LAN Technology

Wireless LAN Protocols

Arash Habibi Lashkari
PHD of Computer Science - Information Security
July 2010

Wireless LAN Protocols

Outlines:

- WLAN: Wireless LAN by IEEE 802.11 Protocols
- IEEE 802.1X: EAP over LAN (EAPOL) for LAN/WAN Authentication key Management
- IEEE 802.15 and Bluetooth: WPAN Communications
- WiMAX: IEEE 802.16

IEEE 802.15

IEEE 802.15.1 – ”Bluetooth”

IEEE 802.15.3 – High data rate WPAN

IEEE 802.15.4 – Low data rate WPAN

IEEE 802.15 - General

- Wireless Personal Area Networks (WPANs)
  - Short Range
  - Low Power
  - Low Cost
  - Small Networks
- Communication within a persons operating space

IEEE 802.15.1 - General

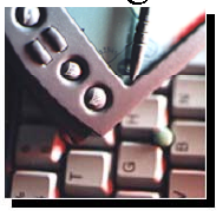
Adopted the Bluetooth MAC and PHY specifications

IEEE 802.15.1 and Bluetooth are almost identical regarding physical layer, baseband, link manager, logical link control and apdation protocol, and host control interface

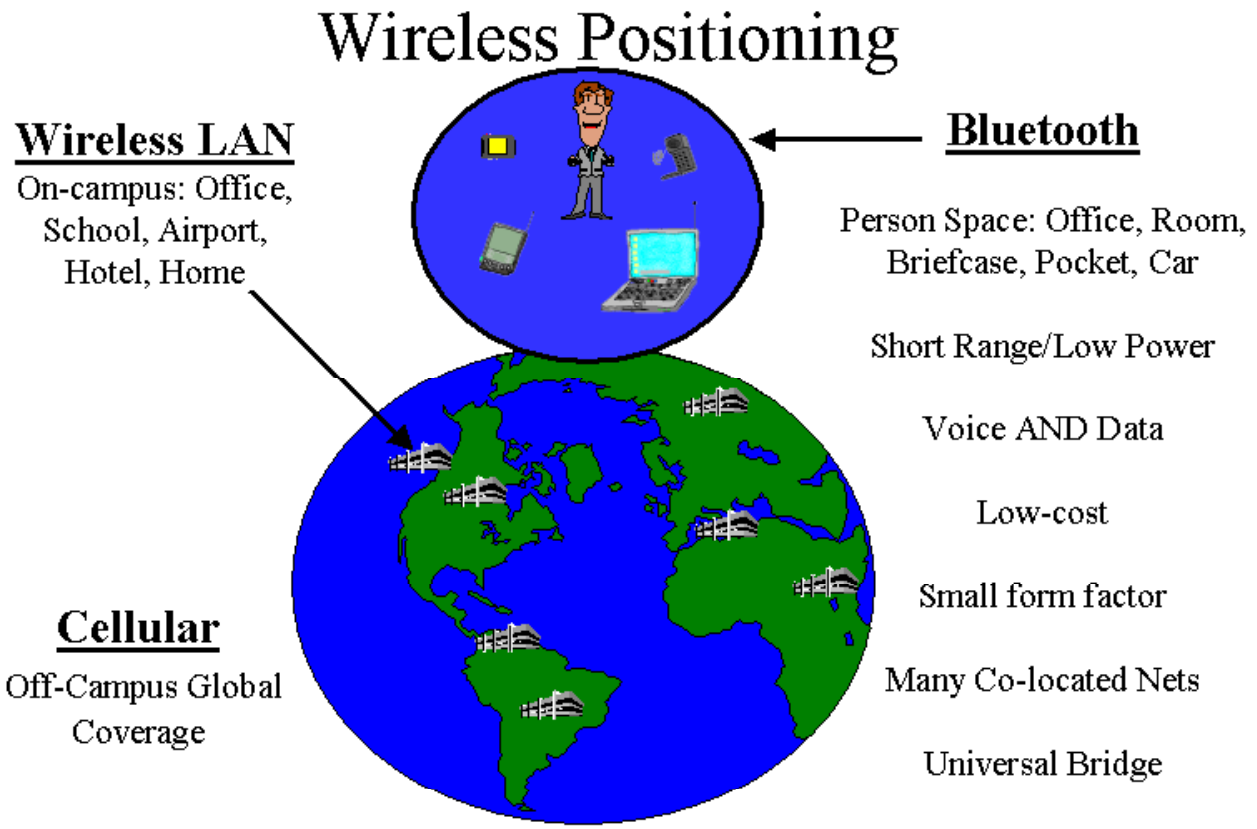
IEEE 802.15.1 – Usage Scen.

