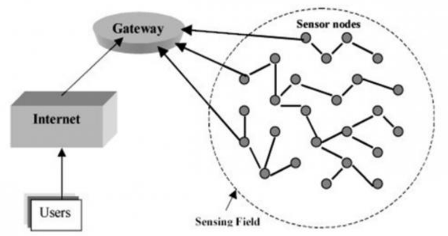
Evolution of industrial wireless sensor networks: Page 2 of 5

November 10, 2017 // By Mark Miller, L-com Global Connectivity, Wireless Product Manager



Industrial automation powered by wireless sensor networks (WSN) is heralding the Industrial Internet of Things and Industry (IoT) 4.0. Key enabling cloud and wireless mesh networking technologies promise to bring multi-year battery life, IP addressability to machines and sensors, cloud-based provisioning and management systems, as well as fieldbus tunneling.

An evolution in opportunities and challenges

As shown in Figure 1, WSNs involve tiny wireless sensor nodes installed on industrial equipment to monitor its performance based on parameters such as vibration, temperature, proximity, power quality, and pressure. These nodes are often composed of a microcontroller, several sensors, communication modules, memory for data storage (e.g.: EEPROM, SDcard), and a power source. Depending upon the access technology, the nodes can communicate to external systems using either Ethernet, Wi-Fi, ZigBee, Bluetooth, or GPRS/3G. Also known as the data acquisition (DAQ) sensor node as well as the gateway, the sink wirelessly receives the data and channels it through to the internet with an internal wired connection such as Ethernet. This prevents the necessity for each individual sensor node to store large amounts of data and provides a means for network backhaul in order to process and analyze data.

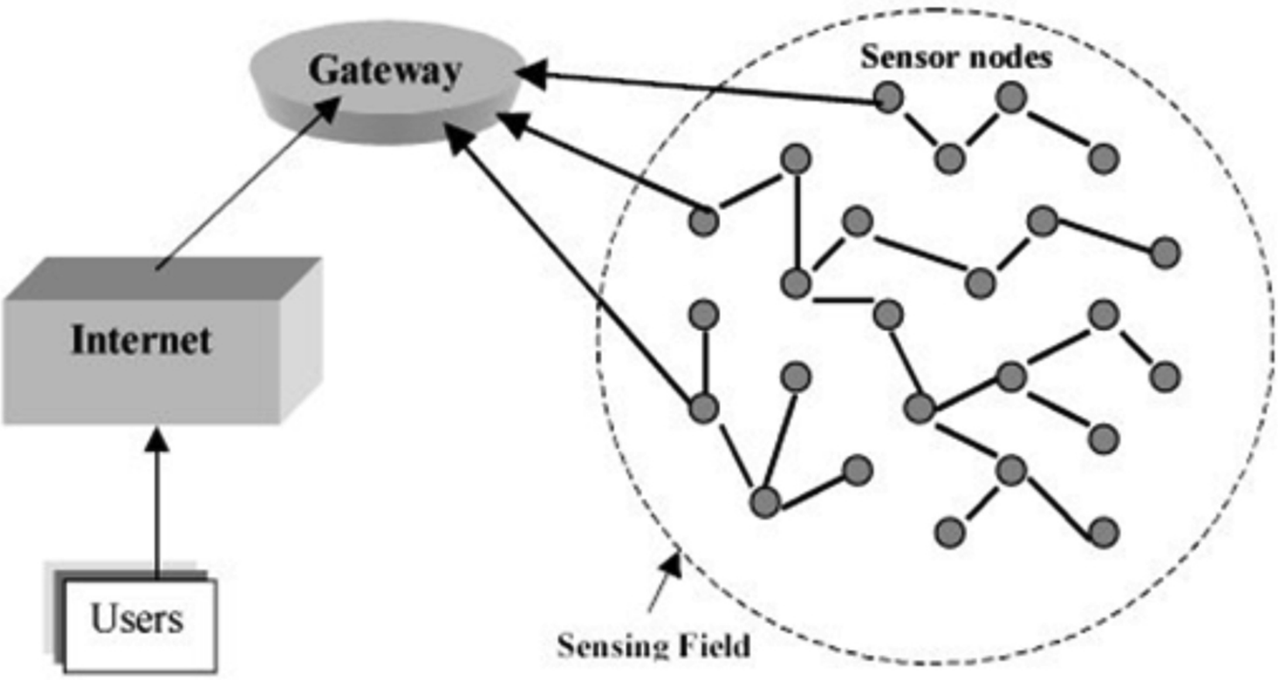


Figure 1: Illustration of a WSN with a number of sensors that perform a diverse range of functions, a sink node that collects and sends data to the internet via cabling, Nearly 8 of 10 WSN users leverage wireless mesh topologies [2].
Source: http://article.sapub.org/10.5923.j.jwnc.20150501.03.html

Energy constraints

Industrial WSNs face major resource constraints with energy, memory, and processing; most sensor nodes are battery powered limiting both the processing power of the sensor as well as the operational lifetime of the node. There are many methods for energy harvesting that are being explored including energy generations through vibration, thermal energy, RF energy, and light. In outdoor environments, photovoltaic (PV) cells can be installed on the board for the primary source of energy where secondary energy storage is accomplished through a rechargeable battery bank and/or supercapacitors [5], [6]. On the plant floor, electric motors can account for more than 90% of energy output and also happen to be one of the biggest sources of energy on the plant floor to be exploited in terms of temperature and vibration. Thermoelectric energy can be harvested through the use of two dissimilar metals where a temperature gradient produces a current (Seebeck effect). Thermoelectric generators (TEG) composed of a number of n- and p-type semiconductor pellets use temperature gradients ranging from a few degrees to hundreds of degrees to generate energy. These temperature differentials can be from a human body or a machine to the ambient environment. Piezoelectric materials can convert vibrational and airflow strain into voltage. Ambient vibration can also be converted to power by means of magnetic induction with a magnet moving with respect to a coil.

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