

Telecommunications Bubble Pumps Up the Optical Fiber Communications Conference

Jeff Hecht

Fiber-optic amplifiers and wavelength-division multiplexing (WDM) developed almost perfectly in phase with the explosive growth of the Internet in the 1990s. The new optical technology promised the bandwidth needed to carry fast-growing Internet traffic. Initially the parallel advances of optical and Internet technology seemed an ideal match. Unfortunately, that pairing ignited a speculative bubble that went out of control, creating trillions of dollars of vastly inflated stock valuation that vanished when the bubble collapsed.

An earlier chapter describes how fiber became the backbone of the global telecommunications network. The roots of the Internet go back to the late 1960s, when low-loss fibers were still in development. The Defense Advanced Research Projects Agency (DARPA) (then called ARPA) began funding computer links among university and government laboratories.

A Changing Landscape in Telecommunications

Separately, telecom companies began experimenting with information services connecting home consoles and television screens to mainframe computers through copper telephone lines. In the 1980s, personal computers became the preferred home connections to private services such as CompuServe. Modem speeds carrying these services over phone lines rose from 300 baud in the early 1980s to 56,000 baud in the 1990s.

Public Internet access began about 1989 and took off after the World Wide Web opened the Internet to a wider range of services. In 1994, the Web grew from 500 to 10,000 servers, and data traffic soared. For a brief, heady period in 1995 and 1996, the volume of Internet data may have doubled every three months as hordes of new users explored the Web. Internet traffic then was a small fraction of voice traffic (including faxes), but it was clear that if it continued increasing at that rate it would soon eclipse voice traffic, which was growing about 10% a year.

The emergence of competition and the breakup of the old AT&T monopoly in 1984 had already shaken the telephone industry. Once considered a natural monopoly, telephony had become fragmented. Many competing carriers and the construction of new high-speed, high-capacity fiber networks cut the prices of long-distance and international calls, greatly increasing voice and fax traffic.

Competition also brought more subtle changes that would have a large impact. As a monopoly AT&T published data on its traffic and system capacity to persuade regulators to approve expansion plans. With deregulation and competition, that information became proprietary, and no carrier knew total network traffic or how fast its competitors were growing.

Meanwhile, new technology was expanding capacity of single-mode fiber systems, which had reached 2.5 Gb/s on the busiest routes by the mid-1990s. The first WDM systems reached the market in 1996. The same year saw installation of TAT-12 across the Atlantic, the first

submarine cable with optical amplifiers. WDM promised the bandwidth needed to cope with the rapidly growing demand.

Yet in the new competitive environment, nobody knew exactly what that demand was. Traditional phone network managers considered bandwidth a scarce commodity. Market analysts and the press heralded the doubling of Internet traffic every 90 to 100 days. Soon the Federal Communications Commission was citing the same numbers, although the original source—a 1996 Worldcom report—was forgotten.

Few in the industry paid much attention in early 1998 when Andrew Odlyzko reported that AT&T's Internet traffic had only doubled during 1997. The dot-com boom was underway, and critical thinking was not in fashion. Writers, business analysts, and stock promoters waxed exuberant about how the Web would revolutionize the economy. With money readily available at low interest, investors poured money into upstart web companies with little more than a handful of employees, a web site, and—perhaps—a warehouse. As the new companies began to go public, their stock prices soared, pumping up the technology-heavy NASDAQ index.

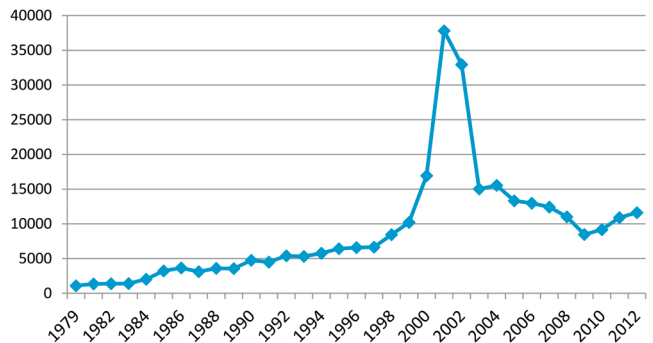
Investors began looking beyond the dot-coms to the telecommunications companies that would provide vital infrastructure for the new economy. Fiber and optics companies were particularly hot commodities because they offered breakthroughs in bandwidth. Investors soon bordered on the euphoric about fiber. Even hard-headed optical engineers decided that if investors were going to throw money at anything optical, they might as well hold out their hats and catch some of it. The boom brought a gold-rush atmosphere to the Optical Fiber Communications Conference (OFC).

