clusters where a coordinator is the cluster head and several other devices are leaf or child nodes. The cluster head sends periodic beacon frames that are used by sensors within its range to attach to the cluster as child nodes. These nodes may, in turn, send new beacons and form a new cluster, resulting in a cluster tree. This structure is highly energy-efficient since sensors synchronize with their parent node. Moreover, the resulting tree topology greatly simplifies routing. The 802.15.4a standard supports both star and mesh topologies, while the cluster-tree topology falls outside the scope of the standard, since upper layers are not addressed.

The MAC layer defined by the 802.15.4 standard [1] specifies two modes of operation: beacon-enabled and non-beacon. In the beacon-enabled mode, Carrier Sense Multiple Access with Collision Avoidance (CSMA-CA) is used, which requires long listening periods which decrease the energy efficiency of the protocol. The beacon-enabled mode greatly improves energy efficiency by defining a so-called superframe, shown in Figure 3. The superframe, managed by the cluster head, contains the synchronization beacon, followed by a contention access period (CAP), and an optional contention free period (CFP). During the CAP, the channel is accessed using slotted CSMA-CA. In order to minimize interference, neighboring clusters in a cluster tree may concatenate superframes as shown in Figure 3, where rectangles denote active parts of the superframe (beacon in black and CAP in white). The defined parameters that configure the