s-net®
WIRELESS SENSOR NETWORKS PROTOCOL STACK

The inherent qualities of wireless sensor networks - distributed data acquisition, decentralized application software, self-organizing communication and multi-hop data transmission - provide entirely new opportunities to various applications. The wireless communication aspect poses special challenges, though. Depending on the application, requirements regarding energy consumption, allowed latency, required data rate, the numbers of supported nodes and desired topology have to be met. The Fraunhofer IIS s-net® protocol kit hence provides a platform for the implementation of application-specific wireless sensor networks that can be individually adapted.

s-net® Protocol Kit

The s-net® sensor network protocol stack is made up of different modules that enable energy-efficient and reliable data communication in wireless sensor networks. Key component is the patented medium access control protocol SlottedMAC. It combines the advantages of time division multiple access systems – namely efficient use of the medium and efficient use of energy - with the scalability and flexibility advantages of contention-based channel access.

Under SlottedMAC, all nodes follow a periodical frame structure. A frame consists of three areas, the beacon area, the data area and the meshed-data area. Beacons are used as time synchronization signals and indicate the start of a frame. Each node receives and transmits beacons in order to synchronize itself and other nodes to their activity schedules and the beginning of the frame. Each node only listens to one beacon meaning that all nodes in the network form a virtual tree structure where the master node serves as root.

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Time division multiplexing and time synchronization of nodes result in ultra-low power communication because of short send and receive activity cycles. Therefore, wireless sensor nodes can autonomously operate on batteries with nearly now manual maintenance need, while still, low latency is guaranteed.
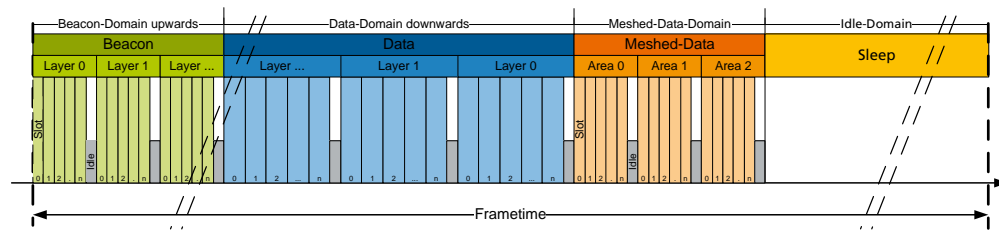
Frame structure used by the s-net® protocol stack

The network layer TriNwk allows a direct addressing of nodes in or outside the sensor network. Hence a one-to-one communication among nodes is possible independent from the underlying medium access layer, so that messages can be forwarded across different technologies. In addition to specific addressing of individual nodes, group addressing is possible, too.

A flexible adaptation mechanism enables the integration of other wireless protocols into the s-net® protocol stack. Hence, s-net® systems can be integrated with other radio systems like Wireless M-Bus into the same solution.

Key Features of the s-net® Protocol Stack

– Ultra-low power operation due to time synchronization of the network and time division multiplex communication for long-lasting battery-operated systems.
– Dynamic network self-organization and adaptation to interference or node failures for increased network robustness.
– Multi-hop communication – storing and forwarding messages from and for other nodes – for easy network extension and large area coverage.
– Fast data transport through single frame multi-hop.
– Easy adjustment of protocol features to different fields of application; for example for supporting different node densities, network sizes or throughput.
– Adaptable frame length from 1 s up to 4 min for adjusting energy consumptions and throughput latency to application requirements.
– Reliable data transmission through automated packet retransmission.

Further Information

The s-net® protocol technology offers meshed networking capabilities for sensor nodes, in particular allowing the use of battery operated routers. Furthermore, nodes can be easily localized within the network.

Currently, s-net® supports the Texas Instruments microcontroller family MSP430, and a number of wireless transceiver modules from Texas Instruments and Atmel.

For a list of currently supported OEM modules, as well as for answers to more details, please feel free to contact us via s-net-info@iis.fraunhofer.de.