Usage scenarios: Headset

Usage scenarios: Synchronization



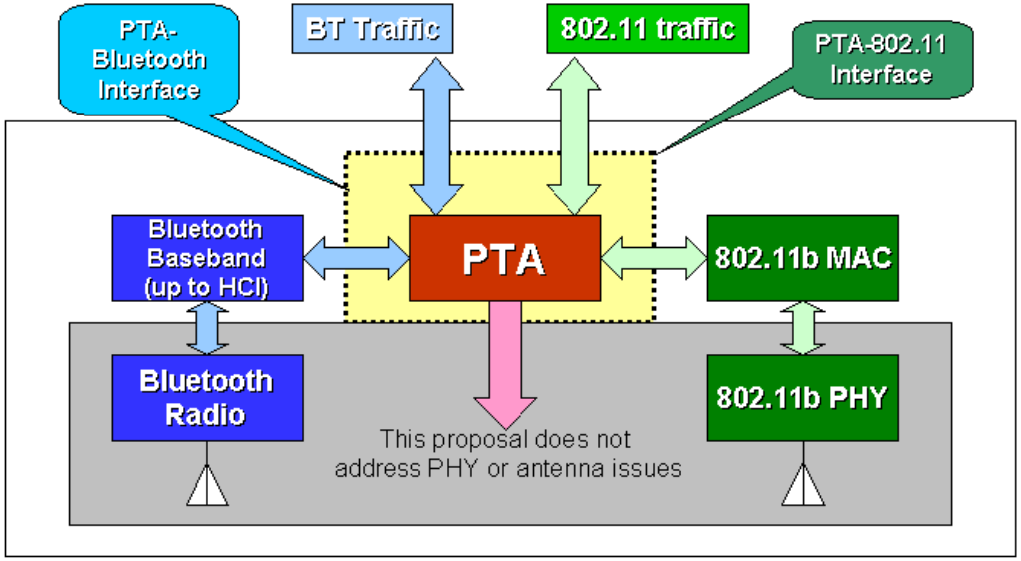
IEEE 802.15.1 – Global setting



IEEE 802.15.2

IEEE 802.15.2

- Coexistence between 802.15 and 802.11
- Predefined traffic management rules for coexistence



IEEE 802.15.3 - Overview

High data rate WPAN

Potential future standard

Motivation: The need for higher bandwidths currently supported with 802.15.1

- 100 Mpbs within 10 meter
- 400 Mpbs within 5 meter

Data, High quality TV, Home cinema

IEEE 802.15.3 - Overview

- Dynamic topology
  - Mobile devices often join and leave the piconet
  - Short connection times
- High spatial capacity
- Multiple Power Management modes
- Secure Network

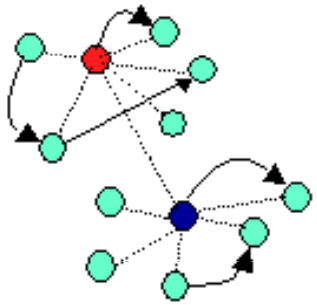
IEEE 802.15.3 - Overview

Based on piconets

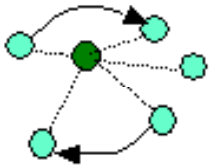
Data Devices (DEV) establish peer-to-peer communication

Includes also a Piconet Coordinator (PNC)