The Growth of OFC

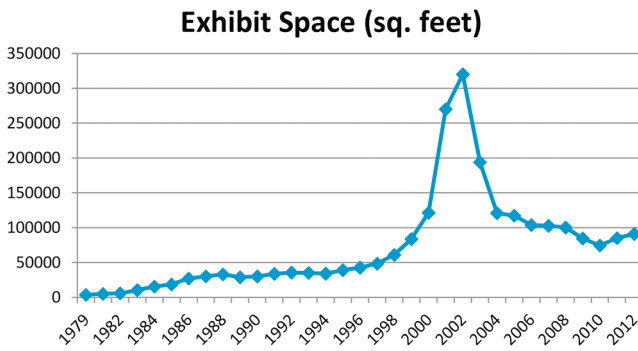
OFC began as a small biennial topical meeting on optical fiber transmission first held in 1975. The first Optical Fiber Communications conference in 1979 had a small trade show and 1082 attendees. It went annual in 1981 and grew along with the fiber industry. In 1986, when fiber had become the backbone of U.S. long-distance traffic, OFC drew 1801 people to Atlanta for the technical sessions, plus 1071 exhibitors and 777 people who only visited the trade show of 150 companies occupying 27,100 square feet. It was the first time more than half of OFC attendees came only for the exhibits. Figure 1 shows how the number of attendees changed over a period extending from 1979 to 2012.

A decade later at San Jose in 1996, only a few more people came for the technical session, but the exhibits had more than doubled, to 2756 exhibit staff and 1990 exhibit-only visitors. Exhibit space had increased over 50%, to 42,700 square feet. Fiber technology had come a long way, and WDM was reaching the market. Ciena squeezed 16 optical channels at 1.6-nm intervals into the erbium-amplifier spectrum. Lucent Technologies and Pirelli also introduced WDM systems. The post-deadline session heard of hero experiments that sent a trillion bits per second through a single optical fiber, although chromatic dispersion and nonuniform amplifier gain limited transmission span to 150 km in the best result, from Fujitsu.

The 1997 OFC, held in Dallas, was only slightly larger than the 1996 event. But the 22–27 February 1998 OFC in San Jose was a big step up. The Optical Society and IEEE had expected total attendance to top 7000, but it jumped 30% to 8446, with technical attendance up 25% to a record 2672. Exhibit space was up 26% to 61,000 square feet, and the number of



▲ Fig. 1. Total attendance over a period extending from 1979 to 2012 showing the sharp peak in the bubble years.



▲ **Fig. 2.** Total square footage of the exhibit area over a period extending from 1979 to 2012 showing the sharp peak in the bubble years.

service by the end of the year transmitting 10 Gb/s on each of 40 wavelengths. Meanwhile, regional and metropolitan networks were installing WDM systems to increase capacity without costly construction.

Meanwhile, the technology-heavy NASDAQ index was rising about as fast as OFC attendance—closing at 1766 in the middle of OFC, up 29% from a year earlier. Fiber’s potential bandwidth was pulling the optics industry along with Internet stocks, and at the end of 1998 the NASDAQ index was up 39% for the year.

The trend continued in 1999, when OFC moved to the larger San Diego Convention Center and drew a record 10,206 people, up 21%, including 3331 technical registrants, a 25% increase. The number of companies rose a comparatively modest 13%, but booth sizes grew faster as big companies pumped up their presence, occupying 83,700 square feet of space, a hefty 37% increase. Stock values were also up, with the NASDAQ at 2339 during the February show, up 32% from during the 1998 OFC.

Wall Street Discovers Optics

As fiber technology improved and the demand for bandwidth soared, sales increased and Wall Street began taking optics seriously.

Optics and telecommunication stocks soared during the late 1990s. The stock of JDS-Fitel, formed in 1981, doubled after it went public in 1996, then doubled again in 1997 and in 1998. In early 1999 JDS announced a \$6.1 billion merger with another fast-growing optics company, Uniphase.

In May, Enron announced it was forming a bandwidth market to trade capacity on installed fiber systems. It seemed like a good idea at the time. *Fortune* magazine had repeatedly ranked Enron as the most innovative company in the country, and the demand for bandwidth seemed almost unlimited.

