

**The Telecommunications
Industry in Massachusetts:**

BUILDING INFRASTRUCTURE AND INNOVATION

PREPARED FOR THE MASSACHUSETTS TELECOMMUNICATIONS COUNCIL BY
THE UNIVERSITY OF MASSACHUSETTS DONAHUE INSTITUTE

November 4, 2003



Massachusetts Telecommunications Council



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NOVEMBER 2003

BY THE UMASS DONAHUE INSTITUTE

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November 2003

As we look to 2004, a comprehensive analysis of the telecommunications industry in Massachusetts reveals a multitude of new business ventures poised to capitalize on new market opportunities for hardware and software products, driven by growth in voice, data, and video services. These products and services, delivered over wireless and wireline networks worldwide, offer enormous potential for suppliers and consumers.

The fundamental strength of our industry is apparent as the industry emerges from a turbulent time marked by dramatically reduced capital spending, restrictive criteria for new venture investing, and reduced employment. Partnerships between industry-leading service providers and suppliers are supporting the commercialization of product and service concepts as the economy rebounds.

Innovative telecommunications technologies and infrastructure are revolutionizing the way businesses and individuals operate on a daily basis and plan for strategic competitive advantages in the future. As we emerge from this period of restructuring and refocusing our companies, we are encouraged by the strength and resilience of our industry. We anticipate increased deployment of services by the larger carriers and continued innovation by our talented suppliers in the years to come.

Bob Schechter

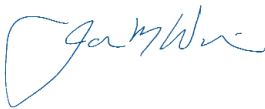


Chairman of the Board, Massachusetts Telecommunications Council

The University of Massachusetts is pleased to collaborate with the Massachusetts Telecommunications Council to produce this detailed analysis of an industry that has existed since Massachusetts native Samuel Morse invented the telegraph and opened his own business in 1845. During the past two decades, Massachusetts has become one of the leading hot spots for innovation in the telecommunications industry through both the investments of large companies and the creation of new ventures. Despite the industry challenges of the last few years, telecommunications will remain one of the most important components of the high tech economy.

The University, combining the intellectual power of its five campuses and the Office of the President, looks forward to assisting our partners in business and government as they work to strengthen the Commonwealth's position as a world leader in telecommunications, a cornerstone of the Massachusetts innovation economy.

Jack M. Wilson



President, University of Massachusetts

TABLE OF CONTENTS

| | |
|---|----|
| Preface | I |
| Executive Summary | 2 |
| Introduction | 3 |
| The State of the Massachusetts Economy | 5 |
| Changes in Telecommunications Employment and Establishments | 6 |
| Communications Services | 7 |
| Communications Equipment Manufacturing | 8 |
| Communications Equipment Manufacturing: Is the Worst of the Decline Over? | 9 |
| Communications Software | 12 |
| An Emerging Segment of the Telecommunications Industry? | 13 |
| Systems Integration | 14 |
| Wholesale and Retail Trade | 14 |
| Telecommunications Construction | 16 |
| National Standing | 17 |
| Share and Rankings by Segment | 18 |
| The Significant Role of Small Business | 19 |
| The Engineering Pipeline | 21 |
| Recent Trends in Venture Capital Funding | 22 |
| Conclusions | 22 |
| Appendix A. Telecommunications Industry Definition: SIC and NAICS Code Detail | 23 |

PREFACE

The Massachusetts Telecommunications Council was established in 1993 as the Commonwealth was emerging from a severe recession and at the very start of an unprecedented period of growth. Today the Council serves over 230 member companies ranging from communication service providers, to product application developers, enterprise IT organizations, industry consultants, and all the companies that support the industry.

In 1996, the Council partnered with the University of Massachusetts to conduct its first employment comprehensive analysis of the telecommunications industry in Massachusetts. The report found that in 1993 employment in this sector was 56,411. As you will discover in today's report, despite some recent declines, the industry still represents a significant part of Massachusetts's economy by employing 110,027 workers in the state.

Like most industries, the telecommunications sector has been impacted by the retrenching economy in the state. However, the industry is well poised to be an economic growth engine as the state looks to attract and grow all industries within the Commonwealth. A strong telecommunications infrastructure backbone is key to maintaining and attracting companies. In addition, innovative advances in telecommunications played a large role in driving the growth of all other sectors of the information economy in Massachusetts and the nation during the 1990s. They will, no doubt, contribute in important ways to the Commonwealth's future economic growth.

It has become clear that the telecommunications industry's infrastructure growth experienced during much of the 1990s has slowed considerably; however, telecommunications products and services have been expanding into other areas of the economy for some time. Devices and services that were used primarily for other purposes a few years ago are increasingly used primarily for communicating ideas, data, and messages between people all over the world. Some would even argue that a personal computer is as much a communications device today as a telephone, that almost all computer software has at least some communications functions, and that much of computer peripheral equipment is used to support the Internet or other communications networks. What was once just a wireless telephone now offers the promise of Internet access, messaging, picture transmission, and personal scheduling.

