IDT Expands Embedded MIPS Family

New RC64574 and '575 Bridge IDT's 64-Bit RISC Cores

by Tom R. Halfhill

Broadening its range of 64-bit embedded processors, IDT is sampling two new MIPS-compatible chips based on the high-performance RC5000 core. The new RC64574 and '575 extend that core in many of the same ways that IDT's RC64474 and '475 extended the 64-bit RC4700 core last year (see MPR 10/5/98, p. 10).

Improvements over the RC5000 include lower power consumption, a higher clock rate, a simplified bus, cache locking, a JTAG interface, better support for SDRAM, additional instructions for digital-signal processing, and smaller packages with fewer pins. One tradeoff, however, is that the new processors lack a secondary-cache interface, so they'll probably deliver less performance in some applications than an RC5000, even at higher clock frequencies.

All of IDT's 64-bit embedded processors are based on two cores: the single-issue RC4000 (MIPS-III ISA) and the dual-issue RC5000 (MIPS-IV ISA). The new '574 and '575 chips combine an RC4650-style bus with an RC5000 core to span both branches of the family. Think of them as higher-performance upgrades from their similarly named and pin-compatible '474 and '475 cousins, or as lower-cost, lower-power alternatives to the RC5000.

More Room on the Bus

As Table 1 shows, the '575 is slightly faster than the '574, thanks to its 333-MHz maximum clock rate and 64-bit bus (which also has a 32-bit mode). The '574, in contrast, has a 32-bit bus and a maximum frequency of 300 MHz.

Otherwise, the two processors are virtually identical. Each has an integer pipeline, a floating-point pipeline capa-

ble of executing one double-precision or two single-precision operations per cycle, a 32K instruction cache, a 32K data cache (both lockable by line and two-way set-associative), and a 96-page translation lookaside buffer.

IDT bumped up the clock speeds by porting the core to a 0.25-micron process. (RC5000 processors, however, remain at 0.35 micron.) The '574 runs at 200, 250, or 300 MHz, while the '575 runs at 250, 300, or 333 MHz. At its maximum clock rate, the '575 can execute 440 Dhrystone 2.1 MIPS, 666 MFLOPS, or 111 million multiply-accumulate (MAC) instructions per second.

Due to a lower core voltage (2.5 V, with 3.3-V-tolerant I/O), the new chips consume only 4 W at their top frequencies, compared with 8 W for an RC5000 at 300 MHz. IDT will offer the '574 in a 128-pin PQFP and the '575 in a similar 208-pin PowerQuad package. The '574 is pin compatible with the '474, and the '575 is pin compatible with the '475. IDT (*www.idt.com*) is sampling now and plans to begin production in 4Q99.

At prices ranging from $23 for the 200-MHz '574 to $88 for the 333-MHz '575, the new chips are much less expensive than the pricey 300-MHz RC5000 ($141). On paper, they also look faster than the RC5000, which executes about 400 Dhrystone MIPS or 600 MFLOPS. But without a secondary cache, it's unlikely that the '574 and '575 can sustain their theoretical performance when running real-world software. Dhrystone loops run entirely in the large primary caches of these processors; real programs would exercise the system bus and external memory.

The '574 and '575 are more expensive than similar MIPS-compatible chips from QED and NEC. QED's RM5261 has a 64-bit bus and delivers about the same performance and power consumption as the '574, yet it costs $18 less than the '574 and $40 less than the '575. NEC's VR5432 is even more competitive. Although it has only a 32-bit bus, its wider superscalar core delivers more performance at lower clock speeds, which keeps power consumption and costs low. It's priced at $28 less than the '574 and $58 less than the '575.

IDT's new chips offer a logical upgrade path for existing IDT customers, but developers starting with a clean slate are well advised to shop around. Ⓜ

Feature	RC64574 IDT	RC64575 IDT	RC5000 IDT	RC64474 IDT	RC64475 IDT	RM5261 QED	VR5432 NEC
64-Bit Core	RC5000	RC5000	RC5000	RC4000	RC4000	RM5000	VR5400
Bus Width	32b	32/64b	64b	32b	32/64b	64b	32b
Max Freq	300 MHz	333 MHz	300 MHz	250 MHz	250 MHz	266 MHz	167 MHz
JTAG?	Yes	Yes	No	Yes	Yes	Yes	Yes
I-Cache	32K	32K	32K	16K	16K	32K	32K
D-Cache	32K	32K	32K	16K	16K	32K	32K
Cache Locking?	Yes	Yes	No	Yes	Yes	Yes	Yes
L2 Interface?	No	No	Yes	No	No	No	No
DSP/Media?	Yes	Yes	No	Yes	Yes	Yes	Yes
Pin Count	128	208	272	128	208	208	208
IC Process	0.25µ 3M	0.25µ 3M	0.35µ 3M	0.3µ 3M	0.3µ 3M	0.25µ 4M	0.25µ 3M
Dhrystone 2.1	400 MIPS	440 MIPS	400 MIPS	330 MIPS	330 MIPS	345 MIPS	347 MIPS*
Power (typ)	4 W	4 W	8 W	3 W	4 W	4.2 W	2.5 W
Price (10K)	$58	$88	$141	$59	$68	$48	$30

Table 1. The new RC64574 and '575 are worthwhile upgrades from IDT's own '474 and '475, but they look less competitive against similar processors from QED and NEC. (*MDR estimate)