IEEE 802.15.3 - Topology

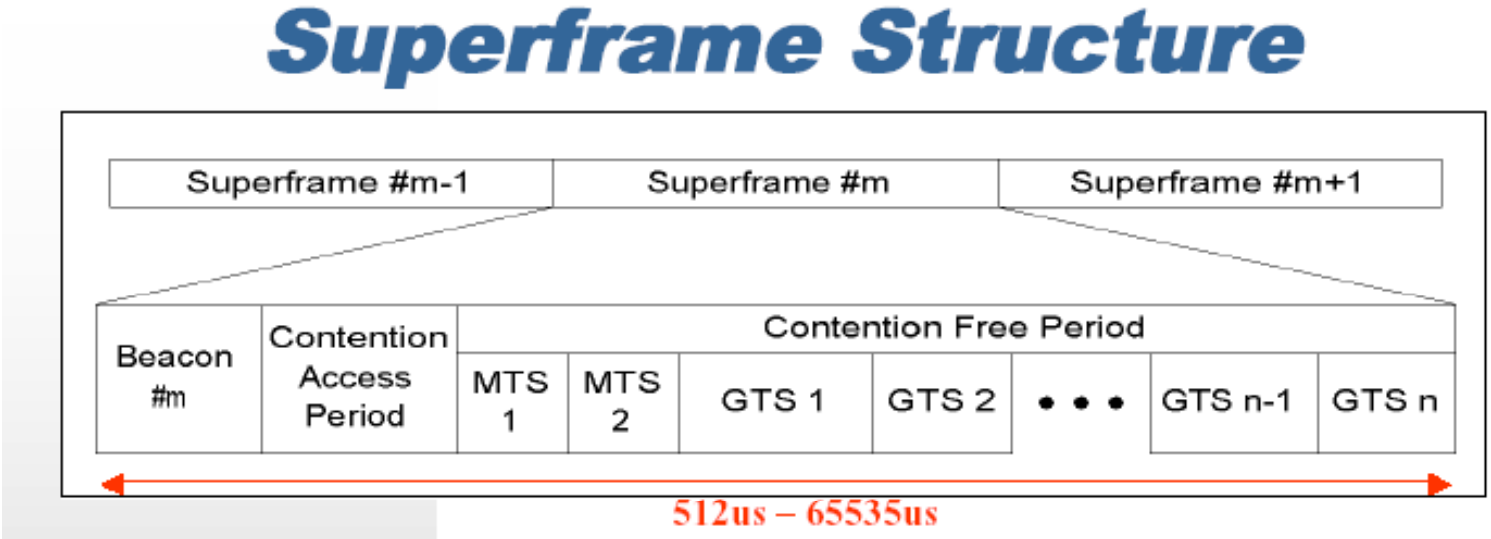


- Parent Piconet Controller
- Piconet Device
- Child/Neighbor Piconet Controller
- Piconet Relationship
- Peer to Peer Data Transmission
- Independent Piconet Controller



•Parent and Child/Neighbor piconets share common frequency channel.
•Independent piconet is either far enough apart or on different frequency channel. It operates independently of other piconets.
•Child piconet controller can exchange data with parent piconet controller.
•Neighbor piconet controller only shares frequency channel.

