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IBM LOOSENS UP CPU LICENSING

"Power Everywhere" Initiative Aims to Spread PowerPC Architecture

By Tom R. Halfhill {4/26/04-02}

IBM Microelectronics has announced some important steps toward making the PowerPC architecture more widely available as licensable intellectual property (IP) for custom chip designs. However, the much publicized "Power Everywhere" initiative still falls short of

matching the flexible licensing models and customizing options from competing IP vendors.

Until last year, IBM licensed PowerPC cores only to customers that worked with IBM on their custom designs and manufactured the chips at IBM fabs. In early 2003, IBM began allowing customers to do their own design work and to manufacture the chips at other foundries. (See *MPR 3/31/03-02*, "IBM Opens Up PowerPC Licensing.") At first, only the PowerPC 405 and 440 hard cores were available for licensing under that model.

Now IBM is relaxing things a little. Among the announcements: IBM will consider licensing any Power or PowerPC core or chip implementation, although limitations apply; some PowerPC 7xx- and 9xx-series cores are being licensed now, although IBM won't say which ones; IBM will allow customers to freely download a synthesizable model of the PowerPC 440 for evaluation; and IBM plans to form an open committee to help steer the future evolution of Power/PowerPC, although IBM will retain control of the architecture.

Soon after IBM's announcements, Applied Micro Circuits Corp. (AMCC) disclosed an unprecedented licensing and acquisition agreement with IBM that hints at how far IBM is willing to go. In addition to licensing PowerPC processor cores to AMCC, IBM sold an entire line of PowerPC chips and at least one engineering team. (See sidebar, "AMCC Strikes a Big Deal for PowerPC.")

IBM's grand strategy is to foster development of a broad IP portfolio around the Power architecture. ("Power"

is IBM's umbrella term for the CPU architecture that encompasses both its Power-series server CPUs and the PowerPC architecture jointly developed with Motorola in the early 1990s.) Many press reports have confused IBM's initiative with the open-source model that has worked so successfully with the Linux kernel, but IBM is not opening the Power architecture to that extent. Instead, a governance committee with open membership will help IBM determine the future direction of the architecture, and IBM will encourage other companies to develop complementary IP for it.

The business model for the Power Everywhere initiative is more like that of the Adobe *Photoshop* model than a true open-source model. Third parties are free to develop and market software plug-ins for *Photoshop*, but Adobe retains control of *Photoshop* itself. Likewise, third-party IP providers for the Power architecture will be able to profit from their work by licensing their IP to customers, but IBM will continue to own Power. Unlike the *Photoshop* model, third parties will be able to join the Power governance committee and influence development of the architecture, under IBM's supervision.

IBM Opens the Gates

The biggest news is that IBM will now entertain requests to license any processor or core in its entire Power portfolio. Even the mighty Power5—a huge 95- × 95mm multichip module with eight processor cores and 144MB of L3 cache—is on the table. (See *MPR 12/22/03-02*, "Power5 Tops On Bandwidth.")

AMCC Strikes a Big Deal for PowerPC

How much PowerPC technology is IBM willing to license or sell under its new Power Everywhere initiative? Much more than anyone expected. On April 13, Applied Micro Circuits Corp. (AMCC) announced a unique deal with IBM: in return for \$227 million in cash, AMCC is not only licensing all PowerPC 4xx-series cores—royalty-free—but is also purchasing outright about 150 standard parts based on the PowerPC 403, 405, and 440 cores. Although IBM will still own the cores, AMCC will own and become the sole supplier of the chips.

There's more. AMCC will acquire IBM's 15-person design team of U.S.-based PowerPC 4xx engineers, who will become AMCC employees. AMCC says it also intends to exercise an option to acquire a 55-person PowerPC design team in France, pending regulatory approval in that country. On top of that, AMCC negotiated a global patent cross-licensing agreement with IBM. The two companies expect the whole deal to close this quarter, pending the usual regulatory process.

