MARCH 01, 2001
PREVIOUS COLUMNS

Let a Hundred Flowers Bloom. . .

. . . while another hundred wilt

Gary Shaffer

What shape will the coming optical shakeout take? Will it burst in dramatic fashion like the dotcom bubble? Or will it be cyclical, allowing greater differentiation among winners and losers, like the series of shakeouts in semiconductors in the 1980s and 1990s? My view is that it's going to be much more like the latter than the former. I expect a lot of moderate winners and a few dominant ones, with the selection process stretched over much of this decade.

That view is far less grim than much of the conventional wisdom surrounding optical investing these days. Moreover, I would take the argument a step further. I think an abrupt shakeout will be *least* severe in the components sector — with all respect to the contrary views of Steve Saunders (see Shedding Darwin on Light).

Let me make my own biases clear. Since 1999 Morgenthaler Ventures has invested in about 15 components or components-related ventures, comprising almost three-fourths of our optical portfolio. Some — like Agility Communications Inc.Lightwave Microsystems Corp., and New Focus Inc. (Nasdaq: NUFO - message board) – are already highly visible in the industry (and familiar to readers of *Light Reading*'s Top Ten Lists — see Light Reading's Top Ten Optical Stocks and Light Reading's Top Ten Private Companies). And, despite the overheating of the entire optical space, we anticipate making another five to seven additions to our optical portfolio this year with only slightly more relative emphasis given to systems.

Why the continued confidence?

Rich technology

Prior to the late 1990s, optical research and development remained, with a few

notable exceptions, an entrepreneurial backwater. Many worthy optics projects received regular funding. Corporate, university, and military spending on optical research grew steadily over the past 20 years. But expansion was gradual. Thus, when Internet-driven demand for bandwidth started expanding exponentially, entrepreneurs and venture capitalists found unusually deep pools of mature technology to exploit and hundreds of highly trained optical engineers eager to help.

Much of that technology has the potential for serving multiple applications throughout the future optical network. Indium phosphide, for example, is finding likely applications in both the backbone and metro area in components such as source lasers, amplifiers (SOAs), modulators, very high-speed switches, and waveguide-based devices. Though a difficult material to work with, indium phosphide will clearly find broad commercial success, especially as communications moves to higher speeds. Other substrate materials like lithium niobate, silica, and silicon are moving into new applications, as well.

Naturally, as Saunders argues, users will patch together components based on disparate underlying technologies until standards emerge. But to then argue that the process will lead to the quick demise of companies offering non-standard solutions underestimates the dynamics of an unusually fluid, rapidly growing market.

A diverse, dynamic market

In highly differentiated markets, competing technologies tend to “niche out” rather than obliterate each other. I can't predict, for example, which of the three main waveguide technologies — all-silicon, silica-on-silicon, or polymer — will ultimately prove the biggest long-term winner. But my guess is that each will find success. All-silicon waveguides, which have the highest optical losses, may succeed in applications that benefit from a high degree of integration, resulting in less of a loss penalty. Silica-on-silicon will probably win out where muxing and demuxing (based on arrayed waveguides, or AWGs) are the primary underlying function. And polymer waveguides may perform well in certain applications that emphasize switching.

But there is a further point that goes beyond mere "nichemanship.”

The depth of optical research and the sudden commercial demand for it, is spawning a far richer ecology than most general business and even many communications industry observers imagine. What first appear as evolutionary dead ends have a way of quickly opening up into major new opportunities that will surprise even industry insiders.

Two years ago, for example, polarization mode dispersion (PMD) was a non-issue in optical networking. With the introduction of 10-Gbit/s systems, however, it has become a big issue in legacy fiber. And with 40-Gbit/s technology on the verge of commercialization, solving it will become imperative. Now, suddenly — to discuss a component category where, unfortunately, Morgenthaler Ventures did not make a bet — devices based on relatively “mature” technologies, such as fiber Bragg gratings (FBGs) and thin film filters, are finding important new application in correcting PMD and other types of dispersion.

Or take tunable lasers, a technology that showed up as little more than a footnote in analysts’ reports even 12 to 15 months ago. Most experts viewed tunable source lasers as a niche technology for limited applications like sparing. The reality, however, is that tunable lasers will now play a major role in just about every mainstream network application. That broad potential has

become clear only over the last year as companies like Agility Communications and New Focus have developed new broadly tunable, high-powered lasers with applications from ultra-long-haul to Metro. Although their offerings appeared, apparently out of nowhere, they were in fact based on years of quiet research.

The rate of innovation is, if anything, accelerating. Looking across the component pipeline in our various portfolio companies, we see the potential for a lot more important “surprises”. Time for a slowdown in innovation? Maybe in about 10 years!

Manufacturing challenges

The case for a limited shakeout becomes stronger yet when we look at how optical components are made. The manufacture of optical components and modules, if we’re honest about it, is still fundamentally a “brute force” effort involving labor-intensive hand assembly and testing of separate components. No true integration has yet taken place, at least in high-volume production. Why are laser transmitters still assembled from many discrete components — lasers, lockers, modulators, isolators, amplifiers, and others — after all these years? It boggles the mind.

The integration challenge is nowhere more evident than in the metro core and access, where costs must fall, not by historical rates of 25 to 30 percent per year, but by up to an order of magnitude — ten times — in order to be cost effective. Ten-times improvement requires a revolution in which new manufacturing platform technologies — not extensions of existing technology — are optimized for much lower cost.

Some of our portfolio companies are following the semiconductor model and planning to etch and grow many functions on a common substrate. Other companies are borrowing from Henry Ford in bringing much higher levels of automation and standardization to high-volume assembly. Still others plan to solve the metro cost problem by fundamental innovation in product design.

Which approach will win? All of them, probably, to varying degrees. That's just one example of why we see lots of tradeoffs, lots of merged technologies, lots of partial victories in the months and years ahead.

Finally, let's really contemplate the optical networking market for what it is. It's not just "big" — it's almost unimaginably big. Within a few years, consumer video-on-demand services over IP in the U.S. *alone* will require backbone capacity measured in *petabits* per second. Cables running down our residential streets will carry *tens of gigabits* per second. And home optoelectronics will be widely deployed, costing a small fraction of what they cost today. The capital cost of deploying all this infrastructure may reach a trillion dollars. Hey, it's not just Congress that gets to deal with numbers that large! Those kinds of numbers will sustain a lot of ups and downs.

Looking at the matrix of optical components markets today, we find perhaps two dozen significant segments. Many did not exist even two or three years ago. Venture capital has clearly over-funded this area (along with the rest of the communications market), with six to eight or more companies funded in most segments. In general, I would expect there to be one or two significant winners in each category, where the no. 3 and no. 4 companies have a reasonable chance of achieving at least a modest VC win through acquisition. That leaves three or more that could fail outright. That's roughly a 50 percent success rate. Not too bad from a venture capital perspective! Moreover, we expect considerable evolution in the matrix of opportunities during the next several years.

It's semiconductors all over again, with rapidly ascending cycles based on essential products, proliferating applications, and a rapidly dropping cost-performance curve. In short, we're just experiencing one major downturn in what should be a cyclical, but highly profitable, ten-year ride.

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