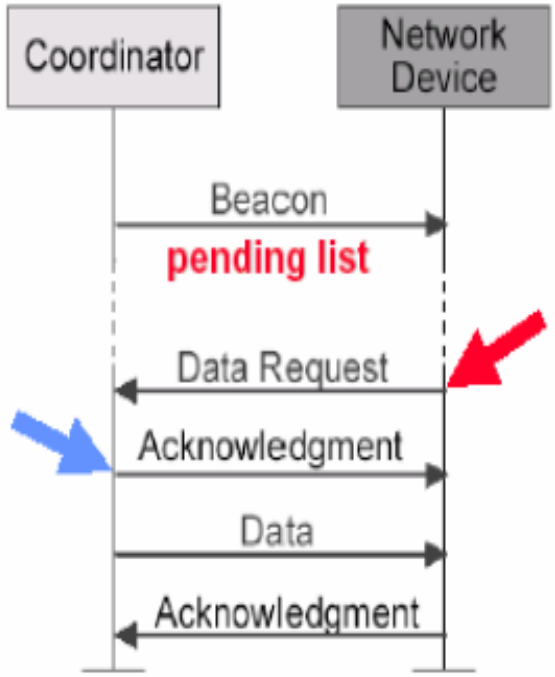


Communication to a coordinator in a beacon-enabled network

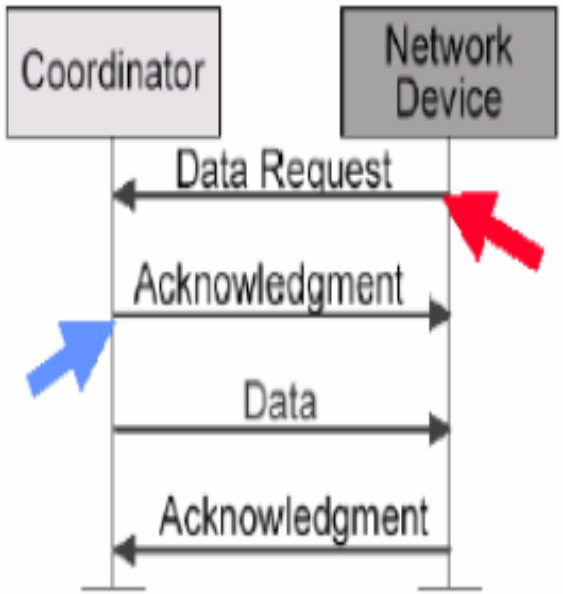


Communication to a coordinator in a nonbeacon-enabled network

Communication Mechanisms-II coordinator-device



Communication from a coordinator
In a beacon-enabled network



Communication from a coordinator
in a non beacon-enabled network

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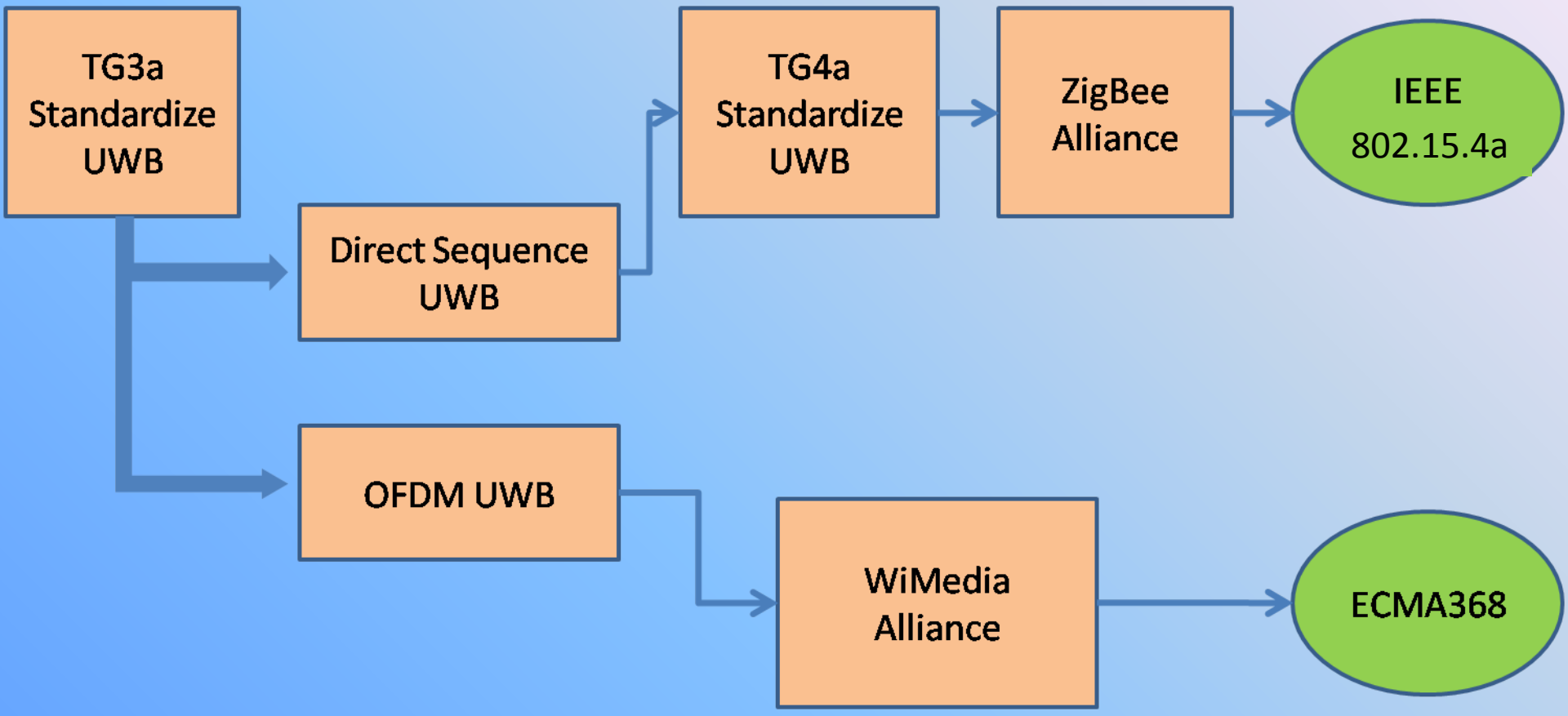
TG3a Standardize UWB
Direct Sequence UWB
OFDM UWB
TG4a Standardize UWB
ZigBee Alliance
IEEE 802.15.4a
WiMedia Alliance
ECMA368

- IEEE 802.15.4a specifies two additional PHYs using ultra-wideband (UWB) and chirp spread spectrum (CSS).
  - The UWB PHY is designated frequencies in three ranges: below 1 GHz, between 3 and 5 GHz, and between 6 and 10 GHz. (**Time-Hopping Impulse Radio (TH-IR)**)
  - The CSS PHY is designated to the 2450 MHz ISM band.

References

- ZigBee/IEEE 802.15.4 Summary, Sinem Coleri Ergen, Sep. 2004
- IEEE Standard 802.15.4 – 2006, IEEE 802.15 group.

Thanks!

Q & A