Why Cypress Acquired Silicon Light Machines

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By T.J. Rodgers

Cypress announced today the acquisition of Silicon Light Machines, a company specializing in optical components. When you finish reading this story about the acquisition, I hope that you will share my enthusiasm for it, because of the huge value it brings to Cypress shareholders. Despite Silicon Light Machine's strategic value to Cypress, I cannot honestly tell an orderly story about how Cypress made this move at some "strategic inflection point" in its history. The process by which we acquired Silicon Light Machines was messy and chaotic-just the way Silicon Valley really works.

The first time I saw an optical chip from Silicon Light Machines (SLM) was in the second quarter of 1999, when Chris Seams, the vice president of our wafer fabrication facilities, showed me a strange looking wafer from our wafer fab in Round Rock, Texas. The chips on the wafer were very odd-slivers of silicon over an inch long, but only the width of a matchstick-very unlike any of our other chips. Thinking that I was looking at a design execution horror story, I asked, "What the ----hell is that?"

"I thought I'd tell you about it before you heard about it from someone else," Chris replied. He told me about the foundry business our Texas plant had taken on during the depths of the 1998 semiconductor recession in order to stem their losses (all Cypress wafer fabrication plants operate as subsidiary companies with independent profit and loss statements). The "secret" foundry deal was finally being revealed because Cypress's business was in a strong upturn, and I had taken to monitoring the weekly allocation of our scarce wafer output. While Chris felt justified in breaking the rules when the fab was very underutilized, he now felt that Round Rock's optics foundry business had to be openly justified-or killed. I chose the latter, telling him to, "Nuke 'em, immediately."

Chris asked me to at least visit Silicon Light Machines, if only to inform them of the bad news. He also told me that the foundry deal was working well; we had good yields and were making a profit. To minimize disruption in our fab, Chris insisted that SLM use only standard wafer fabrication steps, with no exceptions. The SLM chips-a category of chips known as microelectromechanical system (MEMS) chips-are dramatically different from the datacom chips we make in Texas, but we made them using only standard CMOS process steps. Unknown to me, Cypress Round Rock was successfully manufacturing a MEMS optics chip which became the light-switching element in one of the highest resolution projection systems ever made.

Dave Corbin, the Silicon Light Machines CEO, had been warned about the nature of my visit and was in the selling mode when I arrived. Dave introduced me to the SLM team, which included Jim Hunter, a bright, young, former Cypress process engineer who had stayed in touch with his former co-workers at Cypress-the original Cypress/SLM connection had been made by Silicon Valley's fabled start-up-induced employee turnover! I accepted SLM's offer to demonstrate their high-resolution projector, because high definition television is a hobby of mine. I have a high-resolution theater in my home, equipped with the finest Silicon Valley technology: a line quadrupler from Faroudja Electronics in Mountain View and a pair of high-resolution digital projection televisions from Runco International in Milpitas. The Faroudja line quadrupler captures a picture frame, quantizes it into pixels, digitally increases the number of lines of resolution by a factor of four, and sends the pixels to the Runco projectors, which have a one-millimeter spot size. Their spot-placement accuracy is so great that the two projectors required to produce a very bright image can be converged, one image on top the other-two million pixels on top of two million pixels, flawlessly on a ten-foot screen. The picture quality of my system is better than that of a poorly maintained commercial theater, but not as good as the highest quality image in some art theaters.

The Silicon Light Machines image was the best I had ever seen-better than my home theater and better than the best art theater. That day, instead of telling SLM to find a new foundry, I asked them if they would like an investment from Cypress and a new board member-me. SLM's fourth round of funding was in progress. Cypress invested $2.25 million for a 5% stake in the company. I joined their eclectic board of directors, which included Andy Bechtolsheim, who manages advanced products at Cisco, and prior to that, was a founder of Sun Microsystems; Mario Rosatti of the flagship Palo Alto law firm, Wilson Sonsini Goodrich and Rosatti; Stanford professor David Bloom, one of the technologists who invented the Grating Light Valve (GLV) technology, the official name of SLM's technology; top-tier venture capitalists, who had been with the company since the beginning; and two movie moguls, who had a dream of enabling digital cinema across America with the GLV technology.