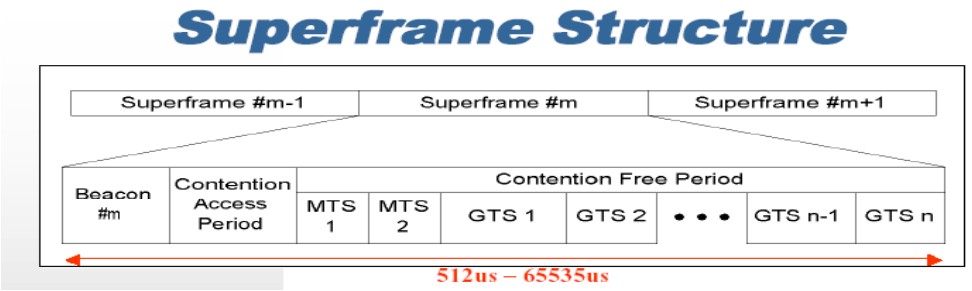
IEEE 802.15.3 - Superframe



IEEE 802.15.3 - Beacon

Beacon

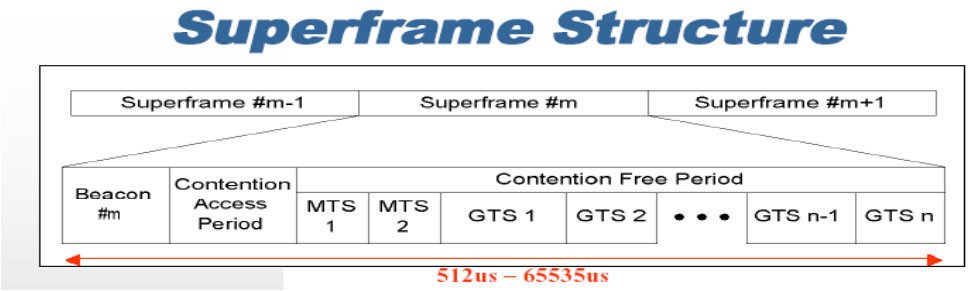
- Control information
- Allocates GTS
- Synchronization



IEEE 802.15.3 - CAP

CAP

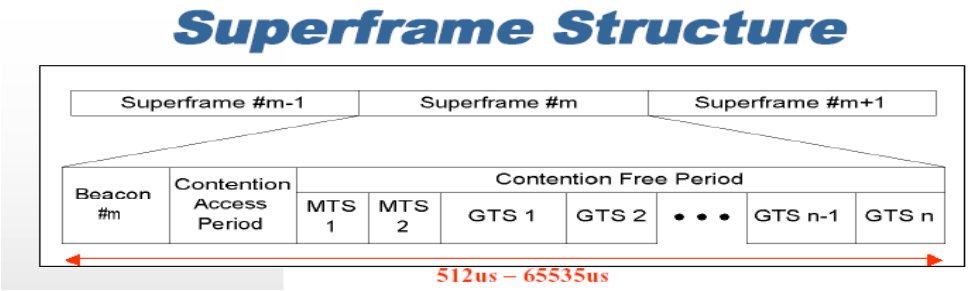
- Allows contention via CSMA/CD
- Command exchange between DEV and PNC
- File transfers from DEV without request



IEEE 802.15.3 - CFP

CFP

- Time slot allocation specified in the beacon
- Reserved bandwidth for DEV
- MTS: Command, GTS: Data



IEEE 802.15.3 - GTS

- GTS reservation
  - DEV sends a Channel Time Request (CTR) to PNC
    - Isochronous data: number and duration of slot(s)
    - Asynchronous data: Total amount of data
  - PNC allocates GTSs to DEV via CTA
  - DEV is responsible of utilizing allocated GTSs

