Monitoring with minimum power

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A new communication protocol for wireless sensor networks just released by the Viterbi School's Information Sciences Institute is the most efficient yet with more than a tenfold improvement on previous versions.

Sensornets – an emerging way to monitor inaccessible and unwired places – depend on placing numerous sensor units across a wide area. The units communicate with each other, sending the information they gather at intervals to the human operators.

In wilderness parks, for example, such networks are used to monitor activity by wildlife. Sensornets are also being explored for industrial applications such as oilfield monitoring and management.

Because the units are battery-powered, minimum power consumption is critical – but at the same time, continuing coverage is essential. Ordinary wireless methods such as WiFi won't work because of this limitation.

The activities of the units are orchestrated by special operating rules called Media Access Control protocols. More than three years of ISI research – supported by the National Science Foundation, Intel and other funders – produced a new protocol, SCP-MAC, which marked a dramatic improvement in energy efficiency.

The protocol combines two techniques: “low-power listening,” in which units switch on for only very brief periods; and “scheduled channel polling,” which synchronizes and schedules the listening.

“The basic approach of SCP-MAC is to let units alternate periods of sleeping with very brief periods of listening, as shown in the figure,” said ISI research scientist and project developer Wei Ye. “Such a sleep pattern is found on birds, who need to keep vigilance while sleeping. To minimize the listening cost, SCP-MAC utilizes ‘low-power listening,’ which detects channel activity very quickly.”

It further reduces the transmission cost, Ye explained, by synchronizing the listening schedules of nodes, so that a unit can wake up its neighbors by transmitting a short tone.

Previous protocols required individual units to be active for approximately 2 to 3 percent of monitoring time – that is, about 29-45 minutes of sensornet activity every day. SCP-MAC reduced the monitoring time to less than two minutes each day.

The system was developed by Ye, who worked with project leader John Heidemann and programmer Fabio Luis Silva in the ISI Laboratory for Embedded Networked Sensor Experimentation.

In February, the group made the new protocol available for download by sensornet users and developers at www.isi.edu/ilense/software/scpmac/

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