INTEL EMBEDS COPPERMINE

Embedded Pentium III and Celeron Identical to Mobile Chips

By Tom R. Halfhill {6/12/00-03}

Intel has introduced five embedded processors based on the same 0.18-micron Coppermine die found in most Pentium III and Celeron processors for the desktop and mobile markets. Actually, the embedded versions of the chips are identical to the desktop/mobile processors,

but Intel guarantees longer availability (at least five years) and is signing up more third-party companies to support the parts with system software and development tools.

Three of the new embedded processors are Pentium III designs, and two are Celeron designs. At the high end are a 733MHz Pentium III with a 133MHz system bus and a 700MHz Pentium III with a 100MHz system bus. Both have 256K of on-chip L2 cache and are packaged in 370-contact flip-chip pin grid arrays (FC-PGAs). Both parts also work with Intel's 840 and 440BX chip sets, which support dual processors—just in case an embedded-system developer finds that only one 733MHz CPU isn't powerful enough for the job. The third Pentium III processor runs at 500MHz with a 100MHz system bus and is packaged in a 495-pin BGA.

At the low end (relatively speaking) are a 566MHz Celeron processor in a 370-pin FC-PGA and a 400MHz Celeron processor in a 495-pin BGA. As with their desktop/mobile counterparts, these processors have only 128K of on-chip L2 cache, because half of the cache on the Coppermine die is disabled. The 566MHz embedded Celeron has a 66MHz system bus, as do all desktop Celeron processors. But the 400MHz embedded Celeron has a 100MHz system bus, as does the 400MHz mobile Celeron.

The different bus speeds and cache sizes are the results of Intel's market-positioning decisions, because all the chips use the same die. In the desktop market, Intel prefers to limit the chips intended for consumer PCs to a slower system bus (and a smaller cache) to keep them from cannibalizing higher-margin Pentium III sales. In the mobile and embedded markets, Intel may be willing to let some Celeron processors operate with a faster system bus, because Pentium III needs less protection in those markets—its relatively high power consumption already

Feature	Intel Pentium III	Intel Pentium III	Intel Pentium III	Intel Celeron	Intel Celeron	QED RM7000A
Core Frequency	733MHz	700MHz	500MHz	566MHz	400MHz	400MHz
Bus Frequency	133MHz	100MHz	100MHz	66MHz	100MHz	133MHz
L1 Cache (I/D)	16K/16K	16K/16K	16K/16K	16K/16K	16K/16K	16K/16K
L2 Cache	256K	256K	256K	128K	128K	256K
Core Voltage	1.65V	1.65V	1.35V	1.5V	1.35V	1.8V
I/O Voltage	3.3V	3.3V	3.3V	3.3V	3.3V	2.5–3.3V
Package	FC-PGA	FC-PGA	BGA	FC-PGA	BGA	TBGA
Power (max)	19.1W	18.3W	12W	11.9W	10W	3.5W
IC Process	0.18μ	0.18μ	0.18μ	0.18μ	0.18μ	0.18μ
Dual Processing?	Yes	Yes	No	No	No	Yes
Price (1K)	$337	$316	$198	$93	$75	$175
Introduction	May-00	May-00	May-00	May-00	May-00	3Q00*

Table 1. Intel's new embedded processors are targeted at applications that require very high performance and can tolerate double-digit power consumption. QED's RM7000A offers comparable performance at much lower power levels but won't enter production for a few months. (*QED will also produce a 350MHz version in 3Q00 and a 450MHz version in 4Q00.)

rules it out for many embedded designs. Also, embedded customers wanted the 100MHz bus to accommodate higher memory speeds over the longer life cycles of their products.

Intel is aiming these embedded processors at applications that demand very high performance, such as routers, switches, industrial-grade PCs, high-end transaction terminals, and set-top boxes. A high-speed router is a good example of an embedded application that could use multiprocessing. Table 1 summarizes the features of Intel's new embedded processors and compares them with QED's new RM7000A, which competes for similar design wins.

Intel refers to these chips as "applied computing" processors. Mainly, that means the processors will have longer product lives than the desktop/mobile versions, which tend to slide off the price list in a year or two. Embedded developers generally need longer life-cycle commitments than PC vendors, because their products often take longer to design and don't become obsolete at the same alarming rate.

The power consumption of Intel's new chips ranges from 10W (maximum) for the 400MHz Celeron to 19.1W (maximum) for the 733MHz Pentium III. Although those numbers would be lower if Intel quoted "typical" power-consumption figures, as most other embedded-processor vendors do, they would still be far above the power envelopes embedded developers usually encounter. Intel is doing engineers a favor by quoting maximum power numbers, which allows them to design their embedded systems with those worst-case thermal characteristics in mind.

Five operating-system vendors have joined Intel's applied-computing platform-provider program: Microsoft, LynuxWorks, QNX, VenturCom, and Wind River. Ten other companies already belong to the program, which provides third-party support in the forms of system software, development boards, and development tools. ◇