IEEE 802.15.3

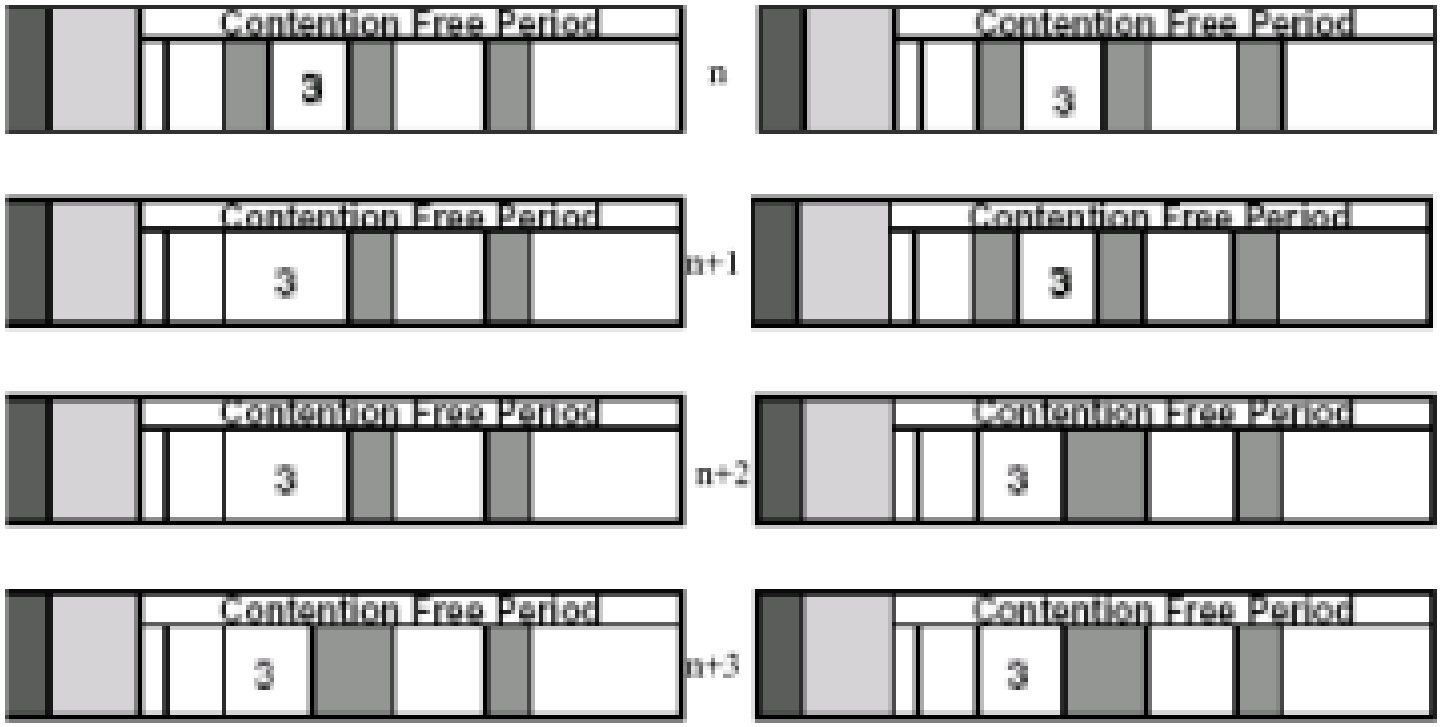
Just to make sure...

- Isochronous signals: Significant instants (e.g. Start of a bit) have the same duration
- Anisochronous signals: Significant instants (e.g. Start of a bit) do not have the same duration
- More accurate to use anisochronous instead of asynchronous when talking about a single signal

IEEE 802.15.3 - GTS

- Two types of GTSs
  - Dynamic GTS
    - Location within a superframe may change
    - PNC can optimize channel utilization
  - Pseudostatic GTS
    - Only for isochronous data
    - Fixed location within a superframe
    - May be changed, but only after a series of notitications to the DEV

IEEE 802.15.3



IEEE 802.15.3

- Starting a piconet
  - DEV scans the for the best channel and sends out beacons -> the DEV becomes PNC
  - If no channels available: Establishes a child or neighbor piconet instead
    - Requests a private GTS from parent PNC
    - All communication takes place within assigned GTS

IEEE 802.15.3 - QoS

- QoS
  - IEEE 802.15.3 supports both synchronous and asynchronous data
  - CAP offers only best-effort
  - The PNC will allocate resources in the CFP
    - Through admission control
    - Synchronous data: Based on number of time slots per superframe, duration of slot, priority and GTS type

IEEE 802.15.3 - QoS

Asynchronous data: Based on total data and priority

After performing admission control, GTSs may be allocated

IEEE 802.15.4 - Overview

Low Rate WPAN (LR-WPAN)

