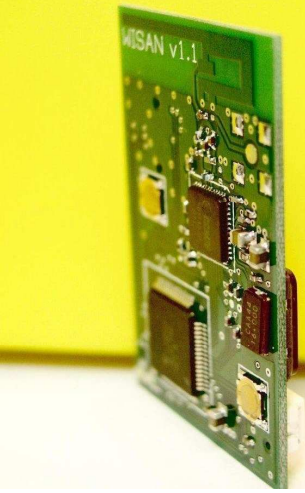


WISAN 1.1

Wireless Intelligent Sensor and Actuator Network (WISAN) is a scalable ultra-low-power platform for sensing applications.

Existing sensor networks do not completely satisfy requirements of problems posed by structural health monitoring: the proactive, constant data rate character of the data streams rather than reactive, event-driven data delivery; real-time requirements to bidirectional data flow from sensors and to actuators.

WISAN is designed to address these issues and support massive arrays of heterogeneous sensors with constant data streams. Development of WISAN is funded by New York State Energy Research and Development Authority (NYSERDA) and industry.

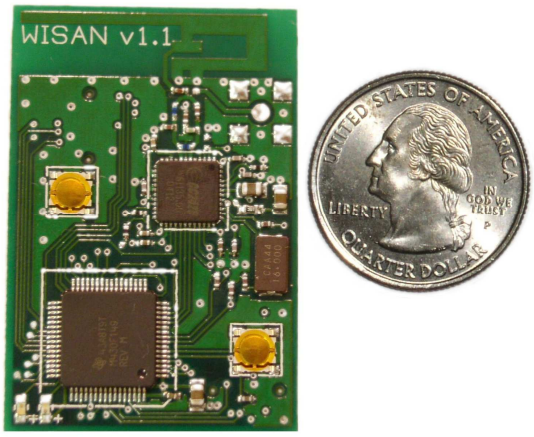
WISAN has the following key features:

1. WISAN provides low-cost massive data acquisition from arrays of heterogeneous sensors with constant data streams forming a distributed data acquisition system. Providing uninterrupted, steady streams of data is the focus of the network.

2. Ultra-low power consumption of a sensor node is achieved through utilization of energy-efficient microcontrollers from TI's MSP430 series and optimization techniques minimizing the amount of time the transceiver is powered during operation.

3. A project in progress (funded by the National Academies) is targeting design of electromagnetic energy harvesting devices that convert ambient vibration into electric energy. Energy harvesting will allow fully autonomous operation of the WISAN nodes on civil structures.

4. WISAN is fully compatible with IEEE 802.15.4 and can be utilized worldwide in 2.4Ghz ISM frequency band and coexists with WiFi and other devices.



Front view of a sensor node

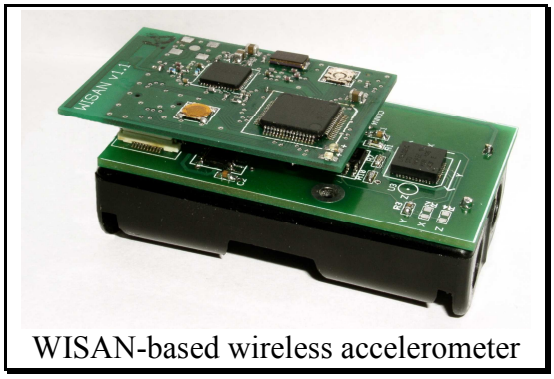
Front view of a PAN coordinator (shown: graphics LCD, Bluetooth interface, user buttons)

5. Each node on the network is synchronized with other nodes on the order of microseconds. The synchronization is periodically updated. This guarantees data acquisition by all nodes at the same time.

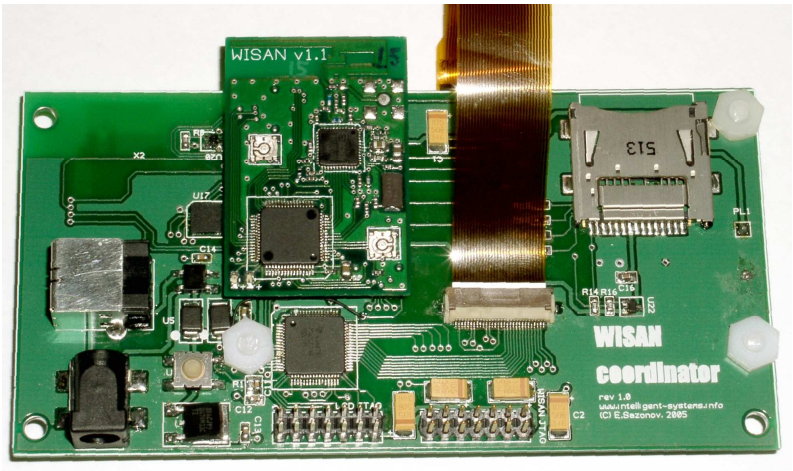
6. The sensor node design allows a variety of external extensions on stackable boards. Interface pins include digital IO, analog in and analog out, SPI, I^2C, and serial.

7. The sensors nodes are capable of acquiring 12-bit data with the sampling rate of 200Ksps. External ADCs enable 16-bit (100Ksps) or 24-bit (780sps) data acquisition. Ultrasound interface with 5-20Msps acquisition rate is in the plans.

8. Hardware design of the nodes allows to perform self-localization of the nodes, that is establish relative position of each node to others.



WISAN-based wireless accelerometer



Rear view of a PAN coordinator (shown: USB interface, JTAG interfaces, miniSD storage card socket)

9. Transparent scheduling extensions on top of IEEE802.15.4 protocol enable almost 100% efficient bandwidth utilization by eliminating network collisions and providing each node with ample bandwidth. In practical terms, the scheduling extensions allow increasing the number of nodes in a cluster by a factor of 5 without sacrificing performance. The same techniques significantly reduce power consumption by a sensor node by eliminating most of retransmissions due to collisions.

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