Rice computer chip makes Technology Review's top 10

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Rice University's technology for a "gambling" computer chip, which could boost battery life as much as tenfold on cell phones and laptops while slashing development costs for chipmakers, has been named to MIT Technology Review's coveted annual top 10 list of technologies that are "most likely to alter industries, fields of research, and even the way we live."

Technology Review, one of the world's oldest and most respected trade publications, features its annual TR10 Special Report in the March/April issue. Both the Department of Defense and chipmaker Intel have underwritten research on Rice's new chip, which is known as PCMOS.

"We are challenging a long-held convention in computing, the notion that 'information' is, by definition, correct and exact," said PCMOS inventor Krishna Palem, Rice's Ken and Audrey Kennedy Professor in Computer Science. "In fact, the human mind routinely makes do with imprecise and incomplete information. Our goal is create a new computer architecture that takes advantage of this innate human ability in order to slash power consumption and hold down microchip design costs."

The PCMOS concept is deceptively simple; slash power to some transistors on the processor and take a chance that a few calculations will be incorrect. The technology piggybacks onto "complementary metal-oxide semiconductor" technology, or CMOS, the basic technology chipmakers already use. The probability of calculation errors yields the

name "probabilistic" CMOS, or PCMOS.

One example of the way people deal with incomplete information comes in watching video on a cell phone, Palem said. His group's previous work has shown that viewers cannot tell the difference between video processed on regular microchips and PCMOS chips. Palem said the key is knowing how people "value" particular numbers. For example, when scanning a bank statement people will almost certainly catch an error worth thousands of dollars, while casting a blind eye to errors worth only pennies.

"Money is just the most obvious example, but we assign values automatically to most of the information we take in," Palem said. "In the case of the video, we concentrate our precise processing on the parts of the picture that are most valuable."

PCMOS chips compute differently than regular chips because of way electricity moves through their transistors. Rather than pushing the same amount of power through all parts of the PCMOS chip, voltage is assigned on a sliding scale. The upshot being that the numbers that users value the most -- the thousands place on the bank statement, for example -- are always correct, while less valuable numbers may be incorrect.

"Professor Palem is proposing a radical change in how we use integrated circuits," said David Rutledge, chair of the division of engineering and applied science at the California Institute of Technology. "Turning down the supply voltage reduces the power requirements and introduces randomness that has the potential to be exploited for computations."

Shekhar Borkar, an Intel Fellow and Director of Intel’s Microprocessor Technology Lab. said, "Innovative technologies like PCMOS will become increasingly important as the industry looks to maintain pace with Moore’s Law."

"Moore's Law," a concept first put forward by Intel co-founder Gordon Moore, refers to the industry's decades-long track record of doubling transistors per square inch on integrated circuits every 18 months. This exponential shrinkage has resulted in transistors on today's chips that measure a scant 45 billionths of a meter across. Palem, who recently finished a yearlong appointment as a Gordon Moore Distinguished Scholar at Caltech, said that as chipmakers strive to maintain Moore's Law, the basic physics of CMOS will yield transistors that are inherently probabilistic.

Source: Rice University