Simple

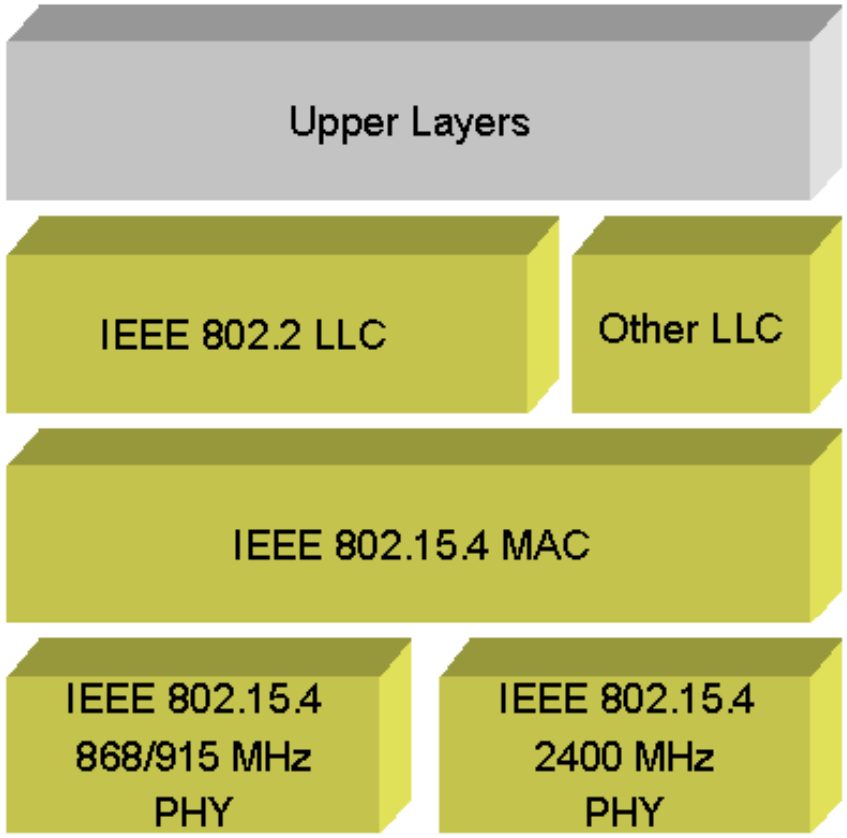
Low cost

Low power consumption

E.g. Sensor networks

Data rates: 20-250 kbps

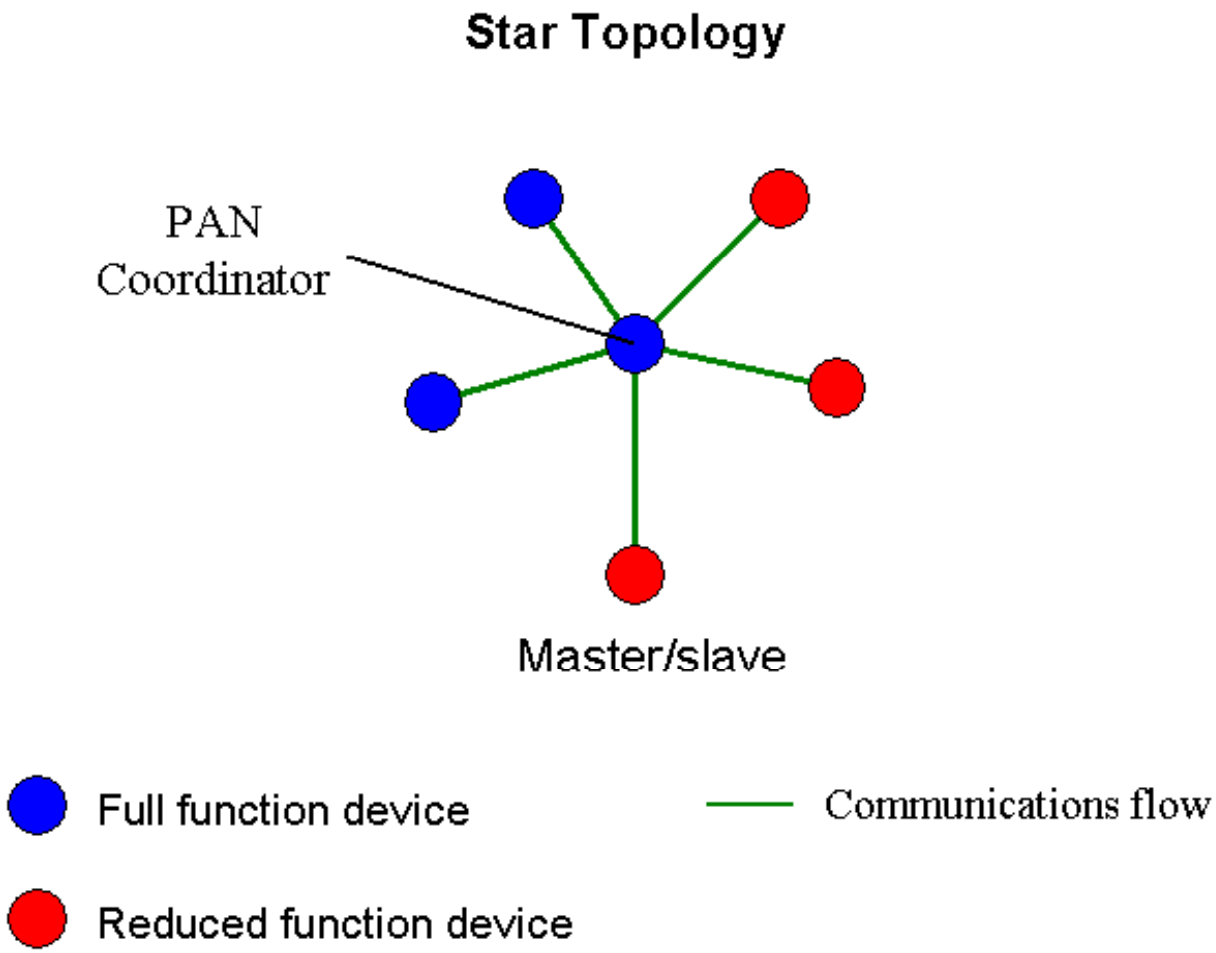
IEEE 802.15.4 – Protocol stack



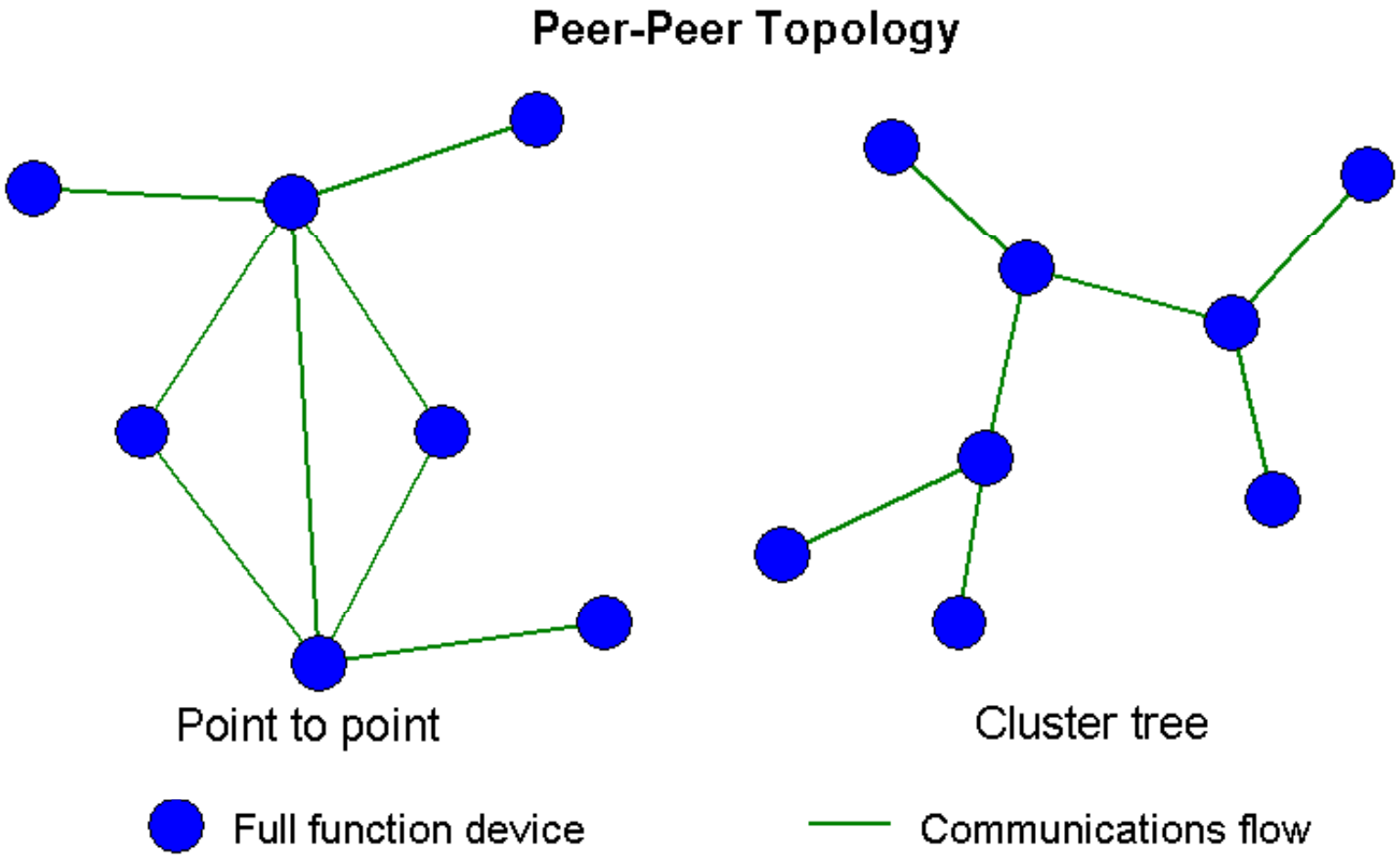
IEEE 802.15.4 - DEVs

- 2 or more DEVs form a PAN
- 2 different types of DEVs
  - Full functional Device (FFD)
    - Coordinator and simple node
