Low-cost wireless sensor networks open new horizons for the Internet of things

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A new European project enables high effective networking based on cheap wireless sensors in a wide range of business applications -- from more comfortable and energy-efficient environmental controls to precision monitoring of agricultural resources.

The EUREKA ITEA software Cluster ESNA project has developed a flexible framework for business-oriented wireless-sensor network applications using a standard architecture to facilitate communications between all types of smart device – from domestic appliances and environmental controls in the home to the latest process control equipment in factories. ESNA offers an impressive balance between advanced technological innovation and a business-oriented approach to defining applications. A series of implementations that were demonstrated in the EUREKA project have already led to real applications including precision agriculture, energy monitoring and management in buildings, and industrial process control.

More and more everyday appliances – from fridges and washing machines, through heating and ventilation controls, to modern multimedia systems – are increasingly intelligent. As home networking becomes the norm, linking all these devices will be a key driver of our future world, providing a high level of control over our everyday environment for our comfort and safety. And by using the ubiquity of the Internet, such control and interactivity can be extended across our society through the so-called 'Internet of things' from factory production to modern agriculture.

Interconnecting low cost devices

Key to this has been the development of wireless networks that enable the interconnection of all types of sensors using radio communications. The matchbox-sized devices can be incorporated into almost any device – and at derisorily low cost. While manufacture of such devices has inevitably moved to Asia, the use of these components in wireless sensor networks has been the subject of immense interest in Europe.

Battery power offers high flexibility as no power cabling is needed. And devices are multifunctional – nodes can be equipped with many different sensor capabilities, such as temperature, humidity, movement, radiation, gases and light, opening up a broad spectrum of applications. Dynamic network establishment adds to robustness – if one node fails, the network automatically rearranges itself to continue operation.

"We discussed wireless sensor network applications at an ITEA brokerage event in Barcelona in 2005," explains project leader Olle Olsson of the Swedish Institute of Computer Science (SICS). The subject attracted interest from partners with complementary interests in a wide mix of technologies, and from partners with more market-oriented focus, wanting to target specific markets and bridge the gap between technology and actual use.

"We saw the way EUREKA operated was good, because it enabled the matching of product and application-oriented technology development in the same project. The result was a project that combined technology 'geeks' and organisations keen to supply technologies for specific markets. We also had end users interested in using rather than selling technologies."

ESNA had two objectives: developing a strong and multifunctional basic software platform supporting very flexible application needs and

demonstrating the use of this platform to meet the needs of specific market areas with relevant application frameworks.

Business-oriented applications

The EUREKA project enabled the development of business-oriented wireless sensor network applications using standard open-source architecture, technology and application-development guidelines, and proof-of-concept implementations. The ESNA architecture supports off-the-shelf sensor network nodes and guidelines cover network dimensioning and the type of nodes to use for different application domains.

"We did develop some really new things," says Olsson. "We worked on a standards-compliant generic platform based on the emerging IPV6 Internet standard, developing the world's smallest implementation of IPV6 in terms of lines of code." ESNA also made a particular effort to reduce energy use. The result was new software-controlled technology enabling devices to operate as long as possible on one set of batteries.

"On the basic software side, we consolidated the open-source Contiki software," says Olsson. "This is an open source, portable operating system for wireless sensor networks. It is designed for microcontrollers with small amounts of memory."

On the applications side, ESNA developed methods for interoperation with other IP environments to ensure wireless sensor networks were not separate, stand-alone islands but rather part of enterprise-wide IT environment. "This involved supporting industrial standards in various application areas. We now have solutions that are innovative in terms of integrating other technologies and systems."

Strong European lead achieved

"Overall, we have developed a strong European lead in wireless sensor networks in a field which is still emerging globally," says Olsson The highly efficient basic software operating system is already being used by commercial actors. And, on the applications side, a sensor node has been launched in Spain by Edosoft for precision agriculture while a Spanish spin-off is targeting energy monitoring and management in the construction industry.

In addition, several industrial components have been developed based on work in the project. Examples include: sensors for industrial process monitoring (ABB); a platform for mesh communications (CRL Sweden); a security monitoring system (Lansen Technology); and a monitoring and control system (Intar). The ESNA partners are also building further on the results achieved in new European co-operative projects.

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