HORIZON 2020

Introducing the next computing power revolution: Minima microprocessor technology to reduce the energy need of digital computing by 20 times.

Results in Brief

Real-time modulation of processor energy consumption achieves a minimum all the time

A major hurdle to realisation of the Internet of Things (IoT) is minimising the energy consumption of infinitely connected devices. New technology to help existing processors do that dramatically is jumping the hurdle and heading to market.

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The Internet of Things (IoT) promises to connect virtually any device to the internet. This process is beginning to happen with ‘things’ from household appliances to wearable devices for fitness to smart farming and healthcare systems. A major barrier to truly connecting anything that can be connected without running down the battery in seconds is optimisation of the energy consumption required for processing all the data to be shared.

The EU-funded MINIMA (Introducing the next computing power revolution: Minima microprocessor technology to reduce the energy need of digital computing by 20 times) project has developed technology to reduce the energy required by virtually

any device that uses digital computing by up to 20 times. It could provide the rocket fuel necessary to propel the world into the future of IoT now.

Dynamic modulation achieves an energy minimum in real time

The processor is the 'brain' of any digital device. It is a small chip containing billions of transistors. Since the energy consumption of a transistor is quadratically proportional to its operating voltage, low-energy designs that decrease this voltage have been the focus of intense development. MINIMA focused on achieving minimal energy consumption in real-time via dynamic modulation of the entire hardware-software system.

The technology takes advantage of the minimum energy point (MEP), defined as the operating voltage at which the total energy consumed per operation (Eop) is minimised. As project coordinator and Chief Technology Officer of Minima Processor, Lauri Koskinen explains, "Minima uses an intellectual property (IP) delivery model that looks at the stack holistically, from the lowest and tiniest physical things making up the processor to the software. Unlike static approaches that seek to make a gate library very robust for low-power operation, dynamic margining is a combined hardware-software solution that enables the device to tune its own energy consumption during operation in response to performance needs, process variations, or environmental conditions in real time."

A world record is now moving to commercial application

Minima Processor had already reached a world-record MEP of 3.15 pJ per operation on a 32-bit processor that lowers energy consumption up to 15 to 20 times compared to nominal voltage design. With EU funding of the MINIMA project, the team has optimised the technology. According to Koskinen, "We have managed to keep the energy consumption benefits while making the technology easily implementable and testable, both key attributes in the fast-paced semiconductor industry."

Minima's technology can make the most out of any existing central processing unit or digital signal processor. System-on-chip providers such as Texas Instruments can turn the lower energy consumption into longer battery lifetime and/or new features without battery lifetime degradation. Minima has now established partnerships with NXP and ARM.

Koskinen concludes, "We created a business as academics and our extremely competent technical team has quickly evolved into serious competitors for long-standing industrial teams in the field. The first product is on its way to a

semiconductor factory now.” As more and more ‘things’ become interconnected, and performance and energy get a boost from MINIMA technology, IoT is poised to move from science fiction to reality at lightning speed.

Keywords

MINIMA | energy | energy consumption | processor | Internet of Things (IoT) | voltage | digital | minimum energy point (MEP) | internet | battery | dynamic margining | semiconductor

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MINIMA

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