In an effort to systematically and consistently track the evolution of this important industry, the definition of the telecommunications used in this study mirrors the definition used in the 1996 study. Some minor changes reflect better information available today. Accordingly, the profile of employment in Massachusetts contained in this report is based on the traditional segments of the telecommunications industry only. Employment estimates are therefore somewhat conservative.

EXECUTIVE SUMMARY

There are seven segments used to define telecommunications in this study. They are: communications services, which includes companies that offer users access to communications; communications equipment manufacturing, which includes developers and manufacturers of various routers, and switches, as well as terminal equipment such as telephones, pagers, and communications PDAs; telecommunications software, which includes companies that develop software created to manage communications within the network and by computers or other devices connected to the network; systems integration, companies who specialize in the integration of hardware, software, human resources, and communications services into networks; wholesale and retail trade of communications products; and construction related to telecommunications infrastructure.

This year's comprehensive analysis found that the telecommunications industry in Massachusetts employs 110,027 workers; a significant portion of the Massachusetts economy. While the number represents an increase in employment by 15,172—or 16 percent since the second quarter of 1998, employment in the segment declined last year by 23,359—or 17.5 percent.

Although the immediate future of the telecommunications industry in Massachusetts is difficult to predict, signs are beginning to emerge that the economic downturn that has contributed to the dramatic reduction in demand for telecommunications products and services is nearly over. Nationally, investment in information and processing equipment is on the rise, orders for computers and electronic products are growing, and inventories are low suggesting that the long awaited increase in demand for technology products is at hand.

Whatever the immediate future holds, it is clear that in the long run the substantial human and technological assets that are present in Massachusetts position the telecommunications industry for a rapid recovery to meet anticipated future demand for communications infrastructure and services.

Major Findings

- In 2003, the telecommunications industry in Massachusetts provides 110,027 jobs. This figure includes only those workers employed by firms whose primary business activity involves telecommunications.
- In the past year industry employment has declined by 23,359, or 17.5 percent. Despite recent losses, it is important to note that industry employment has increased by 15,172, or 16 percent since the second quarter of 1998.
- Communications services remains the largest segment of the telecommunications industry in Massachusetts, employing 38,801. Between 1998 and 2002 this segment grew robustly, adding 25,061 jobs. However, in the past year 10,966 communications services jobs were lost, a 22 percent decline.
- Communications equipment manufacturing continues to be the second largest segment of the telecommunications industry in Massachusetts, employing 21,086 in the second quarter of 2003. However, since 1998, employment in this segment has declined by 4,127, or 16.3 percent. Over 97 percent of these job losses have occurred in the past year.

- From 1998 to 2003 the Commonwealth's share of total national telecommunications employment stayed relatively constant, slipping slightly from 3.3 to 3.0 percent. The fact that the Commonwealth's share of national telecommunications employment has generally remained steady indicates that employment losses in the telecommunications industry in Massachusetts have been in line with those experienced by the industry nationally.
- Communications services, the largest segment of the telecommunications industry in Massachusetts, reflected the nationwide decline in employment and essentially maintained its share of national employment, rising 0.4 of a percent between 1998 and 2002 and declining by 0.2 of a percent between 2002 and 2003. The share of national employment held by Massachusetts communications equipment manufacturing firms stayed steady at 4.7 percent between 2002 and 2003. The Systems Integration segment slightly increased its national share in this same period.
- The share of telecommunications jobs in Massachusetts located in smaller firms has grown steadily since 1998. Currently, firms with less than 250 employees employ 66 percent of all telecommunications workers in Massachusetts, compared to 54% of workers in 1998. In this same period, the share of Massachusetts telecommunications jobs provided by firms employing more than 1,000 workers has declined from 20 percent in 1998 to 8 percent in 2003.
- In relation to other states, Massachusetts has always been a major telecommunications employer, consistently ranking among the top states in each of the industry segments. The state's rankings slipped in nearly every segment over the last year, suggesting that while Massachusetts has fared well as compared to many other states in the nation, our competitive position has slipped somewhat as compared to competitor states.

INTRODUCTION

The telecommunications industry in Massachusetts produces a diverse range of products and provides an extensive array of services all of which are directly or indirectly designed to facilitate the exchange of information between people and machines at different locations. Telecommunications products and services support the transfer of information in a variety of forms, including voice or audio, images or video, data, and frequently, combinations of these forms. Common media for this information exchange include wireline and wireless networks, cable television systems, and the Internet. Communications products and services have a significant impact on nearly every aspect of our everyday lives and have become critical to the efficient functioning of our financial, medical, governmental and educational institutions. For the purposes of this report, the telecommunications industry is defined as including all the companies that play a role in building and maintaining the physical network that allows for information exchange, as well as those firms that provide services that facilitate the use of these networks and are delivered over them.

