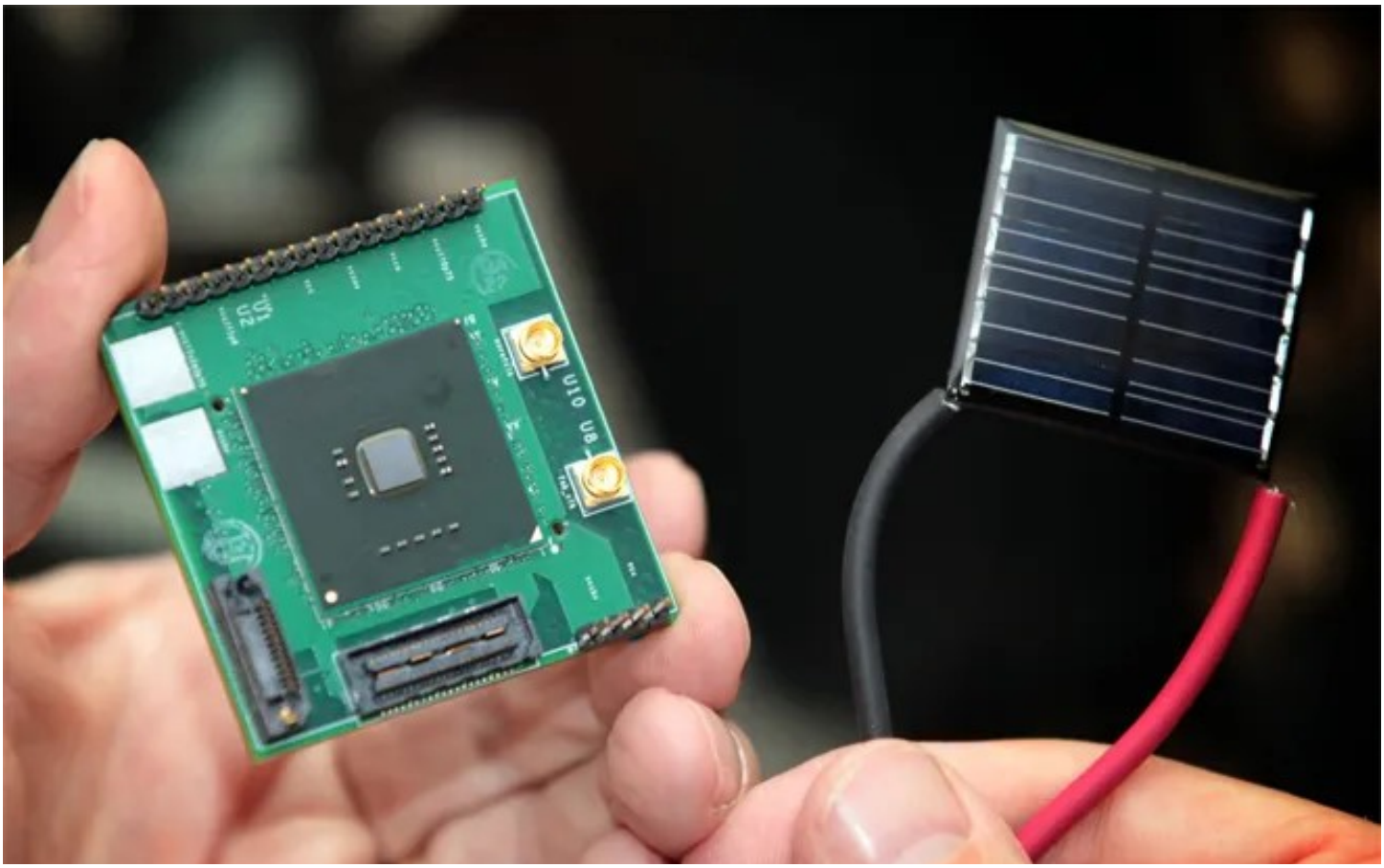
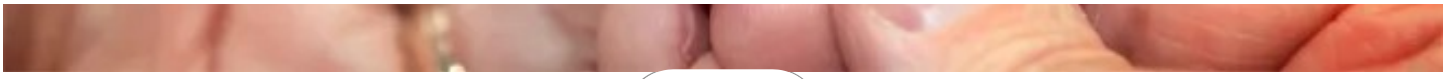
ERIC SMALLEY BUSINESS FEB 21, 2012 6:03 PM

