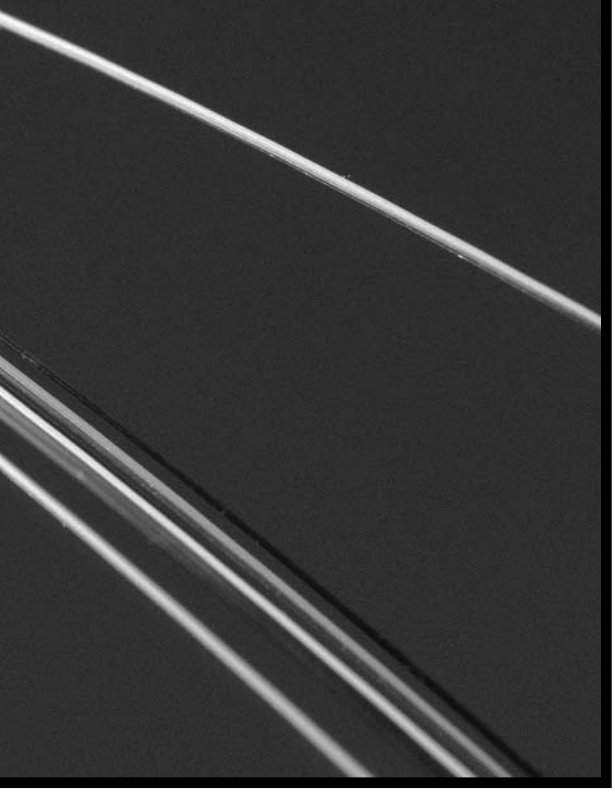
The Telecom Boom and Bust

Their Losses, Our Gain?

By Allan Shampine and Hal Sider



How quickly things change. In 1999, an analyst at Morgan Stanley Dean Witter wrote that "bull markets have turned to bear ones before, and while each follows its own master, the Internet feels different. … This is not just another bubble waiting to be pricked." Two years later, he understated the obvious: these are "trying times for long-haul providers and integrated network providers … as consolidation unfolds in the industry, and firms restructure their balance sheets."

That analyst was acknowledging the spectacular rise and fall of the telecommunications industry in general – and fiber-optic cable deployment in particular – in the 1990s, but he could equally well have been speaking about the 1890s. Like Ozymandias, memories of great network-industry booms and busts tend to be lost under the sands of time. A few observers, notably Daniel Gross in this journal and in his new book, *Pop!*, have explored the parallels between the bubble in fiber-optic networks and cycles in the

telegraph industry in the mid-1800s, the railroad industry in the late 1800s, and the telephone industry in the early 1900s. While historical data are limited, it is possible to flesh out these comparisons in terms of the size and speed of infrastructure built, as well as the denouement for both the industries and the broader economy.

Generally, such busts and consolidations have been precursors to even greater growth, rather than the beginning of long-term decline for the industries in question. But there are some important differences between the recent fiber-optic boom and its predecessors. Specifically, the fiber-optic frenzy has left many carriers with overlapping routes and networks, which could have a longer-term effect on the industry than earlier infrastructure bubbles.

THE FIBER-OPTIC CYCLE: 1997 – 2003

The boom and bust in fiber-optic telecom cable is particularly suitable for comparison to cycles in earlier periods since the sort of data available (mileage and capacity, route pricing, and bankruptcy or stock price data) are also available for the cycles in network industries in the 19th and early 20th centuries.

There are two primary measures of fiber deployment: route kilometers, which measures the length of the trenches in which fiber is laid, and fiber kilometers, which measures the intensity of deployment by multiplying the number of route kilometers by the number of individual signal-carrying fibers on that route.

Between 1996 and 2001, major carriers increased the total number of route kilometers in the United States two and a half times. During the same period, the number of fiber kilometers increased more than sevenfold. It is difficult to overstate the magnitude of this buildout. Companies dug more than 330,000 kilometers of trenches and buried 30 million kilometers of fiber – enough to circle the equator 750 times.

Most of this was on long-haul (that is, long-distance) routes. But companies were also deploying fiber rings and spurs within metropolitan areas. Unfortunately, data on these short-haul routes are not available.

As stunning as this achievement appears, it grossly understates the impact, because advances in technology have steadily increased the capacity of each strand of fiber by orders of magnitude. Thus, Telegeography, an industry research firm, reports that "lit" capacity (industry jargon for capacity in use) in the United States increased up to 100-fold between 1999 and 2002. These figures do not include the large quantities of "unlit" fiber; nor do they include the presence of empty conduits – protective piping for bundles of fibers – that could readily support deployment of additional fiber.

