1. Theory of Operation

The device operates concurrently with other Fireflies devices of the same kind in order to form a mesh network of interconnected active RFID tags. The device and the network operate only on one, pre-defined frequency channel which is one of the 16 standard Zigbee channels numbered from 11 to 25. There is no dynamic frequency hopping during operation.

On poweron, the device starts scanning the pre-defined channel as a passive listener waiting to detect beacons from other devices configured as active network nodes. If there are other active devices within range, the device build a list of them, sorted by RSSI, and connects to the active device with the strongest signal. If there are no active devices within range, the device enters a sleep cycle and repeats the scanning phase. All radio communication is IEEE 802.15.4 standard compliant.

Once connected, the device may be configured by the network administrator to become an active device which causes it to start transmitting periodic beacons.

Devices in the network are organized in a strict spanning-tree hierarchy. They synchronize with each other by listening to the beacon messages of the higher nodes in the hierarchy. At the top of the hierarchy there is an active device of the same kind acting as a network Gateway. The latter has a serial interface in addition to the radio part, allowing it to exchange data with a PC or other fixed infrastructure equipment.

All devices in the radio network operate according to a duty cycle characterized by an Active Period (AP) and a Sleep Period (SP). The sum of AP and SP is the length of the duty cycle and is referred to as Wakeup Period (WP). Additionally, WP and AP are dynamically programmable by the network administrator. Typical values are pre-programmed in the device and default to AP=32ms, WP=512ms, meaning that the device will wake-up every 512ms and remain active for 32ms.

If connected to a LAN, the device bridges the LAN and the radio parts with regard to data traffic.