The diversity of the telecommunications industry extends beyond the range of products and services, however; the companies that make up this industry also serve a broad spectrum of markets that vary significantly in size and scope. Many of the industry's larger firms provide equipment, deliver services, and control and maintain their own network infrastructure. Other firms serve niche markets and provide more customized products and services. Because of the sheer scale and diversity of firms operating in the telecommunications industry in Massachusetts and the speed at which the composition of the industry changes, the development of a comprehensive industry definition requires a careful analysis of the industry's numerous segments.

In an effort to capture the diverse array of firms that provide telecommunications products and services in Massachusetts, this report defines the telecommunications industry in Massachusetts as being composed of firms drawn from 25 standard industrial classifications (SICs),¹ which are aggregated into seven major industry segments: communications services, communications equipment manufacturing, communications software, systems integration, wholesale trade, retail trade, and construction. The table below lists each of the major segments along with their categories².

| Telecommunications Industry Sectors | |
|--|--|
| Communications Services | Communications Software |
| Radiotelephone communication Telephone communication, except radio Telegraph and other communications Television broadcasting stations Cable and other pay television services Communication services, not elsewhere classified Telephone services Telephone set repair Telecommunications equipment repair (except telephones) Communication services Communications consulting | Prepackaged software |
| | Systems Integration |
| | Computer integrated systems design |
| | Wholesale Trade |
| | Cable, wire Wire and cable Electronic parts and equipment, not elsewhere classified |
| | Retail Trade |
| | Telephone & communications equipment |
| | Construction |
| | Communication line and transmission tower construction Communications specialization |
| | |
| Communications Equipment Manufacturing | |
| Communication wire Computer peripheral equipment, nec Telephone and telegraph apparatus Radio and t.v. communications equipment Computer terminals Communications equipment, not elsewhere classified | |

The primary data source for this report is MarketPlace, a product of D&B Sales & Marketing Solutions, formerly iMarket, Inc. The data are derived from various sources, such as credit reporting data, other public sources of information, and data directly gathered from individual companies. This dataset provides more timely and detailed data on industry employment and establishment growth than that available from public sources³.

¹ This analysis adds 2 SICs to our earlier definition of the telecommunications sector—communication services (8999.0800) and manufacturing of computer terminals (3575.0000). The codes were added after a careful analysis of the SICs of members of the Massachusetts Telecommunication Council and after consultation with several industry leaders. The practical impact of adding these codes has been modest, as collectively they represent less than 1% of industry employment and establishments.

² The industry definition used in this report is based on the Standard Industrial Classification System (SIC) rather than the new North American Industrial Classification System (NAICS) for two primary reasons. First, NAICS data do not yet allow for a sufficient time series to be developed that would allow the kind of historical analysis contained in this report. Second, public sources of NAICS based data, including data regularly provided by the Massachusetts Department of Employment and Training, are typically released a minimum of six months after being collected and are therefore not timely enough to allow for a detailed analysis of current conditions in this rapidly changing industry. For these reasons, we have turned to private sources of industry data which allow for both a current and historical analysis of the Massachusetts Telecommunications Industry. These private sources have not yet adopted the NAICS approach to industry classification.

³ Data from the other sources, such as the ES-202 data from the Department of Employment and Training (DET), are not as current and do not cover small companies with only a few employees. This is a critical factor in the analysis of this industry, as many companies in this sector are partnerships, virtual entities that employ independent agents, and are very small organizations. Dun and Bradstreet data also are more likely to include contract employment that can be missed by the ES-202. This is because contract employees are typically not covered by unemployment insurance.

THE STATE OF THE MASSACHUSETTS ECONOMY

According to the National Bureau of Economic Research Business Cycle Dating Committee, the U.S. emerged from the recession that began in March, 2001 in November of that same year⁴. By comparison, the Commonwealth of Massachusetts entered recession somewhat earlier (December, 2000) and has only very recently stopped contracting, as measured by the *Massachusetts Benchmarks* Current Economic Index. By this measure, the decline in real gross state product slowed to a halt in the second quarter of this year, after nine successive quarters of negative growth⁵.

A major reason for the continued decline of the Massachusetts economy some 18 months after the national economy's return to growth is the industrial composition of the Massachusetts economy. The Massachusetts economy is much more reliant on high technology industries, particularly services-based industries⁶. This reliance on high technology industries as a growth driver resulted in robust growth during the 1990s but has also contributed to a longer downturn as a prolonged national slump in business investment and capital spending on technology products have hindered the Commonwealth's economic recovery.

But signs have begun to emerge suggesting that the Commonwealth may be poised for a return to growth by the end of 2003. Nationally, investment in information and processing equipment is on the rise, orders for computers and electronic products are growing, and inventories are low suggesting that the long awaited increase in demand for technology products is at hand⁷. What remains uncertain is whether these positive signs will result in sustainable economic growth and, importantly, whether a return to economic growth for Massachusetts will be followed by diminishing employment declines and an improving labor market.

