IoT Networks IoT WPANs

IoT WPANs

❖ IEEE 802.15.4 Standard

- Low-cost, low-speed, low-power
 WPAN (Wireless Personal Area Network) protocol
- IEEE 802.15.4 applications
 - ZigBee
 - 6LoWPAN (IPv6 over Low power WPAN)
 - WirelessHART (Highway Addressable Remote Transducer)
 - MiWi (Microchip Wireless Protocol)
 - RF4CE (Radio Frequency for Consumer Electronics)
 - ISA100.11a

❖ IEEE 802.15.4 Device Types

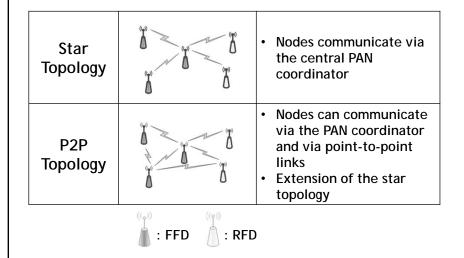
- FFD (Full Function Device)
 - Equipped with full functionality
 - Send, Receive, Route Data, Cluster Formation
 - Can serve as the PAN (Personal Area Network) coordinator
- RFD (Reduced Function Device)
 - Reduced functional protocol
 - · Can only communicate to FFDs
 - Cannot serve as a PAN coordinator
 - Serves role of simple sensor or switch
 - No routing functionality

IoT WPANs

❖ IEEE 802.15.4 Definitions

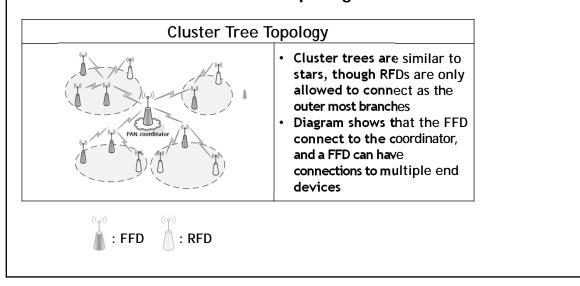
- Network Topology
 - Star network
 - P2P (Peer-to-Peer) network
 - Mesh network (P2P extension with FFDs)
 - Cluster Tree network
- Coordinator
 - Controls the IEEE 802.15.4 network
 - Special form of a FFD
 - Typical FFD functions and network coordination & service features

❖ IEEE 802.15.4 Network Topologies



IoT WPANs

❖ IEEE 802.15.4 Network Topologies



❖ IEEE 802.15.4 General Frame Format

Octets: 2	1	1 0/2		0/2/8	0/2	0/2/8	variable	2
Frame Control	Sequenc Number		ination C dentifier	estination Address	Source PA Identifie		Frame Payload	Frame Check Sequence
Bits: 0-2	3	4	5	6	7-9	10-11	12-13	
0-2							.20	14-15

Max. frame size: 127 octets

• Max. frame header: 25 octets

IoT WPANs

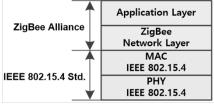
❖ ZigBee



- Supported by the ZigBee Alliance
- Uses IEEE 802.15.4, and adds on higher layer protocols required for low powered radio communications

• IEEE 802.15.4 defines the physical and MAC layers

 ZigBee provides the application and network layer protocols



❖ ZigBee



- ZigBee works well in isolated network environments
- ZigBee Network Topologies
 - Star, Mesh, Cluster Tree, or Hybrid Network
 - Star network is the basic common topology
 - Mesh & P2P networks can provide high reliability (via multiple routes between nodes)
 - Cluster tree network is a combination of Star and P2P topologies

IoT WPANs

- ❖ 6LoWPAN (IPv6 over Low power Wireless Personal Area Networks)
 - 6LoWPAN is an IETF (Internet Engineering Task Force) standard that uses the IEEE 802.15.4 WPAN technology
 - Supports IPv6 packets over IEEE 802.15.4 WPANs
 - · Enables IPv6 IoT wireless network support
 - Low power design aspect included
 - Good for battery operated IoT devices

IPv6 Advantages of 6LoWPAN

- WPAN direct connection to the IPv6 Internet
- IPv6 features can be used to support the WPAN
 - Example: Can use IPv6 security
 - IPsec, Encapsulation, Authentication, Access Control, Firewall Protocols, etc.
 - IPv6 naming, addressing, translation, lookup, and discovery functions can be used

IoT WPANs

6LoWPAN Characteristics

- Small packet size that supports 16-bit short or IEEE 64-bit extended MAC (Medium Access Control) addresses
- Low data rates of 20, 40, 250 kbps
- Star & Mesh topologies
 - Based on IEEE 802.15.4 FFDs & RFDs
- Good for low power battery operated nodes
- Relatively low cost devices

HC (Header Compression)

- 6LoWPAN & IPv6 packet size matching required
 - IPv6 minimum packet size is 1280 octets
 - IEEE 802.15.4 has an MTU of 127 octets
 - IPv6 Header has a 40 octet minimum length
- Compress the IP address when it can be derived from other headers (i.e., IEEE 802.15.4 header)
- Compress the Prefix for Link-Local Addresses
- Completely omit 128 bit IPv6 address when it can be provided from the link-layer address
- Compress common headers → TCP, UDP, ICMP

IoT Networks
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