Boosting smartphone battery life

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A new "subconscious mode" for smartphones and other WiFi-enabled mobile devices could extend battery life by as much as 54 percent for users on the busiest networks.

University of Michigan computer science and engineering professor Kang Shin and doctoral student Xinyu Zhang will present their new power management approach Sept. 21 at the ACM International Conference on Mobile Computing and Networking in Las Vegas. The approach is still in the proof-of-concept stage and is not yet commercially available.

Even when smartphones are in power-saving modes and not actively sending or receiving messages, they are still on alert for incoming information and they're searching for a clear communication channel. The researchers have found that this kind of energy-taxing "idle listening" is occurring during a large portion of the time phones spend in power-saving mode---as much as 80 percent on busy networks. Their new approach could make smartphones perform this idle listening more efficiently. It's called E-MiLi, which stands for Energy-Minimizing Idle Listening.

To find out how much time phones spend keeping one ear open, Shin and Zhang conducted an extensive trace-based analysis of real WiFi networks. They discovered that, depending on the amount of traffic in the network, devices in power-saving modes spend 60 to 80 percent of their time in idle listening. In previous work, they demonstrated that phones in idle listening mode expend roughly the same amount of power as they do when they're fully awake.

"My phone isn't sending or receiving anything right now," Shin said, lifting his power-skinned iPhone, "but it's listening to see if data is coming in so I can receive it right away. This idle listening often consumes as much power as actively sending and receiving messages all day."

Here's how E-MiLi works: It slows down the WiFi card's clock by up to 1/16 its normal frequency, but jolts it back to full speed when the phone notices information coming in. It's well known that you can slow a device's clock to save energy. The hard part, Shin said, was getting the phone to recognize an incoming message while it was in this slower mode.

"We came up with a clever idea," Shin said. "Usually, messages come with a header, and we thought the phone could be enabled to detect this, as you can recognize that someone is calling your name even if you're 90 percent asleep."

When used with power-saving mode, the researchers found that E-MiLi is capable of reducing energy consumption by around 44 percent for 92 percent of mobile devices in real-world wireless networks.

In addition to new processor-slowing software on smartphones, E-MiLi requires new firmware for phones and computers that would be sending messages. They need the ability to encode the message header---the recipient's address---in a new and detectable way. The researchers have created such firmware, but in order for E-MiLi use to become widespread, WiFi chipset manufacturers would have to adopt these firmware modifications and then companies that make smartphones and computers would have to incorporate the new chips into their products.

Shin points out that E-MiLi is compatible with today's models, so messages sent with future devices that use E-MiLi's encoding would still be received as usual on smartphones without E-MiLi. E-MiLi can also be used with other wireless communication protocols that require idle listening, such as ZigBee.

Shin is the Kevin and Nancy O'Connor Professor of Computer Science. This research was funded by the National Science Foundation. The paper is titled "E-MiLi: Energy-Minimizing Idle Listening in Wireless Networks" (PDF). The university is pursuing patent protection for the intellectual property, and is seeking commercialization partners to help bring the technology to market.