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IBM OPENS UP POWERPC LICENSING

Customers Can Take Hard or Soft Cores to Any Foundry

By Tom R. Halfhill {3/31/03-02}

IBM's long-awaited decision to openly license PowerPC cores will offer formidable new competition for ARM, MIPS Technologies, and other vendors of 32-bit microprocessor cores. It's not just that PowerPC is a popular, scalable architecture with a wealth of development tools

and software. IBM's marketing muscle will give the company an instant presence in the intellectual property (IP) marketplace, and its rocklike stability makes it a safe haven for nervous customers in tough times.

Although IBM Microelectronics has been licensing PowerPC cores to ASIC and SoC developers for years, customers had to manufacture the chips in IBM's fabs, which are famously competent but sometimes prohibitively expensive. Until now, the only alternative for developers was to implement their chip design in a Xilinx FPGA, thanks to a special licensing arrangement that allows Xilinx to integrate PowerPC 405 processor cores into programmable logic devices. Under IBM's new open-licensing program, ASIC and SoC developers can take a PowerPC core to any independent foundry—such as TSMC, UMC, or Chartered—for manufacturing. This can save money and give developers more flexibility to port the cores to different fabrication processes.

Open licensing is an extension, not a redirection, of IBM's current business model. IBM will continue to sell standard-product chips based on the PowerPC cores it licenses, because many customers prefer to buy an off-the-shelf chip rather than spin their own. Likewise, IBM will continue to design PowerPC-based ASICs and SoCs for customers, and it will continue to offer foundry services for customers that want to manufacture their own PowerPC-based chips in IBM's fabs. Although IBM is, to some extent, competing with these other lines of business by licensing

PowerPC, the company views open licensing as an opportunity to attract more customers and spread the architecture into wider markets.

PowerPC 440 Breaks the Ice

Rumors that IBM was preparing to license PowerPC have been rampant for years. Now that the day is nigh, IBM is making a surprisingly conservative introduction. Only one PowerPC core will be available when the program begins in 2Q03, perhaps followed by a second PowerPC core later this year. And even though the processors will include several useful pieces of additional IP, IBM's Blue Logic library—a vast collection of peripheral cores—won't be openly licensed until some undisclosed point in the future. Nevertheless, IBM says its entire portfolio of PowerPC cores will eventually be available for licensing.

A major reason for the gradual rollout is that IBM's PowerPC processors weren't designed to be synthesizable or portable to other foundries. They are hard cores optimized for IBM's unique fabrication technology. Making them synthesizable and portable requires a significant amount of work, some of which IBM is farming out to partners. Meanwhile, customers that can't wait for the synthesizable cores can work with IBM on a case-by-case basis to port the hard core of a particular processor to their target fabrication process.

The first licensable core will be the PowerPC 440. (See *MPR 10/25/99-03*, "IBM PowerPC 440 Hits 1,000 MIPS.") IBM will deliver a synthesizable Verilog model in 2Q03,

followed by a VHDL version in 3Q03. Synopsys is developing the synthesizable 440 core for IBM under contract, and the two companies are working closely to create special synthesis scripts for popular fabrication processes. The scripts are designed to produce optimized physical layouts with efficient floorplans and clock timings. As with all soft cores, however, the synthesized version of the 440 will almost certainly deliver less performance and require more silicon than a hand-packed hard core. Accurate estimates of the differences will have to wait until the porting job is finished and IBM and Synopsys can run simulations.

Customers that need more performance than a fully synthesized core can deliver will have an alternative. Under another contract with IBM, Cadence Design Systems is creating a prehardened 440 core optimized for TSMC's widely used 0.13-micron process. That version of the core is scheduled to ship in 2H03.

IBM says it will announce the availability of other licensable PowerPC cores—including the 4xx, 7xx, and 9xx series—later this year. As mentioned above, though, IBM is willing to work with eager customers that want to port a hard version of a core to a specific fabrication process before the soft version is ready. Porting some of the higher-performance processors to a target technology will require some custom work with IBM in any case.

Each PowerPC license will include additional general-purpose soft IP. With the 440, IBM is throwing in all the necessary IP to implement a CoreConnect bus, a bridge between CoreConnect's processor local bus (PLB) and the AMBA high-speed bus (AHB), a PCI-X bus bridge, an L2 cache controller, a DMA controller, an interrupt controller, a DDR-SDRAM controller, and an SRAM controller.

Including the CoreConnect IP makes sense because it is IBM's standard on-chip bus for connecting processor and peripheral cores. (See *MPR 7/12/99-03*, "PowerPC 405 Has CoreConnect Bus.") IBM has always freely licensed CoreConnect, so giving it away with a PowerPC license is a no-brainer.

A critical part of CoreConnect is the PLB, which provides 128-bit pathways between processor cores and high-speed peripherals. By providing a PLB-to-AHB bridge with its PowerPC cores, IBM is offering an easy way for ASIC and SoC developers to integrate peripheral IP that is compatible with ARM's AMBA bus. That's useful, because until IBM opens up the Blue Logic library, developers will have to license peripheral IP not included with the PowerPC license from other sources—unless they manufacture their chips at IBM's foundry.