# Intel 'Solar' Chip Nears Light of Day

**In September, Intel showed off the Claremont processor, a research prototype so energy-efficient it can run Windows on the power generated by a palm-size solar cell. Now, the company is also using the processor's Near Threshold Voltage technique in memory chips and graphics processors, and the technique's public status has also been upgraded from may-not-see-the-light-of-day to likely-to-turn-up-in-products.**







**INTEL LEARNED A** lesson last fall: Don't try to be too clever with your demos.

In September, at the Intel Developer Forum, the chip giant showed off the Claremont processor, a research prototype so energy-efficient it can run Windows on the power generated by a palm-size solar cell. Intel helpfully provided photos of the chip connected to the kind of solar cell you find built into self-charging flashlights.

The green meme stuck, but not quite the way Intel intended. The chip was quickly dubbed the solar-powered microprocessor. "I'm constantly explaining that the solar cell was just a clever demo technique," says Justin Rattner, Intel's CTO. "It was not intended to suggest we were focused on solar-powered microprocessors."

Intel is trying again this week, this time keeping the focus squarely on energy efficiency as it provides details about the processor's Near Threshold Voltage (NTV) technology at the 2012 IEEE International Solid-State Circuits Conference (ISSCC) in San Francisco.

The company is now using the Near Threshold Voltage technique in memory chips and graphics processors. The technology's public status has also been upgraded from may-not-see-the-light-of-day to likely-to-turn-up-in-products.

Energy efficiency is important for a wide range of applications, but especially for mobile and embedded devices that are limited by battery capacities, and for supercomputers made up of hundreds or thousands of processor cores.

The technology works by running integrated circuits at just above the power level needed to turn transistors on, hence "near threshold." Computer chips usually run at several times the threshold voltage to ensure a clear distinction between on and off. Running near threshold voltage saves a lot of energy. "The circuits are still operating, and operating reliably, but they're operating at an energy level that one would previously associate with systems in standby or in some sort of sleep

mode," Rattner said.

Operating at near threshold voltage comes at the expense of performance. You have to dial down the chip's clock speed to accurately distinguish the small difference between on and off. The idea is not to make slower chips, but to make chips that range dynamically from slow but super efficient most of the time to fast when a burst of work comes along. The technology is ideal for highly variable workloads where running at a few tens of megahertz is usually sufficient but where there can be sudden needs for cranking up the throttle to a gigahertz or more, says Rattner.

Claremont can operate from 280 millivolts to 1.2 volts, and at clock speeds from 3 MHz to 915 MHz. At 3 MHz, the chip is using a miniscule 2 milliwatts of power. Overall, Claremont is 4.7 times as efficient as an equivalent processor without near threshold voltage technology.

Intel has built an SRAM memory chip using the near threshold voltage technology. The 22 nm tri-gate chip uses 27 percent less power than an equivalent memory chip without the near threshold voltage technology.

The company is also using the technology in a graphics chip -- a SIMD vector engine that's also built with 22 nm tri-gate technology. The graphics chip operates from 280 millivolts to 1.1 volts. At 280 millivolts the chip is nine times as efficient as an equivalent graphics chip sans NVT. IEEE gave the paper describing the graphics chip the Distinguished Technical Paper award at this year's circuits conference.

It makes sense for Intel to extend the near threshold voltage technology to memory and graphics because in this era of system-on-a-chip (SoC), processors are just one piece of the energy efficiency puzzle, says Jim McGregor, Chief Technology Strategist at market research firm In-Stat. "It's natural to apply NTV to all aspects of an SoC design."

Intel's NTV is great research, says McGregor, and it looks like Intel is getting closer to using the technology. But there's still work to do. There are still reliability issues, especially for devices that are produced in volume, he says.

Intel's strong R&D and leadership position mean its technology generally influences the industry as a whole. And these days, the name of the game is efficiency. "The semiconductor industry is constantly being pushed to improve efficiency," says McGregor. "Especially now that the entire industry is driven by mobile devices."

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