⁴ See: <http://www.nber.org/cycles/july2003.html>

⁵ See: <http://www.massbenchmarks.org/indices/indices.shtml>

⁶ For a detailed discussion of this trend, see Craig Moore, "The Shifting Balance: The New Service-Based Economy," *Massachusetts Benchmarks* 3 Summer 2000): 12-17.

⁷ Alan Clayton-Matthews. "Economic Currents" *Massachusetts Benchmarks*. Summer 2003

CHANGES IN TELECOMMUNICATIONS EMPLOYMENT AND ESTABLISHMENTS⁸

In 1993 there were 1,306⁹ business locations in Massachusetts where people were engaged primarily in telecommunications industry activities. By 1998, the number of telecom-related business sites increased to 4,621. In other words, in just five years, the number of business sites increased 254 percent. The number of telecommunication related business establishments continued to grow in the Bay State between 1998 and 2003, but the pace slowed considerably. By 2003 the number of locations grew to 6,081, a 32 percent increase over the last five years. Included in this five year net increase is the decline in the number of establishments from 2002 to 2003. In the past year the number of establishments declined by 298, or 4.7 percent.

| Telecommunications Industry | Establishments | | | | | | % Change |
|--|----------------|-------|-------|-------|-------|-------|----------|
| Segment | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 98 - 03 |
| Communications Services | 1,514 | 1,590 | 1,721 | 2,268 | 2,508 | 2,384 | 57% |
| Communications Equipment Manufacturing | 356 | 358 | 343 | 355 | 371 | 344 | -3% |
| Communications Software | 734 | 744 | 792 | 1,059 | 1,102 | 1,038 | 41% |
| Systems Integration | 692 | 707 | 725 | 864 | 933 | 910 | 32% |
| Wholesale Trade | 923 | 856 | 834 | 880 | 878 | 828 | -10% |
| Retail Trade | 237 | 229 | 240 | 302 | 382 | 384 | 62% |
| Construction | 165 | 174 | 176 | 200 | 205 | 193 | 17% |
| Total | 4,621 | 4,658 | 4,831 | 5,928 | 6,379 | 6,081 | 32% |

Employment in the telecommunications industry also experienced strong growth in the 1990s but has declined significantly in the last year. From 1993 to 1998 employment grew from 56,411 to 94,855, or by 68 percent. In the last five years employment has grown by 16 percent to 110,027. But between 2002 and 2003 the number of persons employed in the telecommunications industry in Massachusetts fell by 23,359, or 18 percent.

| Telecommunications Industry | Employment | | | | | | % Change |
|--|------------|--------|---------|---------|---------|---------|----------|
| Segment | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 98 - 03 |
| Communications Services | 24,706 | 29,778 | 31,846 | 44,224 | 49,767 | 38,801 | 57% |
| Communications Equipment Manufacturing | 25,213 | 25,224 | 24,880 | 26,612 | 25,101 | 21,086 | -16% |
| Communications Software | 13,370 | 15,937 | 16,557 | 23,298 | 22,182 | 19,088 | 43% |
| Systems Integration | 17,797 | 15,186 | 16,954 | 18,902 | 19,017 | 16,764 | -6% |
| Wholesale Trade | 10,510 | 9,780 | 9,791 | 13,025 | 12,193 | 9,995 | -5% |
| Retail Trade | 1,865 | 1,564 | 1,757 | 2,237 | 2,205 | 1,877 | 1% |
| Construction | 1,394 | 1,615 | 1,645 | 2,349 | 2,921 | 2,416 | 73% |
| Total | 94,855 | 99,084 | 103,430 | 130,647 | 133,386 | 110,027 | 16% |

⁸ All figures in this report are from the second quarter of the given year.

⁹ The 1993 figures cited in this study, of which there are only a few, are based on a slightly different telecommunications industry used in "Connection to the Future: An Analysis of the Telecommunications Industry in Massachusetts" by Professor Craig Moore, 1997. This definition does not include the two SICs mentioned in footnote 1, which account for about 1 percent of telecommunications employment in Massachusetts. Thus, these 1993 figures slightly understate the size of the industry as currently defined.

Communications Services

Communications services firms provide their customers with reliable access to communications network infrastructure and with software and other related products designed to help them use this infrastructure more efficiently. Services provided include local and long distance telephone service (both wireline and wireless), cable television, and Internet access. Examples of communications services firms in Massachusetts include: AT&T, Cingular Wireless, Level 3, RCN and Verizon. In recent years a number of customized services have emerged in response to market demand with diverse applications such as interactive video conferencing, instant stock quotes, and online securities trading. The development of new services has become a competitive imperative for many firms as the competition to provide communications services has heightened dramatically in the last several years¹⁰.