Silicon Light Machines' business plan was to build a motion picture projector from the GLV chip they already had working with good yield in our Texas fab. They had produced three working prototypes that provided a breathtaking demonstration of feasibility. And at that time, one of the prototypes was in Tokyo at Sony's headquarters being evaluated pixel by pixel.

Meanwhile, back at Cypress, the thinking in our datacom division was that we needed to work more on the interaction between electricity and light. Long-haul data communications had been transformed by the invention of wave division multiplexing (WDM), a technique that puts four different beams of light with slightly different wavelengths onto a single fiber without mutual interference between the beams-a technique to quadruple the fiber's capacity. With each light beam carrying a data stream of 2.5 gigabits per second (Gbps), a single fiber becomes capable of carrying 10 Gbps of data, the equivalent of about 800,000 typed pages per second (or 150,000 simultaneous phone calls). At the receiving end, the four beams are reseparated in a manner analogous to the way a prism separates the colors of white light. Each wavelength is then converted back to an electrical signal and decoded to retrieve its data. The need to pack four data transmitting/receiving circuits (which we call physical layers, or PHYs) onto a single silicon chip was obvious (Cypress has already introduced that product). It was not obvious how to integrate our PHY chips efficiently with the bulky optoelectronic equipment that transmitted and received the light.

Optical components are big things welded into metal cans reminiscent of the packaging techniques used in the semiconductor industry decades ago. The prices of optical components, typically in the hundreds or thousands of dollars, also reflect the lack of an effective version of Moore's law in optics manufacturing. Cypress's first step into optics is relatively straightforward: to have our PHY chips send and receive light over fibers, rather than electrical signals over coaxial cable. But even to take that first obvious step meant that we had to understand laser transmitters, infrared photo-diode receivers, how to get light in and out of opaque integrated circuit packages, and how to align optical fibers to chips. The need to integrate optics and electronics became more acute when dense wave division multiplexing (DWDM) was invented to squeeze 28 different wavelengths into one fiber. There have even been demonstrations of up to 160 wavelengths per fiber.

SLM's current product is a high-definition projection system, the heart of which is their Grating Light Valve (GLV) chip, which has 1,080 pixels, tiny one-millimeter-square picture elements (your big-screen TV has about 500,000 pixels of resolution). Each pixel controller on the GLV chip is about 25 microns square in area and is capable of controlling the color and brightness of one pixel on the screen. The GLV projection chip creates a vertical 1,080-pixel line, which is scanned left and right to produce a two-million-pixel image with extraordinary resolution. The GLV technology is easily capable of achieving an eight-million-pixel image. Each GLV pixel is made from tiny aluminum mirrors mounted on flexible silicon nitride membranes. When an electrical signal is applied to the membranes, they flex, creating an interference pattern that effectively switches a pixel on or off. Unlike competing products from Texas Instruments and Lucent, the GLV has no bulky, slow-moving mirrors-it uses diffraction to switch the light 1000 times faster

than its competitors. The red, green and blue laser light sources for the three GLV devices in each projector are bulky. Consequently they can be placed away from the projector, and the light transmitted to the GLV chips through optical fibers. The GLV projector chip is encased in an integrated-circuit-like package with a clear, optically flat, hermetically sealed glass lid. Another SLM chip, also built at Cypress, provides the electronic signals to control the GLV structures that, in turn, controls the pixels on the screen.

Based on the brief description of the SLM projection system above, one can see that the technologies required for optical data communication-aligning fibers, switching light beams, transporting light beams in and out of integrated circuit packages, etc.-are all part of SLM's core competencies. The company has simply worked on visible-light projection systems rather than on infrared-light data transmission systems. As of the first quarter of 2000, my objectives for SLM and Cypress were to help SLM sell the GLV chip to Sony (creating a new business for Cypress) and to get SLM to work with Cypress to help us solve some of the optical problems we were facing in the semiconductor business. I would have offered the $100+ million required to acquire SLM at that time, but I was not prepared to burden Cypress investors with SLM's significant operating costs, even to get a headstart in optics.

