IEEE 802.15.4

- 802.15.4 architecture:
    - Unlike Bluetooth, distinguishes between “reduced function devices” (RFD) and “full function devices” (FFD)
    - Only FFDs can be “coordinators” (like masters in Bluetooth); RFDs only connect to FFDs
    - Star and peer-to-peer topologies are possible
    - Star topologies can be organized into a hierarchy
        - Network coordinator (global)
        - PAN coordinator (local star cluster)
        - Non-coordinator FFD and RFD (leaves)

(Fig. 1)

Beacons and Superframes

- IEEE 802.15.4 permits the organization of time into “superframes”
- Coordinators send “beacon” packets to organize the superframes (for synchronization and control)
- A superframe consists of:
    - Contention access period (CAP) – e.g., access using CSMA
    - Contention free period (CFP) – guaranteed slots for certain devices, assigned by coordinator
    - Inactive period
    - Beacon interval and superframe duration specified by coordinator in the beacon packet
    - Why have an inactive period? – to allow devices to sleep.

(Fig. 2)

Routing in sensor networks: AODV

- AODV = Ad hoc On demand Distance Vector routing
- One of the routing techniques allowed in ZigBee
- Features:
    - Strictly on-demand: routes don't keep routing tables unless in an active route; routes are only formed when needed
    - Avoid stale routes: network is dynamic so all routes must be maintained "fresh"
    - Local and distributed: global coordination and routing not needed
- Path Discovery
    - When a node needs a route to the destination, it transmits a Route Request (RREQ) to its neighbors
    - RREQ consists of: source address, source sequence #, broadcast ID, destination address, destination sequence #, hop count
    - Source address and broadcast ID identify the RREQ
    - Source sequence # maintains "freshness" of reverse route to the source
    - Destination sequence # is the last known sequence # used by the destination – source won't accept any route with a more "stale" sequence number
    - If the neighbor has a route to the destination, it informs the source
    - If no route to the destination, neighbor broadcasts the RREQ to its neighbors & increments hop count

- Reverse Path
    - RREQ travels from the source to various possible intermediate routes – sets up an automatic reverse path
    - Reverse path entries are maintained by each node for at least enough time for the route information to propagate back to the source
- Forward path setup
    - Eventually a path is found – either the RREQ arrives at the destination, or a node with a route to the destination
    - Freshness: If not the destination, the destination sequence #s are compared – if the node's dsn is smaller than the source's dsn, this is a "stale" route and the RREQ is forwarded again
    - Otherwise the node returns a route reply (RREP) to the neighbor from which it received the RREQ
    - RREP propagates back towards the source, and the route is set up
    - Other nodes drop the routing information after a timeout has expired

(Fig. 3)