Firms providing communications services represent the largest segment of the Massachusetts telecommunications industry. Collectively, these firms have experienced substantial employment growth since 1993. The communications services segment currently accounts for 35 percent of all the jobs in the industry, and employment has grown by 57 percent since 1998. However, in the past year employment in this segment has declined significantly. In the last year a total of 10,966 communications services jobs were lost, a 22 percent decline. Of the 23,359 jobs lost in the Massachusetts telecommunications industry in the past year, 47 percent of these job losses occurred in the communications services segment.

| SIC | Communications Services | Employment | | | | | | % Change |
|-----------|--|------------|--------|--------|--------|--------|--------|----------|
| | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 98-03 |
| 4812 | Radiotelephone communication | 2,669 | 2,873 | 3,338 | 4,207 | 5,127 | 4,839 | 81% |
| 4813 | Telephone communication, except radio | 11,550 | 13,887 | 15,671 | 24,509 | 27,447 | 20,360 | 76% |
| 4822 | Telegraph and other communications | 352 | 672 | 359 | 235 | 333 | 280 | -20% |
| 4833 | Television broadcasting stations | 1,355 | 1,558 | 1,667 | 1,623 | 1,664 | 1,516 | 12% |
| 4841 | Cable and other pay television services | 3,681 | 2,947 | 3,120 | 3,713 | 5,656 | 3,048 | -17% |
| 4899 | Communication services, not elsewhere classified | 547 | 2,123 | 2,233 | 2,860 | 2,783 | 2,892 | 429% |
| 7389.1 | Telephone services | 3,020 | 4,041 | 3,846 | 4,514 | 3,924 | 3,088 | 2% |
| 7629.0302 | Telephone set repair | 81 | 76 | 31 | 100 | 64 | 28 | -65% |
| 7629.9905 | Telecom. equipment repair (not phones) | 47 | 46 | 46 | 76 | 82 | 93 | 98% |
| 8999.0800 | Communication services | 46 | 104 | 183 | 339 | 632 | 539 | 1072% |
| 8748.03 | Communications Consulting | 1,358 | 1,451 | 1,352 | 2,048 | 2,055 | 2,118 | 56% |
| | Total | 24,706 | 29,778 | 31,846 | 44,224 | 49,767 | 38,801 | 57% |

¹⁰ See Trends in Telephone Service Report issued in May of 2002 by the FCC's Industry Analysis and Technology Division Wireline Competition Bureau. This report can be downloaded at: <http://www.fcc.gov/wcb/stats>.

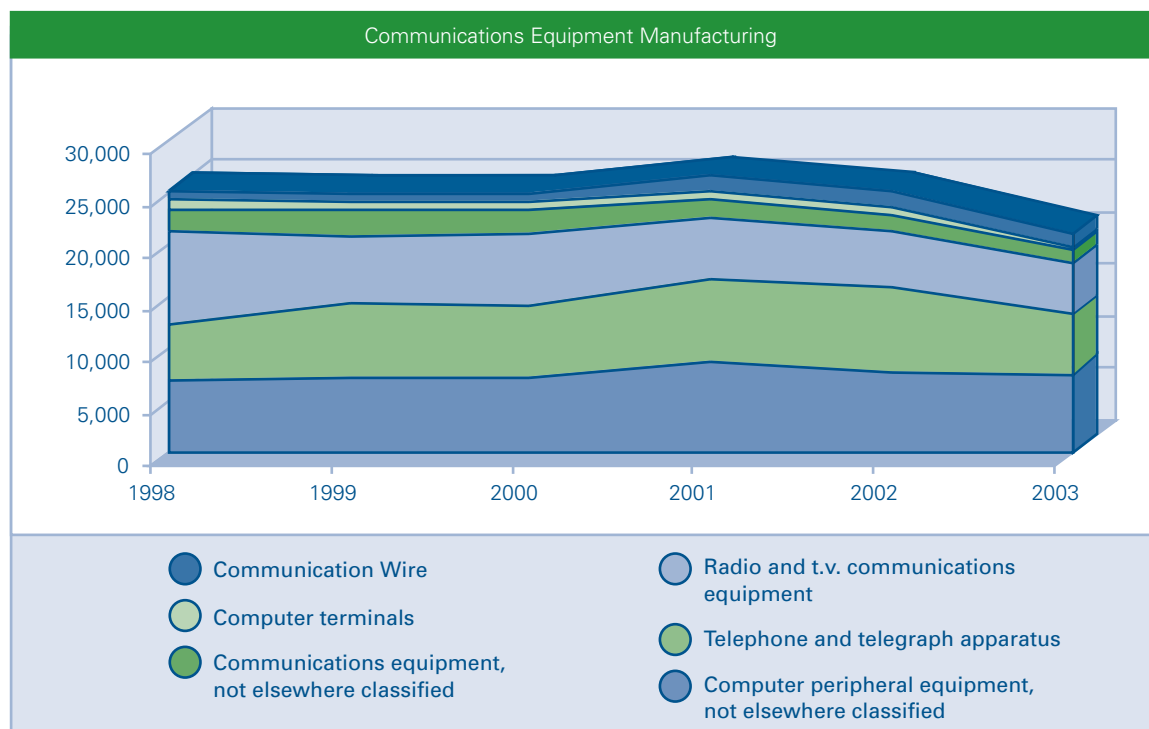
A closer examination of this segment reveals that a majority of the jobs were lost in the telephone communication (except radio) category. While this category experienced significant growth during the boom period, more absolute growth in fact, than any other communications services category, it has suffered more losses than any other category in the last year. In the past year employment in this category declined by 7,087, or 26 percent. Cable and other pay television services also experienced a sharp decline in employment during this same period. The number of jobs in this category dropped from 5,656 to 3,048, or 46 percent. These two categories account for the bulk of the jobs lost in communications services during the past year.

