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Moore's Law has ruled computers for 40 years

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Forty years ago, when the Beatles rocked music and the Vietnam War ignited bitter generational debate, the typical computer was as big as a room and cost more than $100,000, making it a tool of engineers, scientists and mathematicians.

But all that began to change April 19, 1965, when a California scientist made a prediction about the future of computer chips.

It proved to be more than an accurate blueprint for cramming more parts into the same-sized chip. It also became a prophecy of ever cheaper technology, leading to the world of 2005, featuring a PC in every cubicle and wireless connections on the go.

Writing in a trade publication, *Electronics Magazine*, Gordon Moore, then 36 and a future co-founder of Intel Corp., predicted the number of transistors on a computer chip would double roughly every two years.

Eventually known as Moore's Law, the prediction still holds true for the fingernail-sized pieces of silicon that serve as the brains of computers, laptops, cell phones, portable music devices and other gadgets.

"Moore's Law is not a scientific law, but it is an expectation, an icon and a milestone toward which the microchip industry has moved toward with remarkable success," said University of Central Florida optics professor Martin Richardson.

As evidence, consider the pace at which transistors have been added to microchips over the years. A 1971 chip had about 2,300 transistors, while in 1982 the number had increased to 134,000. Last year's top models contained more than 590 million.

As a foundation of the $200 billion a year high-tech industry, Moore's Law probably has legs for another decade.

But after that, new technological wizardry will be needed in a world where chips will have become overly crowded and hot, experts said.

To keep Moore's Law relevant, Richardson's team at UCF, along with other scientists, has been closely involved over the last 10 years in research using extreme ultraviolet light to assist in the making of even smaller, denser chips.

Keeping Moore's Law humming along is important not just for technology, but also because of its economic aspect.

Because the key components could fit in the same space, chips have become increasingly faster and more potent without requiring any more silicon to make.

In fact, the cost of performing a given task has decreased every two years or so, increasing productivity in business, medicine and other areas, said Bernard Myerson, chief technologist for the IBM systems and technology group.

Put another way, one of the transistors on a computer chip now costs about one hundred-thousandth of a penny, or by another estimate, the cost of a single printed newspaper character.

"The ability to more than double the work you get from a piece of silicon, along with other technological improvements, has been a seminal change in human capability," he said.

After 40 years, the number of components on a chip has grown by a factor of about 1 million, but, fortunately, the overcrowding hasn't yet made for a similar increase in heat.

"If each of those little things burned as much power as 40 years ago, a chip would be as hot as the sun," he said.

However, it's getting harder and harder to keep chips cool.

"We have to find how to deal with this power wall," he said. "Otherwise, it would take a helicopter to keep a chip cool."

Crafting the chip of the future will take new processes, including a technology using extreme ultraviolet light that Richardson's group has helped to pioneer.

"The work we have been doing allows us to create a light bulb like a miniature sun, producing bullets of light from a laser," he said.

"We are moving toward 1 billion transistors on a chip and maybe the endgame for Moore's Law," he said.

Information from Intel Corp. and IBM was used in this report. Chris Cobbs can be reached at ccobbs@orlandosentinel.com or 407-420-5447.