JDS Uniphase stock took off, soaring almost a factor of nine in 1999 as it continued a wave of acquisition. In November it announced it would buy Optical Coating Laboratory Inc. for \$2.8 billion in stock. Stocks of other optics companies such as Corning and of system makers such as Nortel and Lucent likewise multiplied in price. The whole NASDAQ index nearly doubled during 1999, climbing from 2193 to 4069, but optics stocks rose even faster as investors clamored for optical stocks. Friends and family asked optickers for stock tips. Figure 3 shows how the price of JDSU stock varied over a period extending from 2 January 1996 to 2 January 2004.

January 2000 saw another blockbuster merger, with JDS Uniphase buying E-Tek Dynamics in a deal that would close for \$17 billion in June.

OFC recognized the importance of the booming market in selecting technology author and analyst George Gilder as the opening plenary speaker. Gilder had become a fiber enthusiast because he thought the seemingly infinite bandwidth of optics could transform the world. His stock recommendations had lured investors into optical and telecommunication companies, and his presence on the program helped

exhibitors rose nearly 16% to 342. Figure 2 shows how the total square footage of the exhibit space changed over a period extending from 1979 to 2012.

Hero experiments reported at the 1998 post-deadline sessions reached a key milestone—the dense-WDM demonstrations that sent a terabit per second hundreds of kilometers through a series of fiber amplifiers. Bell Labs sent a hundred 10-Gb/s channels 400 km, and NTT sent fifty 20 Gb/s channels 600 km. The highest data rate carried commercially at a single wavelength was only 2.5 Gb/s at the time, but Lucent said they would have hardware in

draw throngs of stock analysts, venture capitalists, and investors to join a record crowd of engineers and scientists.

Lines wound around the Baltimore Convention Center, overwhelming show managers. Technical registration was 6636, almost double the previous year, and total attendance was 16,934, up 65%. Exhibits from 483 companies sprawled over 121,300 square feet.

As if to celebrate Gilder’s talk, the NASDAQ index crossed the 5000 mark for the first time on 7 March 2000, the day of his opening talk. The NASDAQ continued upward during the conference, peaking at 5132 on the final day before closing at 5049. As attendees went home to recover from the show, the chief analyst of Prudential Securities said the index could reach 6000 by the end of 2000.

The market had reached dizzying heights. MCI Worldcom’s market capitalization reached \$168 billion in April 1999. Lucent Technologies reached \$285 billion in December 1999. But those were their peak valuations, and other technology stocks were slipping as well. The Monday after OFC the NASDAQ dropped 141 points and did not see 5000 again until July 2015. May saw the first big dot-com failures, and more followed in the summer. The NASDAQ closed the year at 2470, and did not see 3000 again until 2012.

Optical stocks were slower to slip. JDSU’s market capitalization peaked at \$181 billion during the summer. On 10 July, JDSU announced a mind-boggling plan to buy SDL Inc. for stock then worth \$41 billion. That made SDL CEO Donald Scifres a billionaire on paper in August, when *Forbes* ranked him number 218 on its list of the 400 richest Americans. But JDSU stock started sliding downhill in September, and when the deal closed on February 2001, the stock was worth only \$13.5 billion.

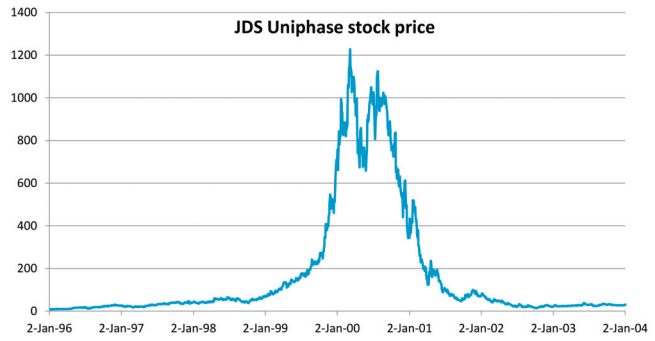
Aside from stocks slipping to more realistic values, the fiber industry seemed healthy going into 2001. Needing more space, OFC booked the sprawling Anaheim Convention Center for 19–22 March 2001. Booth space sold like hotcakes. A record 970 companies occupied 270,000 square feet at the trade show; both numbers had doubled from 2000. Total attendance more than doubled to 37,806, with technical registration reaching 10,888, a 64% increase.

Industry executives, analysts, and investors packed the OSA Photonics and Telecommunications Executive Forum on the fiber market held across the street at the Disneyland Hotel. Optimism was in the air, but so were hints of trouble. Opening speaker John Dexheimer cited concerns including the first failures in telecommunications, a “massive debt hangover” from some \$250 billion in dubious loans to lay new fiber, and many companies trying to do the same thing.