Communications Equipment Manufacturing

Communications equipment manufacturing firms develop and manufacture various routers, and switches, as well as terminal equipment such as telephones, pagers, and communications PDAs. Communications equipment manufacturing firms in Massachusetts include: Juniper Networks, RSA Security and Sonus Networks. From the early to mid-nineties the communications equipment manufacturing segment was the largest in the telecommunications industry and enjoyed modest employment growth. However, between 1998 and 2003, employment declined from 25,213 to 21,086, or 16.4 percent. Ninety seven percent of these job losses occurred in the past year.

Much of these employment declines have taken place in the telephone and telegraph apparatus category. This sector has lost 2,452 jobs in the past year.

| SIC | Communication Equipment Manufacturing | Employment | | | | | | % Change |
|-----------|---|------------|--------|--------|--------|--------|--------|----------|
| | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | |
| 3357.01 | Communication Wire | 935 | 764 | 849 | 1,366 | 1,367 | 1,306 | 40% |
| 3577 | Computer peripheral equipment, not elsewhere classified | 6,811 | 7,267 | 7,174 | 8,631 | 7,674 | 7,534 | 11% |
| 3661 | Telephone and telegraph apparatus | 5,393 | 7,187 | 6,954 | 8,162 | 8,138 | 5,686 | 5% |
| 3663 | Radio and t.v. communications equipment | 9,003 | 6,296 | 6,826 | 5,706 | 5,375 | 4,885 | -46% |
| 3575.0000 | Computer terminals | 821 | 747 | 742 | 876 | 964 | 327 | -60% |
| 3669.99 | Communications equipment, not elsewhere classified | 2,250 | 2,626 | 2,335 | 1,871 | 1,583 | 1,348 | -40% |
| | Total | 25,213 | 24,887 | 24,880 | 26,612 | 25,101 | 21,086 | -16% |



Computer peripheral equipment is now the largest category in communications equipment manufacturing. Since 1998, employment in this sector has increased from 6,811 to 7,534, or by 11 percent. However, from 2002 to 2003, employment in this sector declined by 140 jobs.

Radio and TV communications equipment, which with 9003 workers employed more people than any other sector in 1998, has lost 46 percent of these jobs in the years since and now employs only 4,885 people. Employment in the much smaller communications equipment (NEC¹¹) sector of communication equipment manufacturing has also declined significantly over the past five years, falling from 2,250 in 1998 to 1,348 in 2003, a decline of 40 percent. The collective impact of these employment declines in communications equipment manufacturing has been a 16 percent reduction in overall employment since 1998.

COMMUNICATIONS EQUIPMENT MANUFACTURING: IS THE WORST OF THE DECLINE OVER?