For example, a company called Level 3, which deployed a large network in the 1990s, planned to place six to eight conduits in each trench, while only utilizing one of them initially. In fact, the company ended up placing 10 to 12 conduits. Similarly, Qwest, and other new network providers financed their fiber deployment by selling and swapping unlit fiber and conduit with other carriers. As a result, many network routes are served by multiple carriers sharing conduit or fiber or both.

In the early 2000s, the explosive growth of fiber-optic capacity came to an abrupt halt. There were more bankruptcies of large telecoms in 2001 and 2002 than in the entire prior decade. The stock prices of companies

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with fiber networks performed as one might have expected. Global Crossing, Broadwing and Qwest went bankrupt, losing most or all of their stock value; many others suffered severe financial difficulties, with subsequent scandals and litigation.

The deployment of so much fiber led to significant excess capacity on major long-haul routes. In many cases, two or more carriers had capacity in the same trench with each having adequate capacity to serve all the existing traffic. Not surprisingly, prices fell sharply. For example, from the beginning of 2000 to mid-2001, even before many fiber carriers entered bankruptcy, prices for routes like New York to Los Angeles had fallen by 80 percent. Four of the larger network operators (Broadwing, Global Crossing, Level 3 and Qwest) lost almost $14 billion in 2000 and 2001 alone.

Data on post-bust fiber deployment are difficult to obtain. Anecdotally, it appears that the laying of long-haul fiber has slowed, although a variety of companies have continued building local networks like the fiber rings in downtown business districts. In particular, AT&T (formerly SBC and BellSouth) and Verizon have announced multi-billion dollar local fiber projects in recent years. As with long-haul fiber, it is common for multiple firms to share fiber on metropolitan routes. Thus, while there have been many mergers and acquisitions, it is not clear that the total number of companies offering fiber has decreased significantly.

The fiber-optics industry's boom and bust was thus characterized by an enormous increase in capacity over roughly five years, followed by a spate of bankruptcies, large losses in company valuations, significant declines in prices, and consolidation. This, in turn, was followed by new deployment and new entry focusing on a different portion of the network.

TELECOM BOOM AND BUST

How do the booms and busts of the past compare?

RAILROADS: 1870 – 1894

In 1870, roughly 53,000 miles of railroad track were in use in the United States. Three decades later, that figure exceeded 200,000 miles. This change may not seem quite as dramatic as the optical fiber binge, but it was without a doubt more difficult to achieve. One need only think of the continental crossing, and the heroic engineering needed to lay track across the High Sierras. By contrast, much of the optical fiber in the 1990s was laid alongside railway tracks using trench-digging railroad cars – thereby piggybacking on the older network industry's infrastructure.

In the early 1890s, railroads fell on hard times. The industry's net earnings, which had been growing steadily for a decade, dropped by half in 1894 and remained at that level through 1895. Rail traffic did not decline, but prices did. Between 1883 and 1894, revenue per ton-mile dipped by roughly 30 percent. Revenue per passenger-mile also fell, by roughly 19 percent.

Many railroads went bankrupt, including iconic names like the Union Pacific, the Atchison, Topeka & Santa Fe, and the Philadelphia & Reading (memorialized in the board game Monopoly). The situation was grim enough that the Census Bureau began keeping accounts of the miles of track operated by bankruptcy trustees in 1894. That year, roughly 41,000 miles – 22 percent of the total – were in receivership.

This, however, was hardly the end of the line. The number of track-miles in receivership declined by half within three years, and by 90 percent by 1900. Meanwhile, neither the number of railroads nor their capacity decreased. Indeed, the number of locomotives in service and the amount of operational track continued to grow, with track mileage roughly doubling between 1894 and 1924. By 1899, the net income of the railroad industry was higher than it had been in 1893, and by 1900 it had more than doubled from the 1893 level.

Despite an increase in the number of railroads, the degree of concentration increased, with seven rail groups controlling roughly two-thirds of operational track by 1906. But this increase in concentration does not appear to have been associated with price increases. Revenue per ton-mile and revenue per passenger-mile essentially stayed flat until World War I.

Overall, then, the railroad industry experienced a few years of hard times, but its overall growth continued. Prices stayed relatively flat despite an increase in concentration following the industry downturn.

