THE WALL STREET JOURNAL.
WSJ.com

NOVEMBER 14, 2011, 3:35 PM ET

Barcelona Center Makes Super Bet on Cellphone Chips

Supercomputers, once built from handcrafted circuitry, were transformed when companies started assembling them from inexpensive PC-style microprocessors. Researchers in Barcelona are placing an early bet that the next big leap will be cellphone chips.

The Barcelona Supercomputing Center said Monday it is developing what it believes is the first supercomputer based on the ARM Holdings chip designs used in most cellphones. BSC, as it is called, plans to start with ARM-based chips from Nvidia called Tegra as well as Nvidia graphics processing units, or GPUs–the kind of chips used in videogame systems, which are also shaking up the supercomputer market.

Barcelona Supercomputing Center
Barcelona's supercomputer in a chapel

Behind the experiment is a power struggle–that is, a struggle to control the power consumption of supercomputers, which take up huge data centers and draw the electricity of small cities. ARM developed its designs to fit the power-sipping demands of mobile phones, where the x86 designs from Intel and Advanced Micro devices for PCs, servers and supercomputers were designed mainly with high performance in mind.

"The ARM architecture has one advantage, that it was designed and built from the ground up to be power-efficient," says Alex Ramirez, group manager of BSC's heterogeneous architecture group, who discussed the effort at a supercomputer conference underway this week in Seattle.

The power efficiency of ARM chips, of course, has been apparent for years. Why has it taken so long to construct a supercomputer from them?

Here the legacy from cellphones is a drawback; ARM chips historically lacked some key elements needed for science. "The challenges here are many," says Ramirez, who says he has been working on the notion of ARM-based supercomputers for eight to ten years.

One problem, until recently, was the absence in ARM chips of a computer numbering format known as double-precision floating-point, which is vital for carrying out some kinds of calculations. Nvidia's Tegra 2 chip added support for the technology.

But both Tegra 2, as well as the forthcoming Tegra 2 model, only handle 32 bits of data at a time. Supercomputers have long relied on 64-bit processing, which allows them to tap into much larger pools of memory. ARM has announced a 64-bit design, but it won't be ready for some time.

So the BSC project, dubbed Mont Blanc, will starting with a system that is pretty limited, Ramirez admits. But it makes sense to start the effort now, he argues, so researchers can start adapting their software to make use of the ARM design.

BSC expects to have an initial system with 256 dual-processor Tegra 2 chips running by the end of November, Ramirez says. An upgraded system with Tegra 3 chips–which have five ARM calculating engines–and additional GPU chips should be installed by June, he says.

Why the GPUs? Such chips have hundreds of simple processors that can be used for an increasing number of computing chores, and are starting to be used in combinations with standard microprocessors like x86 and ARM.

It might seem like the Mont Blanc effort could simply exploit the built-in graphics circuitry that is also included in Tegra chips, but that currently won't work, Ramirez says. That circuitry can't now be programmed for general-purpose tasks, he says, unlike Nvidia's stand-alone GPU chips.

Eventually, all the inconveniences may be eliminated, with 64-bit ARM chips and built-in graphics circuitry that can be flexibly programmed. "That's coming definitely in the next few years," Ramirez says.

The Mont Blanc effort is expected to deliver a fourfold to tenfold improvement in energy-efficiency by 2014.

BSC was established in 2004 with support from Spain's education ministry and the Catalan local government. The next year it installed an IBM system called Mare Nostrum that was the most powerful in Europe at the time, and still the most visually striking–housed in a glass enclosure inside the Torre Girona chapel.

Ramirez says he can't yet discuss how that system will be upgraded, but he expects that work will be completed in the near future.