Low-power computers could benefit environment and U.S. economy

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(PhysOrg.com) -- A University of Wisconsin-Madison engineering professor has received a prestigious CAREER Award from the National Science Foundation (NSF) to design low-power computing systems that, if implemented on a broad scale, could have significant environmental and economic benefits.

When an Internet surfer opens Google and types in a keyword, the command goes to one of the company's U.S. data centers, which are large-scale facilities with hundreds of computer servers. In the last seven years, the utility bills to power and cool the servers and auxiliary equipment at U.S. data centers increased from $15 billion to $30 billion in 2008, the last year data is available.

This cost, coupled with the amount of electricity consumed by computers in offices and homes, has consequences.

"To generate that amount of electricity, we have to burn a lot of fossil fuels, and that's not good for the environment," says Nam Sung Kim, an assistant professor of electrical and computer engineering. "Also, we have to perform computations for almost every aspect of our lives now, and by reducing the cost for doing these computations, our national economy could gain a competitive edge."

Kim is crafting designs and architectures for low-power computing systems that could address these challenges. He is developing algorithms for two strategies to reduce computer power consumption. The first strategy is to program machines that can process computations more efficiently. For example, several computations must be completed for every pixel displayed on a monitor or laptop screen. Each screen is composed of tens of thousands of pixels, but a viewer would not notice if some of those pixels didn't show up. "I'm trying to reduce the computation procedure as much as I can while still, for example, providing a screen with decent picture quality," Kim says.

The second strategy is to reduce wasted energy during computations. To achieve this, Kim is trying to identify which sections, called blocks, of computer circuits can be turned off during certain functions. Turning the blocks off when they are not in use rather than letting them remain on and idle reduces the overall power consumption of the processor.

Timing when to turn the blocks on and off without a noticeable effect on the computer's overall performance speed is a significant challenge for Kim.

"Once the block is turned off, it takes some time to wake it back up, like it takes time to wake a computer up after putting it into sleep mode," he explains. "To minimize performance impact, or penalty, I have to predict which blocks will be used and won't be used in order to wake them up in time. My main objective is to hide the time penalty so users don't notice a slowdown."

Reducing the amount of electricity used by individual computers could add up to massive energy cost savings-a possibility that has attracted the attention of the government and industry. NSF CAREER awards recognize faculty members who are at the beginning of their academic careers and have developed creative projects that effectively integrate advanced research and education, and along with the award, Kim has received a five-year grant of almost $437,000. In addition to the CAREER award, Kim receives funding from Microsoft and Samsung

Electronics.

Provided by University of Wisconsin-Madison