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CORTEX-A8 BALANCES POWER, PERFORMANCE

ARM's Fastest Processor Wins Award for Best Processor-IP Core of 2005

By Tom R. Halfhill {1/30/06-07}

Years from now, the industry may remember 2005 as the pivotal year when ARM began extending its reach from low power to high performance. In any event, we believe ARM's fastest processor to date—the Cortex-A8—deserves our *MPR* Analysts' Choice Award for Best Processor-IP Core of 2005.

The Cortex-A8 is ARM's first superscalar processor core, and it's the first ARM processor capable of attaining clock frequencies in the gigahertz range. It's the biggest departure in processor design for ARM since the company was founded in 1990, after spinning off from Acorn Computer. For 15 years, ARM has specialized in licensing small, relatively simple embedded-processor cores that emphasize low power consumption over high throughput. It's a successful formula that has made ARM the industry leader in licensable intellectual-property (IP) processor cores for chip integration.

Although low-power processors remain ARM's strength, the Cortex-A8 branches out in a bold new direction. The Cortex-A8 is the first implementation of the 32-bit ARMv7 instruction-set architecture (ISA). Two-way superscalar pipelines, 13 stages deep, give the Cortex-A8 bigger muscles and faster reflexes. ARM's new Neon extensions provide additional acceleration for data-intensive media tasks. The Thumb-2 subset of 16-bit instructions preserves the high code density so important to embedded-system developers. New Jazelle RCT extensions improve Java performance, especially with just-in-time (JIT) compilers.

At the same time, ARM isn't abandoning its penchant for stingy power consumption. The Cortex-A8 employs several techniques to conserve energy, including power-efficient logic, dynamic voltage/frequency scaling, extensive clock gating, low-leakage physical-IP libraries, and a synthesizable model that has some hand-tuned critical paths. In every way, the Cortex-A8 carefully balances high throughput with power efficiency. ARM says the Cortex-A8 can hold power consumption to 300mW or less while running at 600MHz. (See our two-part coverage in *MPR 10/25/05-02* and *MPR 11/14/05-01*, "Cortex-A8: High Speed, Low Power.")

ARM is moving toward higher performance because vital markets for ARM processors demand it. Cellphones are the primary driving force. Next-generation cellular handsets will integrate a staggering array of compute-intensive functions, such as streaming audio and video, live video capture, broadband Internet access, and fast-action games. ARM must find ways to deliver more processing power without seriously eroding battery life. The Cortex-A8 is designed to enrich cellphones and other portable devices with the kinds of applications that formerly required a beefy PC.

Most Nominees Are More Specialized

Other embedded-processor cores we considered for this year's award were Elixent's D-Fabrix v2.0 Reconfigurable Algorithm Processor, MIPS Technologies' MIPS32 24KEc Pro general-purpose processor with DSP extensions, Philips Semiconductors' TriMedia TM3270 media processor, Silicon Hive's Avispa-IM1 pixel-processing engine, Silicon Hive's Avispa-CH1 wireless communications engine, the Videantis v-MP2000M mobile video coprocessor, and the Videantis v-MP2000HD high-definition video coprocessor.

For More Information

For our analysis of the most important embedded-processor events of the past year, with links to dozens of relevant *MPR* articles, see *MPR 1/30/06-02*, "Embedded Processors Thrive in 2005." For our specific coverage of the Cortex-A8, see *MPR 10/25/05-02* and *MPR 11/14/05-01*, "Cortex-A8: High Speed, Low Power."

All are great products that received detailed *MPR* coverage in 2005.

Note that most of the nominees are specialized cores, not general-purpose embedded-processor cores like the Cortex-A8 and MIPS32 24KEc Pro. And a few of them (especially the Elixent and Silicon Hive processors) have exotic architectures. We believe there are two reasons for this specialization. First, ARM enjoys such a strong market position that fewer companies are willing to challenge ARM's processors directly. In particular, it's easier for startups like Videantis to raise funding if they're addressing a market niche not dominated by ARM or another major company.

The second reason for the lack of new general-purpose embedded-processor cores was that two of ARM's direct competitors—ARC International and Tensilica—were comparatively quiet in 2005. ARC introduced a new line of preconfigured processors, but they are based on the ARC 600 and ARC 700 cores announced in 2003 and 2004. Tensilica announced the Xtensa 6 near the end of the year, but it's a relatively minor variation of the Xtensa V and Xtensa LX cores announced in 2002 and 2004. The MIPS32 24KE family is an enhancement of the MIPS32 24K family with some new DSP extensions.

ARM provided five leading licensees (including Freescale, Matsushita, Samsung, and Texas Instruments) with early access to the Cortex-A8 and delivered the latest synthesizable models and design tools in December. Actual work on the first Cortex-A8 chips began several months ago, concurrent with ARM's core development. The first silicon could appear later this year or early in 2007. If the Cortex-A8 lives up to its promises, it will move ARM into a new realm—one that should worry ARM's competitors.