    - Any topology
    - Talks to any device
  - Reduced Functional Device (RFD)
    - Simple node only, either source or desination
    - Star topology only
    - Talks to network coordinator only

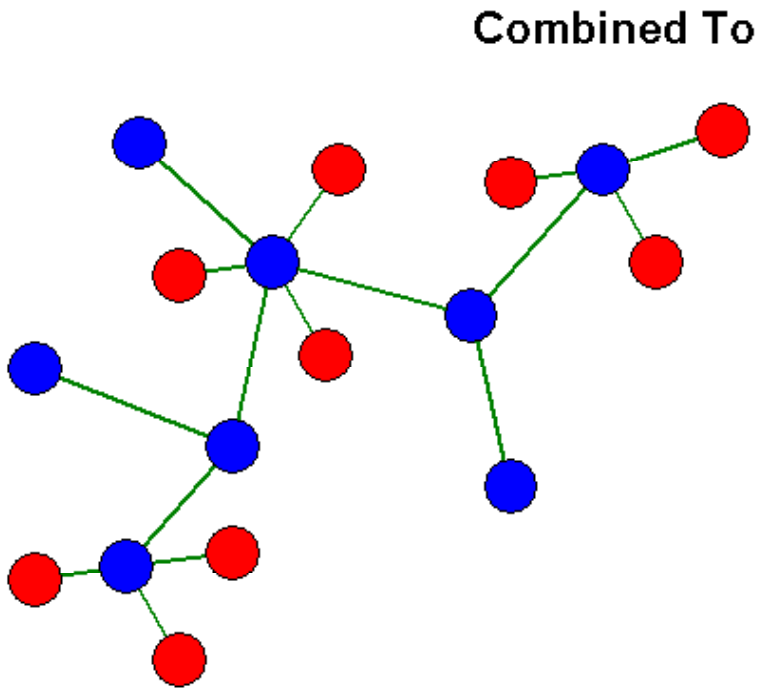
IEEE 802.15.4 - Star



IEEE 802.15.4 – Peer-to-Peer



IEEE 802.15.4 - Combined



Clustered stars - for example, cluster nodes exist between rooms of a hotel and each room has a star network for control.

Full function device

Reduced function device

Communications flow

IEEE 802.15.4 - QoS

- QoS – 3 traffic types
  - Periodic data: e.g. Sensor data
  - Intermittent data: generated once a while, e.g. Ligth witch traffic
  - Repetitive low latency data: E.g. Mouse device traffic
- Sophisticated QoS mechanisms may reside in upper layers

Questions