THE EARLY TELEPHONE INDUSTRY: 1894 – 1922

As with fiber-optic cable and railroads, both the size of the physical infrastructure and use of the early telephone system grew exponentially. However, unlike fiber networks and railroads, the story of the early telephone is the story of a single company – AT&T and its Bell subsidiaries. Alexander Graham Bell held the original telephone patents, but telephones had not become widely established in his lifetime. The government began collecting data on competing telephone networks in 1894, two years after the expiration of Bell's patents made competition possible.

Although the Bell companies had a head start, independents grew virtually in lock step with them well into the early 1900s. During this period, the independents typically did not interconnect with the Bell companies – that is, a subscriber to one service could not

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place calls to a customer of another. Having multiple non-connecting networks clearly frustrated both providers and callers, a problem that economic pressures were unlikely to allow to persist indefinitely. In fact, it is rather surprising that no significant degree of interconnection occurred for 12 years. However, in 1907, non-interconnecting companies began to disappear. AT&T acquired some of them, and agreed to interconnect with others.

The degree of consolidation attracted sufficient unwelcome attention that AT&T was roused to lobby for the Willis-Graham Act of 1921, which exempted telecom mergers from antitrust scrutiny in order to "unify the service." Independent telephone companies continued to exist, but the days of overlapping, non-interconnecting networks were largely over. In most areas, only a single carrier offered phone service.

Miles of wire in the networks and average number of phone calls for independent telephone companies grew little from 1916 until the end of World War II. By contrast, the Bell company network's wire mileage and average number of phone calls increased roughly fivefold over the same period. Despite this increase in concentration, Bell profit margins fell steadily, reaching their nadir just before AT&T received its antitrust exemption in 1921. Similarly, telephone rates remained steady or declined.

THE EARLY TELEGRAPH: 1850s – 1897

Data on the nascent telegraph industry are sketchy. From anecdotal evidence, though, we do know that a host of companies initially deployed networks, often in competition with one another. The government began collecting data on the telegraph industry in 1866, by which point Western Union had become the largest operator in the country. Indeed, most data on the early telegraph cover only Western Union. And these numbers show that Western Union's greatest growth began in 1866, much as growth in early telephone deployment took off after that industry's consolidation between 1910 and 1920. Between 1866 and 1897 (a period similar to 1916 to 1946 for the telephone industry), Western Union's miles of wire and number of messages handled grew 10-fold.

Price data are sparse in this early period, but prices reportedly fell prior to 1866 due to excess capacity, and then rose following industry consolidation. For example, rates between New York and Philadelphia rates were essentially flat from 1850 to 1870. However, most of the growth in telegraph lines occurred after industry consolidation, and Western Union's margins declined continuously over the period.

WHAT THIS MEANS TO THE ECONOMY

Many analysts have fretted about the long-run impact of the telecom bust on competition. In particular, the consolidation of competitive local exchange carriers and fiber providers has raised concerns.

The examples of earlier network industry busts, however, suggest that periods of consolidation mark only pauses in continuing expansion. In each of the earlier examples, most of the industry's growth took place after the first collapse, even though the initial growth periods were quite impressive on their own terms. Probably most important, the earlier examples suggest that prices tend to stay flat or to decline as the industries continue to grow, despite the disappearance of many of the early entrants.

The fiber-optics cycle seems to be playing out the same way. Significant fiber deployment continues, with firms publicly committing to billions of dollars worth of fiber projects. Price data are particularly difficult to come by – but again, the data that are available (from bandwidth trading companies like Band-X) suggest that prices, which fell during the bust period, have not rebounded.

Research in the economics of network industries shows that, in the presence of companies with network externalities and firm-specific advantages, a "critical mass" is needed to reach a stable market equilibrium. So industries can be expected to consolidate to the point that each surviving firm achieves this critical minimum size. Some networks also may display "natural monopoly" characteristics – for example, it may be inefficient to have multiple railroad tracks on the same route. In such cases, it may not be surprising that the industry continues to grow in a healthy manner following early consolidation, since the initial fragmentation of the industry is not sustainable.

It remains to be seen if the telecommunications industry will follow a similar pattern, given the fact that many firms cooperated in the deployment of new networks and now share routes and capacity. It may be that having carriers share conduits will result in even greater pricing pressure than observed historically in growing network industries. So far, however, the fiber-optic industry is following the same pattern as the historical network industries. M