In the first quarter of 2000, George Lucas and Texas Instruments surprised everybody by demonstrating for real that the age of digital cinema was upon us. Lucas' newest Star Wars film was electronically screened in New York and Hollywood in four venues, using a digital cinema picture projected with a Texas Instruments chip, one that uses tilting mirrors for light switching. There was virtually unanimous agreement that the digital image was better than that projected from a pristine 35mm print. Interest in the SLM chip picked up dramatically, because relative to the TI chip, the GLV technology is not only capable of projecting a better image, but it's also easier to produce. (Rumor had it that TI had produced only a few of their cinema-quality chips, ever.)

Two weeks ago, Sony signed an agreement to license-exclusively-the GLV chip for all imaging systems ranging from home television all the way through large projectors for digital cinema. The licensing fee is substantial-large enough to make Silicon Light Machines instantaneously and continuously profitable for several years. After the Sony deal, the question for SLM's management team was what to do next with the company's extraordinary talent base. The obvious answer was to begin work on optical data communications-the hot new field.

That's when the "picture" finally came into focus for Cypress and we decided to move aggressively on the acquisition. SLM was now working in an important new area directly related to Cypress's networking business. The operating loss problem had been eliminated. The projector chip that Sony wanted to use was already in production in a Cypress fab. I had learned while serving on the board of directors that SLM's management team was bright, clear-thinking and articulate, and that SLM's employees would fit into Cypress's culture of bright, hard working engineers who value getting the job done. Furthermore, the SLM employees who had been working extraordinary hours for five or more years were ready for the financial reward of swapping their restricted stock for liquid Cypress shares.

Thus, in the SLM acquisition, Cypress has purchased a large-scale, high technology entity that is self-funded for several years, allowing us to venture aggressively into the world of optoelectronics without suffering the bottom-line damage usually incurred by such a large-scale R&D effort.

SLM will be maintained as a wholly owned subsidiary company to allow for the possibility that, at some time in the future, SLM's product line may be so attractive to the market that Cypress shareholders would receive a significant financial benefit from a spin-off IPO. We also believe that keeping SLM as a separate business unit will aid in retaining and attracting SLM employees.

There are other mutual benefits:

- SLM lives in a world where scientists run companies and products cost hundreds or thousands of dollars. Cypress lives in a world where engineers run companies and products cost $2.00. When the time comes to take SLM products to the market in high volume and with high quality, our products will have the technical content provided by scientists, the manufacturability designed in by our engineers, and manufacturing costs that reflect Moore's law.
- While SLM knows a lot more about optics than Cypress does, Cypress knows more about communications than SLM does. This year, Cypress will sell approximately $900 million worth of chips to data communications companies. Our San Jose and Texas design centers currently design PHYs that move data at up to 2.5 Gbps. Our Arcus design facility in Bangalore, India, has the skills to design the million-gate logic chips used to sort out the 24-light-beam traffic mess inherent in DWDM systems. The company's combined skill set will be greater than the sum of its parts.
- Cypress's six largest customers are Motorola, Nortel, Lucent, Cisco, Alcatel and 3Com. The technologists at SLM will therefore have an opportunity otherwise unavailable to them to engage quickly with the best of the communications industry. Conversely, Cypress will have a new core competency to make us more valuable to our strategic communications customers.

I hope this narrative will help Cypress shareholders understand why I am so enthusiastic about this exceptional opportunity. I am also proud that Cypress has remained entrepreneurial, despite our billion-dollar size. What makes Silicon Valley so special is our free minds and free markets-and the chaos that goes along with them. Those who want to succeed here must take advantage of that chaos, not try to escape from it.

Years hence, if the SLM acquisition turns into a big business for Cypress, I could retroactively create the "strategic vision" that caused Cypress to acquire an optics company, or hype how Cypress intuited that the year 2000 would be the crossover between the "century of electronics" and the "century of optics." But life in the Valley isn't that well ordered: an employee quit, connected his start-up to us through the "net" of Silicon Valley, and caused a foundry deal to come about that wouldn't have happened if there had not been an unexpected recession in Asia. The foundry deal was kept alive because of a special interest of mine, and that deal morphed into a great opportunity for Cypress, as catalyzed by a digital cinema screening in Hollywood. So much for grand strategies.