Intel Updates Its iCOMP Index

Preparing for Klamath, New Version Emphasizes 32-Bit Code and Multimedia

by Linley Gwennap

As it prepares to launch two major new products over the next several months, Intel has revamped its in-house performance metric. To compare the performance of its processors, the vendor now uses the new iCOMP 2.0. For those familiar with the previous version, the most obvious change is the scaling: a 120-MHz Pentium is rated at 100 on the new scale versus 1,000 on the old one.

The iCOMP index has always been a marketing tool for Intel; no other microprocessor vendor has adopted it. Intel created the original version *(see* **061302.PDF** *)* to help PC buyers understand that a 33-MHz 486 is significantly faster than a 33-MHz 386, despite the similarity in clock speeds. The new version will show that a 200-MHz P55C delivers better performance than a 200-MHz Pentium, and a 200-MHz P6-family processor is even better.

To achieve these goals, Intel has made two significant changes to the composition of iCOMP. To emphasize the impact of P55C's MMX enhancements, Intel added a multimedia component of its own design. Second, Intel removed all 16-bit code from the test suite, benefiting Pentium Pro. Both changes will improve the score of Klamath, a P6-family processor with MMX due to appear early next year.

Emphasis on 32-bit Code

The iCOMP rating is a synthesis of results from several benchmarks. The score for a particular processor is the weighted geometric average of the individual benchmarks. Table 1 compares the benchmarks and their weights from the original index and the new version.

The original index consisted of 70% 16-bit code (PC Bench and Whetstone), reflecting Intel's focus on the 16-bit Windows 3.x operating system and its applications. With the advent of Windows 95 and the Win32 API, however, the PC market is moving to 32-bit code. Thus, the new index consists entirely of 32-bit benchmarks. Unfortunately, Windows 95 still contains a significant amount of 16-bit code. Although Pentium has no problems with either 16- or 32-bit code, the P6 core performs relatively poorly on 16-bit code *(see* **091001.PDF** *)*.

iCOMP Index		iCOMP Index 2.0	
Benchmark	**Weight**	**Benchmark**	**Weight**
PC Bench 7.0.1	68%	CPUmark32	40%
		Norton SI32	15%
SPECint92	25%	SPECint95 (base)	20%
SPECfp92	5%	SPECfp95 (base)	5%
Whetstone	2%	Intel Media Benchmark	20%

Table 1. Changes in benchmark weightings include replacing the 16-bit PC Bench with the 32-bit CPUmark32 and Norton SI, as well as adding a multimedia benchmark. (Source: Intel)

Thus, the shift to pure 32-bit benchmarks in iCOMP 2.0 overstates the performance gains a typical PC user will see using Windows 95 on P6 processors. Intel's own tests show a 200-MHz PPro is only 55% faster than a Pentium-120 when running 32-bit applications under Windows 95. The iCOMP 2.0 index, in contrast, implies the performance difference between the two parts is 120%. Intel notes the new index reflects performance in the purely 32-bit environments that will become common in 2–3 years.

SPEC Benchmarks Boost P6 Scores

In revising the index, Intel moved from the obsolete SPEC92 benchmarks to the newer SPEC95 suite *(see* **091102.PDF** *)*. We applaud Intel for choosing to use the baseline SPEC95 metrics instead of the peak forms, rejecting the excessive compiler tuning of the latter.

The SPEC tests are recompiled for the target platform, as opposed to CPUmark32, which is a binary benchmark. Recompilation helps Pentium Pro; as Figure 1 shows, CPUmark32 and SPECint95 track very closely for Pentium, but for Pentium Pro, Intel's compilers deliver a 13% performance advantage on SPECint95. This data implies that recompiling integer code for the P6 using the most advanced compiler technology will provide roughly a 13% performance gain over code compiled for Pentium.

Users who do not recompile their code, however, will not see this performance gain unless they buy new applications that are optimized for the P6. Today, most applications are optimized for Pentium or even the 486, which is where the installed base is. Over time, more software vendors will target the P6, but this change will occur slowly.

Including the SPECfp95 metric also helps Pentium Pro relative to Pentium. In this case, the P6 core's faster floating-point unit carries a real performance advantage. This metric is weighted at only 5%, so it doesn't have a big effect on the overall iCOMP score. For typical PC users today, floating-point performance has virtually no impact. In the future, FP will become more important because of its effect on 3D geometry calculations, which are critical for emerging 3D-graphics applications *(see* **100103.PDF** *)*.

Measuring Multimedia Performance

A critical problem with all currently popular PC benchmarks is that they do not measure multimedia performance. Thus, the impact of Intel's MMX extensions is completely overlooked by these conventional tests. MMX has a clear performance benefit on multimedia applications, so Intel has created a set of tests to measure this benefit.

The Intel Media Benchmark consists of four components—video, audio, imaging, and 3D—that are combined using a weighted geometric average. The video component, which has a 40% weight, implements MPEG-1 video decompression. The audio component, weighted at 25%, consists of MPEG-1 audio decompression. It also includes sample-rate conversion, special effects, and stereo mixing.