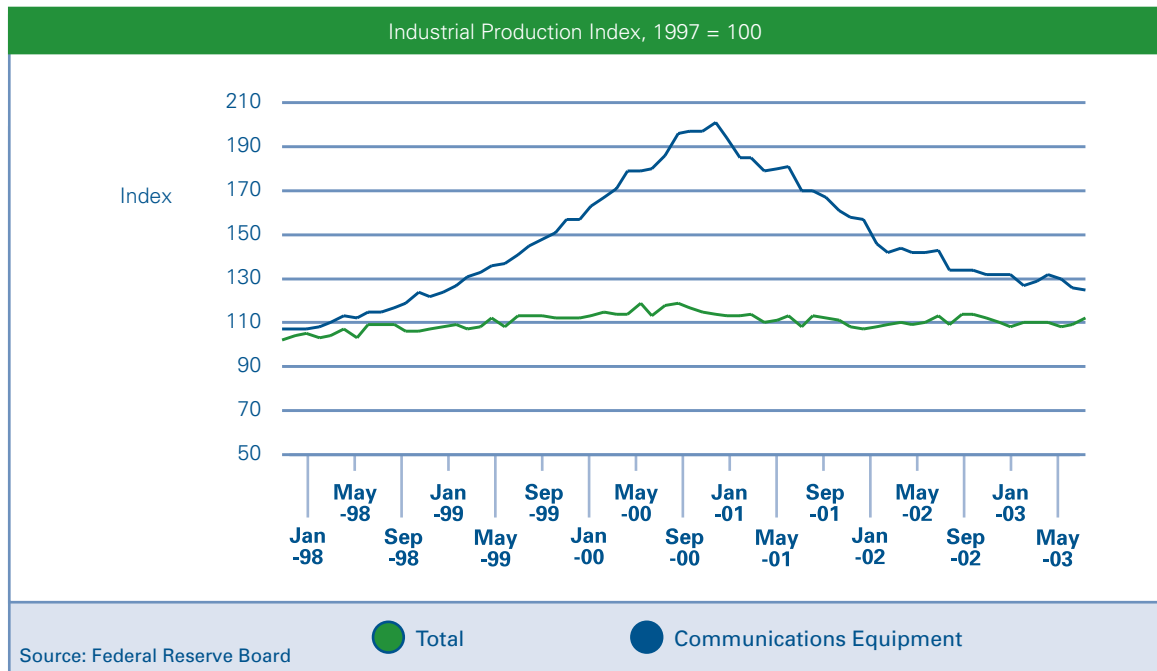
In recent years, the national production of communications equipment has dropped precipitously. Data collected by the Federal Reserve show that the national industrial output of the communications manufacturing sector peaked in December 2000, and since then has declined to near-1998 levels¹².

National sales have declined in dollar value since the production peak as well, with quarterly sales almost \$16 billion less in the first quarter of 2003 than at the peak of production in the fourth quarter of 2000¹³.

¹¹ Not Elsewhere Classified.

¹² Industrial Production and Capacity Utilization Report (G17). July 16, 2003. Board of Governors: Federal Reserve Bank.

¹³ U.S. Census Bureau, Economics and Statistics Administration, Quarterly Financial Report for Manufacturing, Mining and Trade Corporations (Washington, D.C.: Government Printing Office, June, 2003).



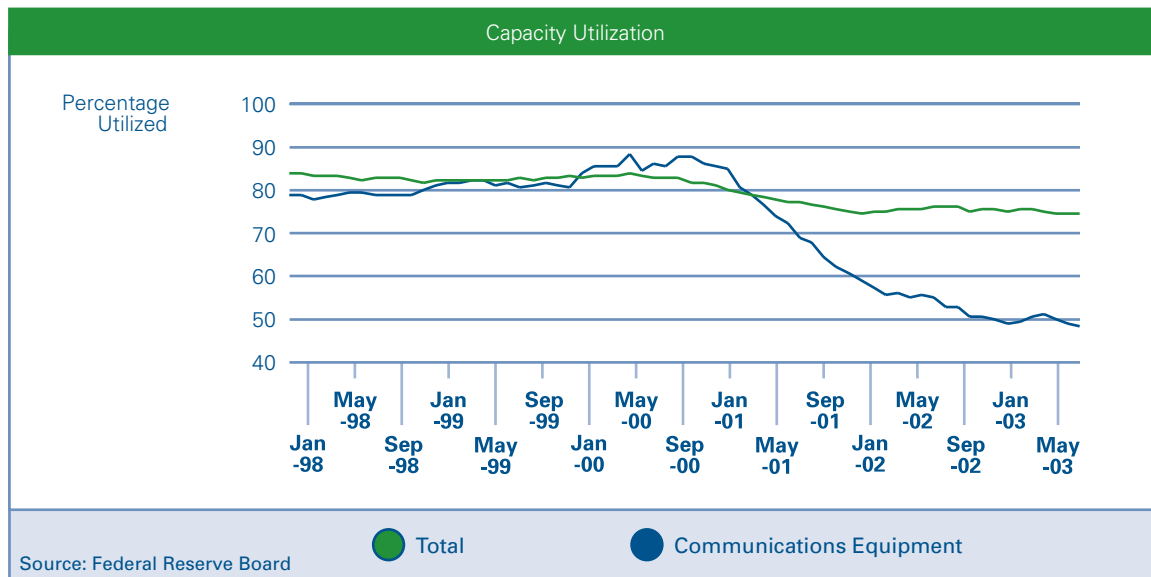
These dramatic declines in national production and sales of communications equipment forced firms in the segment of the telecommunications industry to restructure in order to adjust to a significantly weakened market. A number of strategies were used: dramatic cuts in their workforces; the disposal of noncore assets and the initiation of cost control programs. Even so, the communications equipment industry nationally continues to suffer from more communications equipment manufacturing capacity than it has been able to utilize, according to the Federal Reserve Board¹⁴.