The groundbreaking acquisition will give AMCC a complete product line of PowerPC chips suitable for

communications, wide-area networking, mass-storage devices, consumer electronics, and other embedded applications. The 150 PowerPC 403, 405, and 440 chips to be acquired by AMCC reaped about \$55 million in revenue for IBM in 2003 and are on track to generate more revenue this year. By additionally licensing the 4xx-series cores, AMCC is signaling its intention to develop new chips in those families.

AMCC, a fabless company, will continue using IBM as a foundry for manufacturing the acquired PowerPC chips as well as for future designs. IBM will also continue providing AMCC with system-on-chip (SoC) design tools and expertise.

With the AMCC deal, IBM is making it clear that almost everything in its Power portfolio is available for purchase or licensing: chips, processor cores, even whole design teams. Note that IBM retains ownership of the IP that's critical to its Power Everywhere strategy: the Power architecture and the processor cores based on it. However, it wouldn't surprise us if some PowerPC cores—particularly older ones—are someday tossed up for grabs, too.

However, a few strings are attached. Unlike other processor-IP vendors, IBM won't release all its cores into the eager hands of customers for on-site design work. Development projects using cores other than the PowerPC 405 and 440 require a "custom service engagement" with IBM. That means IBM and the customer will collaborate on the design work at one of IBM's new Power Architecture Centers. There are currently 15 centers in seven countries in North America, Europe, Asia, and the Middle East. IBM says that, in the future, it plans to expand this "collaborative innovation" model beyond the Power Architecture Centers. It's unclear whether this expansion would include customer sites, independent design centers, and foundries.

Another catch is that in some cases, customers must use IBM as the foundry. PowerPC 405 and 440 cores can be fabbed anywhere, but other Power cores weren't designed for rapid system-on-chip (SoC) integration or process portability. They aren't synthesizable, and the cores were optimized for specific standard parts built in a specific fabrication process. It will take a while to transform those processor cores into more portable general-purpose IP cores. Until then, IBM will manufacture any chips based on those cores. However, to broaden the choice of foundries—starting with the 90nm generation on 300mm wafers—IBM has aligned its fabrication technology with Chartered, Infineon, Samsung, and Sony.

By raising the possibility of licensing any Power processor core or chip design, IBM is making the point that Power spans a wider performance range than almost any other CPU architecture. Although MIPS and Sparc processors are competitive with PowerPC in the low-to-midrange part of the spectrum, they don't reach quite as far into the

high-performance realm. At the high end, one could imagine a customer adapting the Power4, Power5, or PowerPC 970 to create a fast network processor for high-speed routers. At the low-power end, PowerPC cores are suitable for many consumer, industrial, and automotive embedded applications, but ARM and other vendors have better options.

To entice potential customers, IBM is offering a free package of downloadable files called the Power Architecture Pack. The pack includes synthesizable models of the PowerPC 440 core and IBM's CoreConnect on-chip bus, plus some related software. The models can be synthesized and simulated with Synopsys design-automation tools (not included), and users can co-simulate other IP, including peripheral IP from IBM. Contrary to the comparisons in some press reports, however, the Power Architecture Pack is not an open-source release of the PowerPC 440. The Verilog files are encrypted, so the source code isn't even visible. Nevertheless, the pack is a good way for prospective customers to evaluate the PowerPC 440 and CoreConnect IP without making costly commitments.

Other processor-IP vendors have similar taste-testing offers, of course, though few vendors allow users to download synthesizable IP from their web sites. One exception is Sun Microsystems, which for a few years has offered synthesizable, unencrypted models of some Sparc and PicoJava processors under a special community source license. The free license allows users to simulate the processors for academic or evaluation purposes. To fabricate chips, users must obtain a regular license from Sun. Likewise, users must negotiate a license with IBM before implementing the contents of the Power Architecture Pack in a chip.

IBM Seeks Industrywide Support

IBM may have been inspired by Sun's example in more ways than one. Another part of the Power Everywhere initiative that received much press attention is an open governance committee that will guide the future evolution of the Power architecture. This planned committee will resemble the groups that influence ongoing development of Sun's Java language and platform, as well as bodies that govern Bluetooth, DVD, PCI, and many other industry specifications and standards.

