More Transistors On Board

Leander Kahney 11.23.99

In a significant breakthrough for chip technology, a team of engineers at the University of California at Berkeley claim they've crammed a record number of transistors onto a chip.

Led by Chenming Hu, a professor in the department of electrical engineering and computer sciences, the team says their chip has 400 times more transistors than current designs.

"It's a new structure that will allow the industry to build much smaller transistors," said Hu.

In contrast to today's transistors, which use a single gate -- or switch -- to control the flow of electricity through the device, Hu's team has figured out a relatively easy way to build double-gated transistors using today's technology. Experts describe the feat as the Holy Grail of the semiconductor industry.

The two gates, located at either end of the transistor, stand up vertically from the surface of the chip like a fork, which allows them to be made smaller and more numerous.

Dubbed "FinFET," because the transistors (technically known as Field Effect Transistors) look like fins, the components measure only 18-nanometers (or 0.018 microns) across, which is ten-times smaller than today's smallest designs (0.18 microns) and the width of only 100 atoms.

Hu said the transistors' size may be halved in future designs.

Philip Wong, senior manager of exploratory devices and integration technology at IBM's Watson Research Center in Yorktown Heights, New York, said Hu's breakthrough is more significant than recent work by Lucent's Bell Labs in designing vertical processors.

"Lucent's design is a new way to make a conventional device," Wong said. "Chenming Hu has a new way to make a new device. The Berkeley device will scale down to a much smaller device. It looks much further out."

According to Wong, the Berkeley team has found the most efficient way to make double-gated transistor designs, which have been around for a number of years.

"It's by far the best way we've seen to [make] these things." Wong said.

Wong said the Berkeley team's breakthrough may prolong the life of today's semiconductor industry in its present form. Chip industry insiders have stated that the drive toward constant miniaturization will hit a brick wall in about 2010, when it must adopt radical new technology yet to be developed.

Wong said, "It will enable further miniaturization according to Moore's Law," named for Intel's Gordon Moore, who postulated that processor speeds will double while the size halves every 18 months. "It should give us another 15 years, until 2014 maybe."

Significantly, Hu's team hasn't registered patents on the design or manufacturing process.

"I have patented things in the past but in this case we feel it's best to make it as widely available as possible," Hu explained. Hu, who has also released software under open source licenses, said he was confident the industry will adopt the technology.

He said he has already been courted with informal inquiries because it should be relatively inexpensive to convert chip plants to manufacture the new design.

The Berkeley team will present a paper on its designs at the International Electronic Devices Meeting in Washington next month.

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