The Next Generation

Intel Prepares To Unleash Haswell

Intel's processor releases follow a well-established pattern consisting of a two-stage cycle. In the first stage, the company launches a CPU based on an existing microarchitecture, but using a new, smaller manufacturing process. Then in stage two, Intel pairs that manufacturing process with a new microarchitecture. Intel refers to this pattern as "the tick-tock model."

When Intel combined the microarchitecture from its "Sandy Bridge" chips with its 22-nanometer manufacturing process and introduced its new 3D tri-gate transistors, the result was the company's 3rd Generation Core processors, including the high-end Core i7-3770K.

Tick.

Now Intel's Oregon design team is ready to take the next step, a family of processors that take advantage of the same 22nm process and ultra-efficient, high-performance 3D transistors, but with a new microarchitecture design. These new chips will provide even greater CPU performance and use even less power, and in addition will dramatically raise the bar for processor graphics.

Tock.

TICK / TOCK

Tick/Tock Development Model

45nm Process Technology	32nm Process Technology		22nm Process Technology	
Nehalem	Westmere	Sandy Bridge	Ivy Bridge	Haswell
NEW Intel® Microarchitecture (Nehalem)	Intel Microarchitecture (Nehalem)	NEW Intel Microarchitecture (Sandy Bridge)	Intel Microarchitecture (Sandy Bridge)	NEW Intel Microarchitecture (Haswell)
TOCK	*TICK*	*TOCK*	*TICK*	*TOCK*

Haswell CPU
22nm Process Techology

Haswell builds upon innovations in the 2nd and 3rd Generation Intel® Core™ i3/i5/i7 Processors (Sandy Bridge and Ivy Bridge)

The Story So Far

Intel shared some exciting glimpses of its next CPU family, code-named "Haswell," at its Intel Developer Forum in the fall, and the future looks bright. The new chip design is packed with features designed to make Haswell the most versatile, efficient Intel processor to date, including the following items:

THE NEXT GENERATION OF INTEL HD GRAPHICS. Haswell processors will be equipped with three Intel HD Graphics variants, based on market segment, usage models, and other factors. Much as the previous generation's Intel HD Graphics 4000 component obviated the need for entry-level discrete graphics cards, Haswell's high-end graphics component will make mainstream graphics cards redundant.

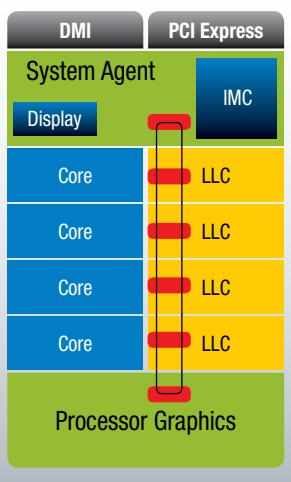
Haswell processors will support the DirectX 11.1, OpenGL 4.0, and OpenCL 1.2 APIs, and will provide improved gaming performance over 3rd Generation Intel Core processors (by as much as 2x) at higher resolutions and increased quality settings. Haswell will also provide faster video encoding through Intel Quick Sync Video, as well as faster JPEG and MJPEG decodes, and a slew of other image- and video-enhancement technologies.

Haswell-equipped systems will also support 4K resolution, either via a single 4K display or four monitors in Collage Mode. Native triple-display support will also be a standard Haswell feature.

INTEL AVX2 AND FMA INSTRUCTION SETS. Intel Advanced Vector Extensions 2 is a new instruction set that gives Haswell processors higher performance when working with high-performance computing, audio and video content, and games. The FMA (fused multiply-add) instruction set provides improved accuracy and performance, adding up to 2x FLOPs per cycle over previous-generation processors.

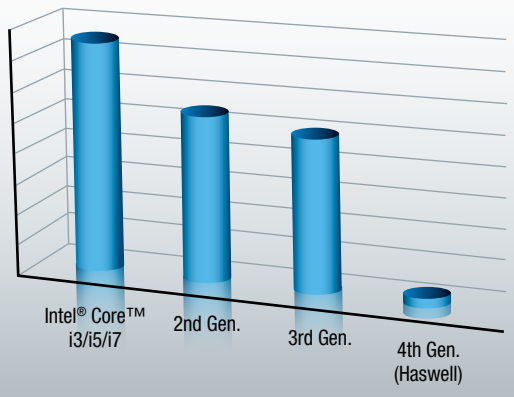
HIGHER CACHE BANDWIDTH, LOWER LATENCY. Haswell's microarchitecture includes a shared LLC (Last-Level Cache), where each core has its own addressable slice, and a unidirectional ring interconnect connecting the cores, Processor Graphics, and the System Agent. This is similar to Sandy Bridge, but with one vital difference: this generation of Intel Core processors will benefit from 64-byte core cache lines, resulting in twice the per-cycle bandwidth vs. the Sandy Bridge microarchitecture.

Cache, Interconnect, and System Agent: Haswell Innovations



Maximizing Battery Life

CPU Idle Power
(High volume mobile CPUs)



HIGHER EFFICIENCY. Haswell's new microarchitecture is designed to provide significantly higher performance per core, but that's only part of the equation. With the increasing emphasis throughout the computing world on using less power—not to mention the need to extend battery life in notebooks and mobile devices—efficiency is becoming every bit as important as performance. And Haswell is ready to answer the call.

Haswell processors will have much deeper idle states, with greater emphasis on turning off idle portions of the chip, even when the display is active. In fact, early tests show that Haswell will use as much as 20x less idle power than Intel's 3rd Generation processors, and will transition to idle-state power usage up to 25% faster.

One Core Fits All

The Haswell microarchitecture is designed from the ground up to be incredibly flexible; its core design is a fit for everything from tablets and notebooks to desktops, workstations, and servers. As such, Haswell parts with varying wattage requirements, cache sizes, and core counts will be available, making it possible for you to enjoy their many benefits in all of your computing devices. ■