

NEC R4111 Boosts Speed of Windows CE

Latest Integrated MIPS Chip Increases Speed and Caches, Lowers Power

by Jim Turley

NEC is maintaining a constant stream of new embedded microprocessors, and the latest out of the chute is a new MIPS chip to boost the performance of Windows CE units and other handheld devices. The new R4111 is a pin-compatible upgrade for the R4102 that boosts performance by a third while consuming less power than its predecessor.

By using a leading-edge 0.25-micron process, the chip boosts clock speed from 66 MHz to 80 or 100 MHz; it is also the first chip from NEC to use the MIPS-16 code-compression hardware. The part's lower power consumption and its 16-bit code option should make it attractive to makers of high-end handheld devices such as digital cameras, GPS receivers, and wireless "smart phones."

The new chip is priced at \$29 in 10,000-unit quantities; in typical NEC fashion, the new chip is priced about the same as the part it replaces. Accordingly, the list price of the R4102 is expected to drop to about \$20 when the R4111 enters production early next year.

Caches Grow; Core and Peripherals Hold Still

To get some mileage out of the higher clock rate, the R4111 enlarges the R4102's 4K/1K instruction/data caches to 16K and 8K, respectively.

Like the R4102, the R4111 includes much of the logic needed for a self-contained handheld computer, with a 32-bit DRAM interface, PCMCIA controller, serial and IrDA interfaces, A/D and D/A converters, and a keyboard controller, among other features. For a handheld PC system, such as NEC's own MobilePro, an LCD controller is the only significant logic required.

The R4111 shares the same basic 64-bit MIPS core as NEC's other R41xx chips, including the MAC (multiply-accumulate) unit that improves performance on modem emulation. Except for supply voltage, the R4111 is pin-compatible with the R4102, which should permit easy upgrades from the earlier processor. These chips replace the earlier R4101 (see MPR 7/8/96, p. 4), which is still in production, and the original R4100, which is no longer available.

Power Drops With Voltage

At 80 MHz, the part consumes 140 mW (typical); at 100 MHz, consumption increases to 180 mW. These minute levels place the R4111 on an even footing with many 16-bit microcontrollers. Only a very few 32-bit chips can approach these levels. Hitachi's SH7708, for example, consumes 95 mW from its 3.3-V supply, but at just 25 MHz, its performance isn't much of a match for the R4111's.

Positioned slightly above the R4111 is Digital's SA-1100 (see MPR 9/15/97, p. 1), an all-in-one controller for PDAs and similar handheld devices. At its slowest 133-MHz speed, the SA-1100 consumes 200–330 mW. If both companies are to be believed, the two devices are about equal in terms of power efficiency. Both chips use dual power supplies, one for the core and another for the pad ring.

With identical cache partitioning and roughly similar pipelines and instruction sets, the relative performance of the R4111 and the SA-1100 should be a function of their clock rates: at 200 MHz, the StrongArm chip is roughly twice as fast. The SA-1100 also has more on-chip features than the R4111, including a color LCD controller, that make the Digital chip more valuable.

First Embedded CPU at 0.25 Microns

The R4111 achieves its low power levels from its 2.5-V power supply. The 2.5-V logic level is, in turn, due to NEC's use of its newest 0.25-micron fabrication process, similar to the one used for the newest R10000 processor (see MPR 10/6/97, p. 5). This is the first time NEC—or any vendor—has employed 0.25 micron geometry for an embedded microprocessor. The MDR Cost Model projects an estimated manufacturing cost of \$14 for the 42-mm² R4111.

NEC has consistently used its leading-edge fab processes for embedded processors. The R4300 was built on 0.35-micron lines in 1995, allowing NEC to produce great quantities of this part for Nintendo (and, since then, for other customers) with the least amount of silicon. The R4101 and R4102 are also built on 0.35-micron processes in order to achieve their power efficiency.

Some companies relegate their embedded chips to older, more amortized fabs to lower production cost; others take the opposite approach, striving for the best performance and hoping that high production volumes will eventually defray the cost. NEC has consistently followed the latter strategy with its MIPS line. The R4111 is just the latest development in this strategy, which so far has been paying off well for the company. ☐

Price & Availability

NEC's VR4111 is sampling now; production is scheduled to begin in 1Q98. In 10,000-unit quantities, the 80-MHz chip is priced at about \$25; the 100-MHz version will list for about \$29. For more information, contact NEC (Santa Clara) at 800.366.9782 or www.nec.com.