

<http://m.startribune.com/at-skywater-a-project-with-darpa-could-reshape-the-fortunes-of-a-minnesota-chip-factory/491645971/>

At SkyWater, a project with DARPA could reshape the fortunes of a Minnesota chip factory



[Evan Ramstad](#)

The writing has been on the wall for more than a decade: Moore's Law will end.

The maxim around which the global high-tech industry has been organized for 50 years — that chipmakers will be able to double the number of transistors within a given geometry every two years, making chips exponentially faster each time — is

reaching its physical limits. Transistors on chips are simply getting too small and close to each other to have room for more.

One of Minnesota's handful of chipmakers, SkyWater Technology, was recently selected by the Defense Advanced Research Projects Agency, or DARPA, to work with it and MIT on one of the most promising ideas to keep pushing chip designs — and computing — forward.

The Bloomington company for the next three years will help DARPA and MIT engineer and test processes to manufacture chips that have circuitry on more than one plane. In addition, the circuits will vary in type between the two main varieties, memory and logic. Within the industry, the concept is known as a 3-D system-on-a-chip and may allow chipmakers to keep squeezing more computing power out of chips that are smaller than fingernails.

For SkyWater, a company formed two years ago as a spinoff from Cypress Semiconductor Corp., the contract is potentially a giant step in diversifying from its main business as a factory-for-hire, or foundry, for other chip companies.

“We’re investing a lot of our engineering talent in doing the research and development, but we’re also getting paid through the program to develop the technology,” said Thomas Sonderman, SkyWater’s president. “If the technology pans out the way we expect it to, then we’ll be the ones leading the industry in bringing it to market.”

The regular doubling of chip circuitry that Gordon Moore, a pioneering Silicon Valley engineer at Fairchild Semiconductor and co-founder of Intel, noted in 1965 happens because the space between transistors is reduced, making room for more of them.

Today, the leading-edge manufacturers produce chips with transistors that are just seven nanometers apart. A nanometer is one-billionth of a meter, or one-millionth of a millimeter.

At around two nanometers, the transistors will be just a few atoms apart from each other, and many scientists believe that is too close to maintain the integrity of a circuit. Electrons could just spin off. Analysts forecast that the biggest chipmakers will

build factories for chips of circuits at the five-nanometer level from 2020 to 2024. But they are not likely to get the transistors any closer than that.

Building circuits on multiple planes is one solution to the geometric scaling problem. DARPA's [Electronics Resurgence Initiative](#), formed last year with dozens of chipmakers and tech heavyweights, is a multiyear effort to develop the 3-D circuit idea and others that will keep computing moving forward.

"This DARPA program allows you to build layers upon layers of both logic and memory," said Brad Ferguson, senior director of sales at SkyWater. "You can stack in the third dimension what you could only do in a 2-D fashion monolithically."

The 3-D concept for chips first emerged in the 1960s. Some chips used in smartphones today rely on a form of the concept in which separate logic and memory chips are bonded together in 3-D fashion. DARPA aims to go the next step. "You cannot have as high of a level of interconnection between chips as you can within them," Ferguson said.

In its deal with SkyWater, much of the research will happen at MIT's Microsystems Technology Laboratories. SkyWater's Bloomington facility will be used to test equipment and processes to build 3-D system-on-a-chip designs at the volume levels required for commercialization.

SkyWater has already started reconfiguring its test room to accommodate equipment for the new type of chip. By 2020, the company and MIT will aim to demonstrate the manufacturing process and the following year have it ready for other chipmakers to use.

"DARPA didn't just want a science project," Sonderman said. "They want a foundry-ready platform that can be taken to the market at the end of three years of the program."

SkyWater's Bloomington plant, like another nearby owned by Polar Semiconductor Co., was originally built by Control Data, the maker of mainframes and midrange computers that for decades was the top player in Minnesota's high-tech industry. Cypress bought the factory in the 1990s, and later expanded it with more production, testing and office space.

Under Cypress, the Bloomington plant about a decade ago started a side business allowing chip-design companies to develop and test new processes for building chips. That engineering services business became a higher-margin contributor to the plant's output and laid the foundation for the post-spinoff SkyWater to distinguish itself from other chip foundries and land the DARPA contract. "If we didn't have engineering services in our business model, we would not get exposed to that possibility," Sonderman said.

The privately held company doesn't disclose its financial results. But SkyWater is growing, Sonderman said, citing the addition of nearly 100 employees to the just over 400 who were working for it when it was spun off from Cypress last year. It has built a roster of 18 clients beyond Cypress, for which it continues to produce chips.

And even while the DARPA project into new designs of chips proceeds, SkyWater executives expect that each 10 percent increment of additional revenue from engineering services will deliver a 30 percent boost to earnings before interest, taxes and depreciation.

The work with DARPA holds the potential for SkyWater's paid-for factory to leap to the cutting edge of chipmaking processes, stretching the life of the factory, and Control Data's legacy on Minnesota's tech scene, for more decades.