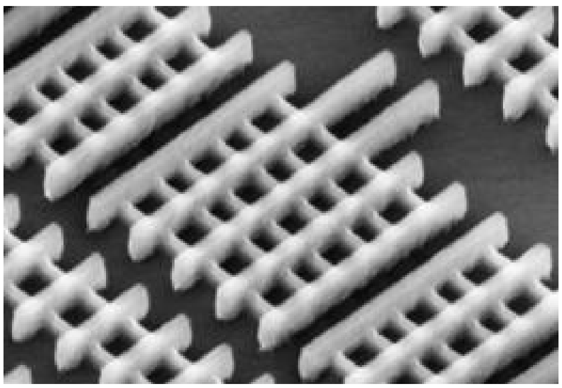
Intel redesigns transistors for faster computers

May 4 2011, By JORDAN ROBERTSON , AP Technology Writer



22nm Transistor. This image shows the vertical fins of Intel's revolutionary tri-gate transistors passing through the gates.

Intel Corp. said Wednesday that it has redesigned the electronic switches on its chips so that computers can keep getting cheaper and more powerful.

The switches, known as transistors, have typically been flat. By adding a third dimension - "fins" that jut up from the base - Intel will be able to make the transistors and chips smaller. Think of how skyscrapers address the need for more office space when land is scarce.

The company said the new structure will let chips run on less power. That gives Intel its best shot yet at cracking the growing markets for chips used in smartphones and tablet computers. Intel has been weak there because its current chips use too much power.

Chips with the 3-D transistors will be in full production this year and appear in computers in 2012.

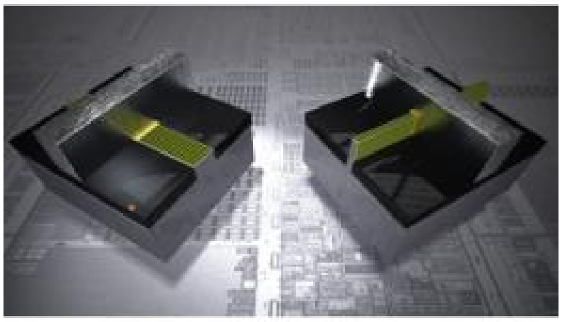
Intel has been talking about 3-D, or "tri-gate," transistors for nearly a decade, and other companies are experimenting with similar technology. The announcement is noteworthy because Intel has figured out how to manufacture the transistors cheaply in mass quantities.

Transistors are at the center of the digital universe. They're the workhorses of modern electronics, tiny on/off switches that regulate electric current. They're to computers what synapses are to the human nervous system.

Transistors operate in the shadows, but they're integral to daily life. And they need to shrink, so that computers can get smaller and smarter.

A chip can have a billion transistors, all laid out side by side in a single layer, as if they were the streets of a city. Chips have no "depth" - until now. On Intel's chips, the fins will jut up from that streetscape, sort of like bridges or overpasses.

However, Intel's advance doesn't mean it can add a whole second layer of transistors to the chip, or start stacking layers into a cube. That remains a distant but hotly pursued goal of the industry, as cubic chips could be much faster that flat ones while consuming less power.



An illustration of a 32nm transistor compared to a 22nm transistor. On the left side is the 32nm planar transistor in which the current (represented by the yellow dots) flows in a plane underneath the gate. On the right is the 22nm 3-D Tri-Gate transistor with current flowing on 3 sides of a vertical fin.

The demand is there for smartphones that deliver the Internet in our pockets, supercomputers that beat human champions at "Jeopardy!," and other feats of computer wizardry that would have been impossible in the 1970s. Processors then could only hold several thousand transistors. Today they hold billions.

The latest change isn't something that consumers will be able to see because it happens at a microscopic level. But analysts call it one of the most significant shifts in silicon transistor design since the integrated circuit was invented more than half a century ago.

"When I looked at it, I did a big, `Wow.' What we've seen for decades now have been evolutionary changes to the technology. This is definitely a revolutionary change," said Dan Hutcheson, a longtime semiconductor industry watcher and CEO of VLSI Research Inc., who was briefed ahead of time on Intel's announcement.

For consumers, the fact that Intel's transistors will have a third dimension means that they can expect a continuation of Moore's Law. The famous axiom, pronounced in 1965 by Intel co-founder Gordon Moore, has guided the computer industry's efforts and given us decade after decade of cheaper and more powerful computers.

The core of Moore's prediction is that computer performance will double every two years as the number of transistors on the chips roughly doubles as well. The progress has been threatened as transistors have been shrunken down to absurd proportions, and engineers have confronted physical limitations on how much smaller they can go. Controlling power leakage is a central concern.

For Intel, which is based in Santa Clara, Calif., the change is a reminder of its leadership in advanced semiconductor technology and its incentive to keep Moore's Law alive.

Previous major changes have focused on new materials that can be used for transistors, not entire redesigns of the transistors themselves.

"People have been trying to avoid changing the structure," Hutcheson said.

Other semiconductor companies argue that there's still life to be squeezed from the current design of transistors. Hutcheson agrees, but said Intel's approach should allow it to advance at least a generation ahead of its rivals, which include IBM Corp. and Advanced Micro Devices Inc.

The reduced power consumption addresses a key need for Intel.

The performance expectations and power requirements for PCs are much higher than they are for phones and tablet computers, so Intel's dominance in PC chips doesn't necessarily lead to success in mobile devices. Even Intel's Atom-based chips, which are designed for mobile devices, have been criticized as too power hungry.

The new technology will be used for Intel's PC chips and its Atom line.

Technological leadership alone won't guarantee success, however, as Intel has learned in repeated attempts at cracking the mobile market.

Other chip makers such as Qualcomm Inc. and Texas Instruments Inc. have entrenched partnerships with cellphone makers, and there is suspicion about the performance of Intel's chips in mobile devices.

"When it comes to the mobile market, they have their work cut out for them," Hutcheson said of Intel. But "this gives you the transistors to build the next great system."