Licensing Terms Are Under Wraps

IBM is collaborating with leading vendors of electronic design automation (EDA) tools to make it easier for developers to implement, test, and simulate PowerPC-based designs. These vendors include the usual suspects—Cadence and Synopsys. Synopsys DesignWare users will have access to

simulation and timing models of the synthesizable PowerPC 440 core and CoreConnect bus so they can evaluate possible chip designs before licensing the processor. They can also integrate preverified peripheral IP from the Synopsys DesignWare library.

Of course, IBM will offer its own design services to new PowerPC licensees, just as it now does to captive foundry customers. IBM Microelectronics' Engineering and Technical Services division can port cores to different fabrication processes, write software, and even design entire ASICs and SoCs to customer specifications. Fees vary as widely as the services and are not included in the standard licensing fees.

IBM is offering one-time design licenses as well as unlimited-use licenses for PowerPC cores. The company won't publicly disclose its up-front licensing fees and chip royalties, other than to say it offers "competitive pricing" and "industry-standard terms and conditions."

Pricing secrecy isn't unusual for leading IP vendors. For one thing, it prevents the outbreak of public price wars. Furthermore, fees and terms are always negotiable, because they can vary according to the shifting competitive environment and other economic factors. Typically, vendors with the most-expensive licenses are least likely to publicize them. A few smaller IP vendors—such as Tensilica and now-defunct Lexra—have been a bit more forthcoming about their pricing, because they want to lure customers away from larger companies.

It's a fair guess that IBM's licensing fees tend toward the higher end of the pricing spectrum. One reason is perceived value: IBM is a top-tier vendor and PowerPC is a top-tier product. Also, the PowerPC core license includes the aforementioned general-purpose IP, which often isn't included with other licensable processors.

Two customers have already signed licenses for the PowerPC 440, and IBM says it's negotiating with additional parties. So far, no customer has publicly announced a PowerPC license. This also is not unusual. The vast majority of customers that take licenses for microprocessor cores prefer to remain anonymous, usually because they don't want to tip off competitors before their products hit the market.

IBM Could Be the One-Stop Shop

IBM's open-licensing program is off to a fairly slow start, with only one synthesizable processor core and some related soft IP. But when IBM rolls out more processors and eventually opens up the Blue Logic library, it could radically change the competitive landscape by offering a larger selection of IP and services than any other vendor.

Today's leading vendors of licensable 32-bit microprocessor cores are ARM and MIPS. Compared with IBM Microelectronics, both are relatively small companies, and both focus almost exclusively on processors. Their customers must go elsewhere to license the peripheral IP—such as Ethernet, USB, and wireless baseband controllers—commonly

integrated into modern ASICs and SoCs. In addition, ARM and MIPS are fabless, so their customers must seek manufacturing services from an independent foundry. The same things are true for smaller IP vendors such as Tensilica. One exception is ARC International, which strives to be a single source for 32-bit processor cores, popular peripheral IP, system software, and software-development tools. ARC does a reasonably good job but is stretching its limited resources to support an extensive product line.

Although the popularity of on-chip buses such as AMBA and CoreConnect make it easier to integrate IP from different sources, developers may have to deal with multiple IP vendors, integrate the various cores into their design, and verify that everything works together. One hidden bug or incompatibility can disrupt the whole project and force developers to respin the silicon, which costs money and delays the product's time to market.

As development risk becomes a greater deterrent for companies that need custom chips to gain a competitive edge, they are increasingly looking for simpler, almost turnkey, alternatives. Instead of dealing with multiple IP vendors and the resulting coverification headaches, they often prefer to license as much IP as possible from a single reliable source. IP components that are preverified to work together can save significant amounts of time and money in a project. If the source of that IP could also offer experienced design services, software-development expertise, and even a world-class foundry, chip developers might flock there.

Price & Availability

A synthesizable Verilog model of the PowerPC 440 microprocessor core will be available in 2Q03, followed by a VHDL version in 3Q03. An optimized hard core is scheduled for release in 2H03. IBM will announce the availability of other PowerPC cores later this year and will work with customers that need early access to hard versions of the cores. One-time and unlimited design licenses are available. IBM is not publicly disclosing up-front license fees or chip royalties. For more information, visit the IBM Microelectronics Web site at www.ibm.com/chips/.

That's how IBM can differentiate itself from other IP vendors. If IBM decides to fully commit its considerable resources to this line of business, it could offer a breadth of IP, services, and technology unmatched in the industry.

Of course, IBM's offerings rarely come cheap, which leaves room for other vendors to compete. And rival microprocessor architectures are already entrenched in some lucrative product categories that PowerPC probably won't penetrate. (For instance, ARM has a solid grip on mobile phones.) However, by skimming off the best-heeled customers in markets that are still in play, IBM has an opportunity to build a profitable licensing business while propagating the PowerPC architecture. ♦

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