The structure and membership of IBM's Power committee are yet to be determined. However, it will be a collaborative and advisory group, not a controlling body. The committee will be able to recommend changes to the Power architecture and contribute IP, for which the contributors will receive remuneration from licensees. IBM's long-term goal is to oversee the growth of a portfolio in which 80% of the IP is provided by third parties. But just as Sun retains ultimate control over Java, IBM will wield ultimate power over Power. The architecture won't be wrapped in an open-source or free-source license, like the ones governing Linux, the European Space Agency's Leon-1 processor core, or the soft-IP cores from OpenCores.org.

One of IBM's concerns is preventing any fracture of the Power architecture that could endanger software compatibility. For that reason, IBM will not permit the governance committee or Power licensees to unilaterally modify the instruction-set architecture (ISA). Certainly, IBM will consider the committee's recommendations and customer requests for broadly applicable extensions to the ISA. But customers will not be allowed to create proprietary extensions for specific applications.

ARM is similarly protective of its ISA. In contrast, configurable-processor vendors like ARC, MIPS Technologies, and Tensilica allow customers to do almost anything with their cores. Indeed, ARC and Tensilica licensees don't even have to reveal their proprietary extensions or modifications to the vendor.

Note that Power Everywhere is an IBM initiative, not an IBM-Motorola alliance. Motorola was conspicuously absent from the announcements and the press event in New York City. Later, Motorola CTO Dave Mothersole told *MPR* that his company supports IBM's Power strategy. He is waiting to see how the Power governance committee shapes up, but Mothersole said Motorola won't necessarily have to join, because the two companies already cooperate on PowerPC architectural development. However, the level of cooperation is not what it used to be, so *MPR* suspects Motorola will eventually join the committee.

PowerPC processors and cores developed exclusively by Motorola are not part of the IBM Power licensing portfolio. But IBM will license some jointly developed IP, such as

Price & Availability

IBM's Power Architecture Pack—with synthesizable Verilog models of the PowerPC 440 processor and CoreConnect bus—is free and available now for downloading at www.ibm.com/power. The same Web page links to more information about the Power/PowerPC architecture and the Power Everywhere initiative.

the multimedia extensions known to Motorola as AltiVec and to Apple users as the Velocity Engine. (See *MPR* 5/11/98-01, "AltiVec Vectorizes PowerPC.") Although Motorola is not licensing PowerPC technology as widely as IBM is, Motorola does have some PowerPC licensees and will consider selling additional licenses on a case-by-case basis. Motorola is reluctant to pursue this line of business more aggressively because it's less lucrative than selling standard parts and semicustom designs.

One Step At a Time

The most tantalizing aspect of Power Everywhere is what IBM left unsaid. The announcement signals a stronger commitment to processor IP licensing, yet it leaves many details under wraps and reflects IBM's gradual approach to this business. As even IBM acknowledges, Power processors weren't designed for general SoC integration or foundry portability, two prerequisites for broad licensing. A year after IBM entered the processor-IP market, only the PowerPC 440 is available as a soft core.

IBM needs more soft cores, especially in the low-power category, to compete effectively against vendors like ARM. IBM also needs processor cores to compete against the configurable processors from ARC, MIPS, and Tensilica, which offer the greater flexibility and the power/performance advantages of custom extensions. There are hints that IBM is moving toward the concept of dynamically reconfigurable processors, perhaps like the Tensilica-based chips recently announced by Stretch. (See *MPR* 4/26/04-01, "Stretching Performance.") To further set itself apart from other processor-IP vendors, IBM could make its vast Blue Logic portfolio of peripheral IP more portable to different foundries and fabrication processes.

Differentiation will be the key to success. The fact is, few companies have built a profitable business around processor IP licensing. Everyone's favorite success story is ARM, a pure-play IP vendor on its way to becoming the Intel of embedded processors. Most other processor-IP vendors have dropped out or are struggling. Power Everywhere is a welcome step for IBM, but many more steps will be necessary to win this market. ♦

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