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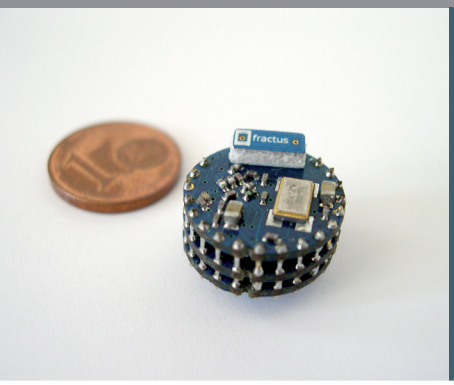

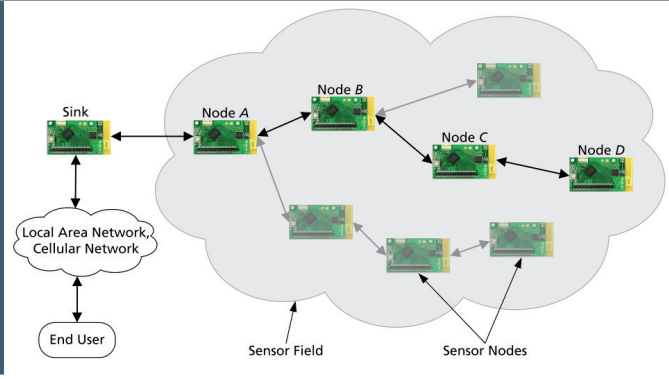

1 *Ultra minituarized wireless sensor node*
2 *Sensor nodes scattered in a sensor field*

WIRELESS SENSOR NETWORKS

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Structural as well as environmental monitoring represents a class of sensor network applications with enormous potential benefits for scientific communities, society as a whole and industry. Covering areas to be observed with numerous networked micro sensors can enable long-term data collection at scales and resolutions that are difficult, if not impossible, to obtain otherwise.

Operation

A wireless sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the area of interest or very close to it. After the initial deployment, sensor nodes form a wireless network using ad-hoc communication.
Typically, each sensor node is equipped with sensing, communication, and computation devices. Fraunhofer IMS offers sensor nodes, which combine a microcontroller, a transceiver, non-volatile flash memory, and application-specific sensors into a single tiny device (*fig.1*). Wireless sensor networks operate autonomously and unattended. Data are routed back to the end user by a multi-hop infrastructureless architecture through the sink (*fig. 2*). A multi-hop network has the advantage of redundancy and scalability. If an individual node fails, a remote node still can communicate to any other node in its range, which in turn, can forward the message to the desired location. The sink and all sensor nodes are associated with a protocol stack. The protocol stack combines power and routing awareness, integrates data with networking protocols, communicates power efficient through the wireless medium, and promotes cooperative efforts of sensor nodes.

Data Processing

The integration of local processing and storage allows sensor nodes to perform complex filtering and triggering functions, as well as to apply application-specific or sensor-specific data preprocessing algorithms. The ability to communicate not only allows information and control to be communicated across the network of nodes, but ît also supports nodes to cooperate in performing more complex tasks, like edge detection, localization, data aggregation, and system health and status monitoring. A class of distributed computation mechanisms is realized to run a set of algorithms in a collaborative manner to produce a joint conclusion about the phenomena being observed. The computing and networking capabilities allow sensor networks to be reprogrammed or retasked after deployment in the field.

Sensor Interfaces

Various sensors can be attached via standardized interfaces, providing more flexibility and making it possible to acquire information about specific events (*tab. 1*).
For example, sensors measuring light intensity, air temperature, humidity, soil temperature, soil moisture can be attached to sensor nodes via a standard 2-wire interface to monitor growth conditions of economic plants.

Development Tools

Fraunhofer IMS offers an additional development board designed to provide customers with all of the interfaces needed to develop and prototype a wireless sensor network (*fig. 3*). Furthermore, the development board does provide a JTAG based interface to debug the operation of the embedded micro controller system or to configure the target hardware.
Software tools to display and monitor sensor readings on a PC and to communicate back to the sensor nodes are also available.

Fraunhofer IMS Range of Offer

The examples above provide an idea how rich and varied the potential applications of wireless sensor networks are in the field of measurement and control due to their wireless communication capabilities.
Fraunhofer IMS offers a wide range of wireless sensor network solutions, technologies and services covering all sectors from hardware components through stack customisation up to application specific system implementations.

Carrier Frequency	2.4 GHz (radio is IEEE 802.15.4 compliant)
Microcontroller	8 bit
Power Consumption	30 µW (sleep) 6 mW (microcontroller active) 60 mW (radio active)
Range (node to node, outside)	125 m
Data Rate	250 kbps
Sensor Interfaces	• ADC (10 Bit) • I2C • SPI • 16 General Purpose Input Output • UART
Operating Temperature Range	-20°C to +70°C
Size (of PCB)	33 x 55 mm^2 (Development Board: 90 x 60mm^2)

3 *Development board*
4 *Evaluation set, sensor nodes*
5 *Technical specifications of a sensor node*