The number of startups in the exhibit hall showed the massive investment in cutting-edge optical technology. The technical sessions included such impressive feats as Alcatel’s transmission of 3 Tb/s through 7380 km of fiber, enough to span the Atlantic. But that capacity was far beyond what anyone needed in April 2001, too many companies on the show floor offered nearly identical products, and some booths displayed no identifiable product but stock.

Within sight of Disneyland, the optics industry had slipped into a cartoon world. Like Wile E. Coyote, the industry had run off clear off the cliff, but in cartoon physics the law of gravity lets you hang in mid-air with your legs churning until you look down. Only then does gravity take hold and bring the inevitable “splat.”

The bubble was collapsing and sales were slumping. In April JDSU laid off 5000 people, about a fifth of its employees. In a 9 May plenary talk at CLEO, JDSU CEO Josef Straus said he had learned “the laws of gravity apply up and down.” The telecom industry was learning that it is hard to make money selling cheap bandwidth, especially when projected Internet traffic growth rates turned out to be as exaggerated as Worldcom’s profit statements.



▲ Fig. 3. Price of JDSU stock over a period extending from 2 January 1996 to 2 January 2004 showing the sharp peak in the bubble years.

Enron's bandwidth market never took off, and by the summer of 2001 the whole company was looking wobbly. By year's end, Enron became the biggest bankruptcy in U.S. history.

By September, Nortel stock worth \$1000 a year earlier was worth only \$72. A grim joke noted that investing the same amount in Budweiser—the beer, not the stock—would have left empty bottles worth \$76 in a state with a deposit law. JDS wrote off nearly \$50 billion in “goodwill” and slashed its staff to less than half its peak level. In January 2002, Global Crossing, which had built a global fiber network, filed for bankruptcy with \$12 billion in debt, the fifth largest in U.S. history.

The magic was gone when OFC returned to Anaheim in March 2002, but the industry's legs were still churning furiously in mid-air. OFC sold 320,000 square feet of booth space to 1204 exhibitors, over 20% more companies than in 2011. But some exhibitors never showed, having run out of money. With 32,944 attendees, the show was busy, but many were job-hunting.

At the OSA Executive Forum, market analyst John Ryan looked back at 1999 to 2001 as “the drunken sailor years” when network operators spent tens of billions of dollars on equipment they did not need. But he held out hope, declaring “Unlike the concept of selling dog food on the Internet, telecom isn't going away.” The audience laughed, a bit uneasily. Four months later, MCI Worldcom eclipsed Enron's record to become the largest bankruptcy in American history, toppled by some \$11 billion in accounting fraud that earned CEO Bernie Ebbers a 25-year jail sentence.

That was the last giant OFC. Attendance dropped by more than half in 2003, as 15,023 people spread thinly through the sprawling Atlanta Convention Center. Exhibitor count and booth space shrank less precipitously, perhaps because the space was sold in advance, and as in 2002 some companies never showed up.

Plots of OFC attendance and exhibits show the bubble years as aberrant spikes, not quite as dramatic as peaks in company stock prices. The most recent OFC, shown in Figs. 1 and 2, in 2012 in Los Angeles, drew 11,617 attendees, with 560 exhibitors occupying 91,000 square feet—putting the 2012 OFC midway between the 1999 and 2000 gatherings. Growth has resumed, at a more rational level.

Looking back, Gilder was right in calling fiber a disruptive technology. But he failed to understand that such a disruption could cause a destructive bubble in stock prices. The bubble's inevitable collapse vaporized illusory gains many times the \$65 billion fraud of Bernard Madoff's Ponzi scheme. The market capitalization of JDSU alone shrank from a peak of \$181 billion to a current few billion dollars, a loss of 2.5 Madoffs.

The industry survived the bubble, although scars remain. Someday your brother-in-law may forgive you for saying JDSU stock was a good investment in 2000.

Further Readings

1. L. Endlich, *Optical Illusions: Lucent and the Crash of Telecom* (Simon & Schuster, 2004).
2. J. Hecht, *City of Light: The Story of Fiber Optics, Revised and Expanded Edition* (Oxford University Press, 2004).
3. O. Malik, *Broadbandits: Inside the \$750 Billion Telecom Heist* (Wiley, 2003).
4. B. McLean and P. Elkind, *The Smartest Guys in The Room: The Amazing Rise and Scandalous Fall of Enron* (Portfolio-Penguin, 2004).
5. A. Odlyzko, “Internet growth, myth and reality, use and abuse,” <http://www.dtc.umn.edu/~odlyzko/doc/internet.growth.myth.pdf>.