Calculations reveal how sensors must take turns to harvest power efficiently from a data hub

March 24 2016

A wireless-powered communication network (WPCN) could connect smart appliances and security monitors in the home. Credit: StockSnap/2508 images

Algorithms that describe the most efficient ways to transmit data and power between wireless sensors and a central hub could help develop large networks of smart devices.

Interconnected wireless devices are increasingly common. For example, smart home appliances can transmit or receive data so that users can remotely control heating or lighting, while remote sensor networks can help gather environmental data such as water quality or air pollution. This burgeoning 'Internet of Things' could see billions of sensors deployed across cities, homes, offices and factories.

But many sensors rely on battery power, which can limit their use. "To change the batteries after a few years of deployment would be problematic," explains Chin Keong Ho of Singapore's Agency of Science, Technology and Research Institute for Infocomm Research. "The sensors might be dispersed throughout a city, and in certain locations, it could be impractical or dangerous to change batteries."

One alternative is to build a wireless-powered communication network (WPCN), containing sensors that can harvest energy from the radio waves transmitted by the central hub.

Supercapacitors offer a promising way to store this energy, because they are smaller, and charge more quickly, than rechargeable batteries. They can also function through many years of charge-discharge cycles with no loss of performance. However, supercapacitors cannot store energy for long periods, because they tend to self-discharge. This means the sensor may not retain power to transmit data if it only communicates with the hub every few weeks.

Ho and colleagues have now developed a strategy to solve this problem. They calculated the best ways to schedule transmissions around a network of sensors fitted with supercapacitors, so that each sensor was sure to have the energy it needed to send its data back to the hub .

First, they aimed to maximize the total amount of data and power that could be transmitted in a given time, and developed an algorithm that described the optimal solution. "The optimal algorithm we developed performs substantially better than the conventional method," says Ho.

The researchers also developed a second algorithm to minimize the total charging and transmission time needed to communicate once with every sensor in the network. This algorithm also accounts for differences in the quality of the communication link between different sensors.

In the future, these algorithms should help to design more efficient WPCNs, and the team is now testing them on wireless power prototypes in the lab.

More information: Full-duplex wireless-powered communication network with energy causality. *IEEE Transactions on Wireless Communications* 14, 5539–5551 (2015). arxiv.org/pdf/1404.0471.pdf

Provided by Agency for Science, Technology and Research (A*STAR), Singapore

Citation: Calculations reveal how sensors must take turns to harvest power efficiently from a data hub (2016, March 24) retrieved 18 April 2024 from https://phys.org/news/2016-03-reveal-sensors-harvest-power-efficiently.html