Triple fillip for Moore 's Law

Breakthroughs claimed for smaller and faster silicon chips for decades to come

IN A week of extraordinary developments, three American technology players, have made separate but complementary announcements of research breakthroughs that could ultimately lead to a new generation of silicon semiconductors chips — smaller, faster, cooler and cheaper than anything the world has known so far.

Together the three claims — from Hewlett Packard, Intel and IBM — end up giving a new lease of life to what is popularly known as 'Moore's Law': the chip industry's most famous empirical formula, first articulated 42 years ago by Intel co-founder and current Chairman Emeritus, Gordon Moore.

It suggested that, semiconductor chips will double the number of transistors they hold, approximately every 18 months to two years.

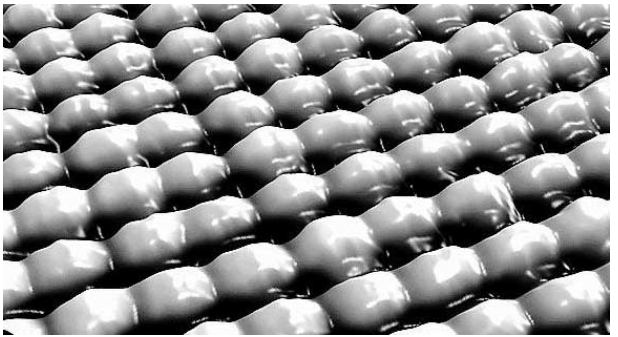
That is why the world's first ever microprocessor, the Intel 4004, held 2000 transistors when it was launched in 1971... and why its latest chip — the Core 2 Quad processor, unveiled on January 8 this year holds more than 580 million.

But with so much cramming of components, the industry had feared that it would soon hit a physical wall: the individual devices would overheat and 'short' by touching each other.

Three separate claims

In the January 24 issue of *Nanotechnology* magazine published by the (British) Institute of Physics, HP Labs researchers Greg Snider and Stan Williams announced research results that could see chips that one can programme even after installing them (called Field Programmable Gate Arrays or FPGAs), carry up to 8 times as many devices on board.

The technique described is inspired: Think of the interconnecting elements as roads linking houses in a colony. Why not place the roads on a separate layer on top of all the houses? That way the houses could be packed even more closely. The interconnects are achieved by placing a 'crossbar' of nanowires on top of the devices... something that the authors say can be achieved as early as 2010, using today's 'hot' nanotechnology.



SMALLER, SMARTER: *This undated handout image provided by Hewlett Packard shows a crossbar switch structure, which is about a third the size of wires used in today's chips.* – PHOTO: AP

Intel, in its announcement on January 27, addresses another challenge posed by adding more and more transistors on a chip: the material used to insulate the transistors from each other — silicon dioxide — is today, so thin that electric current seeps through, creating heat rather than doing faster calculations. The company says it has found a new, less leaky material (said by experts to be hafnium) to replace silicon dioxide.

This has allowed the chip making leader to further reduce the gap from today's 65 nanometres to 45 nanometres in the second half of 2007, when it launches its next generation of chips codenamed Penryn.

A nanometre is a billionth of a metre. A human hair is about 90,000 nanometres thick.

As early as 12 December 2006, IBM had announced work on similar lines (in partnership with the 'other' chip maker, AMD). And news agencies last week, reported that the company has come out with a quick statement that it too, was on the verge of a breakthrough in less leaky insulation layers, using the same material than Intel is said to have used.

Between them the three teams appear to have removed a major road block on the technology path suggested by Moore's Law... the inevitable limit on how close one can pack devices on a silicon slab and expect them to work as an electrical circuit, without violating the laws of Physics.

Money earners

This does not mean that efforts to move beyond electromagnetics to tap new technologies like optical or neural computing units will fade away...they will probably be pursued at a more leisurely pace.

But it does mean that the huge investments made by the $ 250 billion global chip industry in today's silicon-based fabrication plants will be money earners for at least another decade or two, leading inevitably to cheaper end-products for the consumer.

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