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Intel looks beyond silicon for processors past 2017

Intel CEO Paul Otellini says that silicon will last for three more generations of processors, when it will be replaced by a new and “very cool” base material.

Silicon has been the foundation of the processor ever since the processor was invented – and before that, stretching back to the early days of the discrete transistor in 1954.

That’s over 50 years as the magic ingredient of modern electronics and the not-so-secret sauce of the digital era.

But silicon’s days are numbered, at least when it comes to microprocessors, says Intel.

Speaking at San Francisco’s Web 2.0 Summit last week, Intel CEO Paul Otellini said that silicon was in its last decade as the base material of the CPU.

Otellini forecast that Intel would produce “three more generations” of silicon processors before shifting to a new semiconductor material.

Given that Intel’s ‘tick-tock’ model sees a new microarchitecture every two years – and starting at the current 45nm ‘Nehalem’ silicon microarchitecture, which will be followed by 32nm (‘Sandy Bridge’) in 2011, then 22nm (Haswell) in 2013 and 16nm (codename unknown) in 2015 – then Otellini’s talking about the first wave of non-silicon processors kicking off by 2017.

Otellini said that chips based on these new materials are already up and running in Intel’s labs, but he held back on revealing what materials and technologies these are, saying only that “It’s very cool.”

Intel has long been directing large amounts of its already-substantial R&D budget – which is estimated at US\$5 billion per year – towards new ‘post-silicon’ materials and the associated manufacturing techniques.

These include indium antimonide, a ‘compound semiconductor’ which Intel reports as clocking at 1.5x the speed of silicon transistors while drawing one-tenth of the power; optical ‘circuits’ which could lessen the reliance on relatively slow physical circuitry such as copper; as well as carbon nanotubes and semiconductor ‘nanowires’.

Intel is investigating what it terms ‘3D transistors’, which allow current to be controlled on three sides instead of passing through just one gate, to effectively triple the processing power.

Mind you, there’s still plenty of juice left in the current silicon architecture.

The first 32nm Sandy Bridge chips of 2011 are expected to hit 4GHz with four to eight cores (no more dual-core processors) with the CPU and GPU on a single die, making this Intel’s first mainstream ‘SoC’ (System On a Chip)

platform.

Advanced design and temperature monitoring will enable a new 'Dynamic Turbo' which allows the CPU to exceed the total thermal ceiling by 20-30% for brief periods of a few minutes.

And the 22nm Haswell platform is expected to have upwards of eight cores and possibly even include an on-die evolution of Intel's multi-core x86 Larrabee graphics.