

TECHNOLOGY

IBM Discloses Working Version of a Much Higher-Capacity Chip

By JOHN MARKOFF JULY 9, 2015

IBM said on Thursday that it had made working versions of ultradense computer chips, with roughly four times the capacity of today's most powerful chips.

The announcement, made on behalf of an international consortium led by IBM, the giant computer company, is part of an effort to manufacture the most advanced computer chips in New York's Hudson Valley, where IBM is investing \$3 billion in a private-public partnership with New York State, GlobalFoundries, Samsung and equipment vendors.

The development lifts a bit of the cloud that has fallen over the semiconductor industry, which has struggled to maintain its legendary pace of doubling transistor density every two years.

Intel, which for decades has been the industry leader, has faced technical challenges in recent years. Moreover, technologists have begun to question whether the longstanding pace of chip improvement, known as Moore's Law, would continue past the current 14-nanometer generation of chips.

Each generation of chip technology is defined by the minimum size of

fundamental components that switch current at nanosecond intervals. Today the industry is making the commercial transition from what the industry generally describes as 14-nanometer manufacturing to 10-nanometer manufacturing.

Each generation brings roughly a 50 percent reduction in the area required by a given amount of circuitry. IBM's new chips, though still in a research phase, suggest that semiconductor technology will continue to shrink at least through 2018.

The company said on Thursday that it had working samples of chips with seven-nanometer transistors. It made the research advance by using silicon-germanium instead of pure silicon in key regions of the molecular-size switches.

The new material makes possible faster transistor switching and lower power requirements. The tiny size of these transistors suggests that further advances will require new materials and new manufacturing techniques.

As points of comparison to the size of the seven-nanometer transistors, a strand of DNA is about 2.5 nanometers in diameter and a red blood cell is roughly 7,500 nanometers in diameter. IBM said that would make it possible to build microprocessors with more than 20 billion transistors.

"I'm not surprised, because this is exactly what the road map predicted, but this is fantastic," said Subhashish Mitra, director of the Robust Systems Group in the Electrical Engineering Department at Stanford University.

Even though IBM has shed much of its computer and semiconductor manufacturing capacity, the announcement indicates that the company remains interested in supporting the nation's high technology manufacturing base.

"This puts IBM in the position of being a gentleman gambler as opposed

to being a horse owner,” said Richard Doherty, president of Envisioneering, a Seaford, N.Y., consulting firm, referring to the fact that IBM’s chip manufacturing facility was acquired by GlobalFoundries effective last week.

“They still want to be in the race,” he added.

IBM now licenses the technology it is developing to a number of manufacturers and GlobalFoundries, owned by the Emirate of Abu Dhabi, to make chips for companies including Broadcom, Qualcomm and Advanced Micro Devices.

The semiconductor industry must now decide if IBM’s bet on silicon-germanium is the best way forward.

It must also grapple with the shift to using extreme ultraviolet, or EUV, light to etch patterns on chips at a resolution that approaches the diameter of individual atoms. In the past, Intel said it could see its way toward seven-nanometer manufacturing. But it has not said when that generation of chip making might arrive.

IBM also declined to speculate on when it might begin commercial manufacturing of this technology generation. This year, Taiwan Semiconductor Manufacturing Company said that it planned to begin pilot product of seven-nanometer chips in 2017. Unlike IBM, however, it has not demonstrated working chips to meet that goal.

It is uncertain whether the longer exposure times required by the new generation of EUV photolithographic stepper machines would make high-speed manufacturing operations impossible. Even the slightest vibration can undermine the precision of the optics necessary to etch lines of molecular thicknesses, and the semiconductor industry has been forced to build specialized stabilized buildings to try to isolate equipment from vibration.

An IBM official said that the consortium now sees a way to use EUV light

in commercial manufacturing operations.

“EUV is another game changer,” said Mukesh Khare, vice president for semiconductor research at IBM. To date, he noted, the demonstration has taken place in a research lab, not in a manufacturing plant. Ultimately the goal is to create circuits that have been reduced in area by another 50 percent over the industry’s 10-nanometer technology generation scheduled to be introduced next year.

Correction: July 13, 2015

A picture caption on Thursday with an article about the development of computer chips with much higher-capacity misspelled the surname of an IBM scientist shown in a clean room in Albany, N.Y. He is Bala Haran, not Haranand.

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