The imaging component, which represents applications such as Photoshop, carries a small 5% weight, indicating a relatively low percentage of users for this type of work. The benchmark applies various digital filters to images in 24-bit color. The remaining 30% is allocated to 3D. This component measures only 3D geometry, not rendering, and uses both the Direct3D and OpenGL APIs.

While other benchmarking organizations (Bapco, Ziff-Davis, and SPEC) scurry to develop multimedia benchmarks, Intel has created its own by fiat. Without an open definition process, however, the Intel multimedia benchmark won't be a credible competitor to forthcoming tests from any of these benchmarking groups.

High-End System Configurations

A processor must, of course, be benchmarked in a system. Intel generates its iCOMP ratings using high-end system configurations that maximize the results, particularly for the faster processors. The results in Figure 1 were generated using systems with 64M of EDO memory, a Quantum Fireball hard disk, and a Matrox Millennium graphics card. The Pentium systems use a 430VX chip set and 512K of pipelined burst cache; the Pentium Pro systems rely on the integrated 256K L2 cache and the 440FX chip set.

The results range from 67 for a Pentium-75 to 142 for the new Pentium-200. A PPro-150 is conveniently rated at 168, 18% better than the fastest Pentium, while the scale tops out at 220 for the PPro-200. Intel did not provide results for the PPro-166 or PPro-200 with 512K of L2 cache, as these are aimed at servers only.

As the current results do not include the forthcoming P55C, we don't know how much difference the MMX extensions will make on the multimedia tests, but it can make a significant difference on certain types of applications *(see* **100301.PDF** *)*. The new iCOMP, along with the pipeline improvements in the P55C, should allow Intel to position that chip as a step up from the current Pentium, probably overlapping the PPro-150. Similarly, the addition of MMX should increase the iCOMP rating of the future Klamath-200 slightly beyond that of the PPro-200.

For More Information

Contact your local Intel sales office or access the Web at *www.intel.com/procs/perf/icomp* for a complete list of iCOMP 2.0 ratings, a white paper on iCOMP 2.0, and the code for the Intel Media Benchmark.

Benchmarketing for the Unsophisticated

During the three years Intel has used iCOMP, the index has been of some value to PC buyers and unsophisticated reporters trying to assess the relative performance of various processors. Intel provides retailers with handy charts that summarize the ratings, but these are posted only sporadically. Mainly due to Intel's unwillingness to include them in the definition process, no other x86 vendors have published iCOMP ratings for their processors, focusing instead on industry-standard benchmarks such as Winstone.

Any single number is, of course, inadequate for describing the performance of a microprocessor under a range of applications, as Figure 1 dramatically demonstrates for Pentium Pro. Intel's iCOMP is particularly suspect because the vendor has crafted the index to reflect its own marketing need: emphasizing the performance of its newest, most expensive products. It may be only a slight exaggeration to say that Intel started with the iCOMP line shown in Figure 1 and created a metric to produce those results.

In particular, iCOMP 2.0 reflects the performance of Pentium Pro in a hot box on pure 32-bit code that includes a significant chunk recompiled specifically for the new core. This may very well be the scenario in two or three years, but users running typical 32-bit applications under Windows 95 will see a much smaller performance increase from Pentium Pro. For P6 processors, iCOMP 2.0 represents performance on some set of future applications but not on today's. M

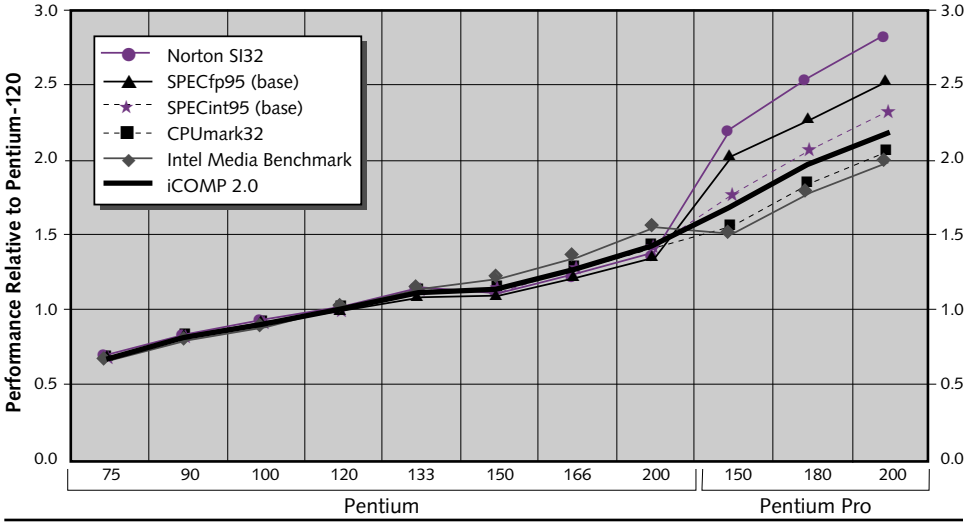

Figure 1. The results of five benchmarks track closely for various Pentium processors, but the data diverges for Pentium Pro. The iCOMP 2.0 rating is a weighted average of the five. (Source: Intel)