| Communications Equipment Sales (million dollars) | | | | | | |
|--|--------|--------|--------|--------|--------|--------|
| Quarter | 4Q | 1Q | 4Q | 1Q | 4Q | 1Q |
| Year | 2000 | 2001 | 2001 | 2002 | 2002 | 2003 |
| Sales | 36,368 | 33,534 | 23,937 | 21,240 | 22,536 | 20,478 |

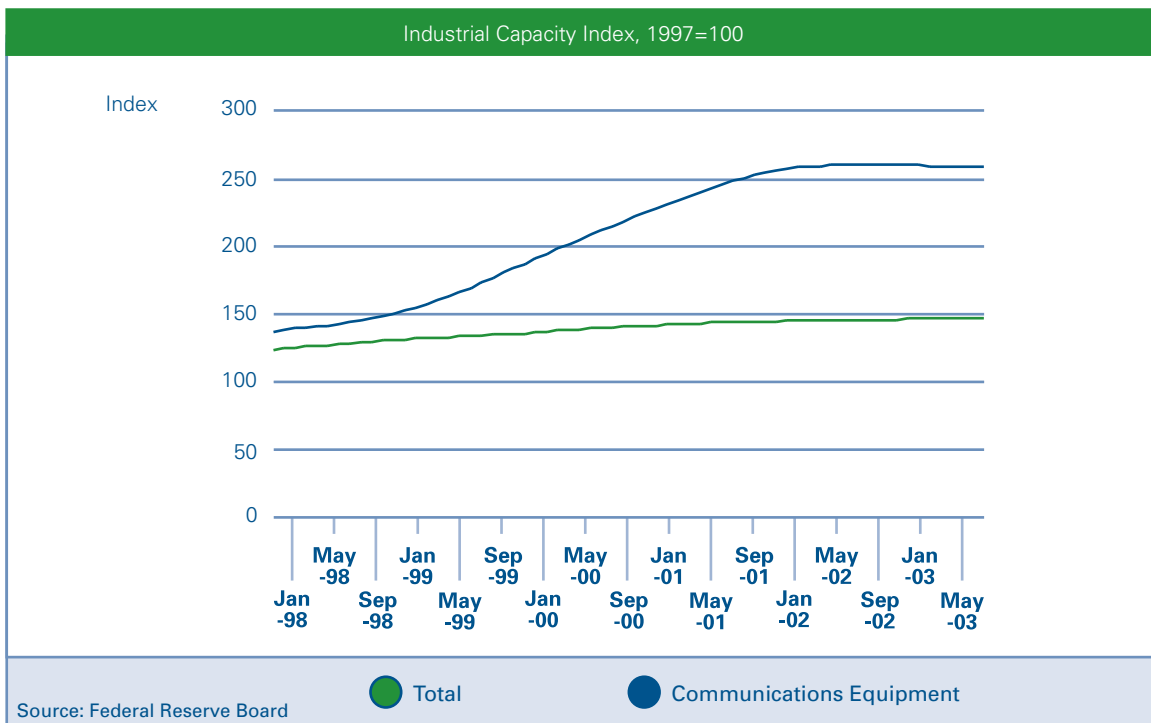
Source: US Census Bureau: Quarterly Financial Report For Manufacturing, Mining, And Trade Corporations

According to the Federal Reserve's Industrial Capacity Index, communications equipment manufacturers ceased adding new capacity around February 2002, and that capacity since then has stayed constant.

¹⁴ Op.Cit.



According to some analysts of the national communications equipment category, the end of the industry downturn which began in 2001 may be in sight. They propose that “supply and demand in the industry are approaching a better balance, following the destabilizing impact of a massive communications network build-out during 1999 and 2000, and sharp spending cutbacks in 2001 and 2002.”¹⁵



¹⁵ Standard and Poor's Industry Surveys: Communications Equipment, July 31, 2003, Volume 171, No. 31, Section 2, page 1.

National data also suggest that the worst of the decline in this segment of the industry may be over. In recent quarters substantial operating losses have become modest profits as firms have dramatically reduced costs in response to plummeting demand.

| Profits (losses) per dollar of sales (in cents) Before taxes | | | | |
|--|-------|------|------|------|
| 1Q | 2Q | 3Q | 4Q | 1Q |
| 2002 | 2002 | 2002 | 2002 | 2003 |
| -35.9 | -28.2 | -7.2 | -6.4 | 2.7 |

Source: US Census Bureau: Quarterly Financial Report For Manufacturing, Mining, And Trade Corporations

| Operating Profits (Millions) | | | | |
|------------------------------|--------|--------|------|------|
| 1Q | 2Q | 3Q | 4Q | 1Q |
| 2002 | 2002 | 2002 | 2002 | 2003 |
| -4,052 | -1,461 | -1,038 | -380 | 104 |

* Operating profits are profits before nonoperating income and expense items and income taxes.

Source: US Census Bureau: Quarterly Financial Report For Manufacturing, Mining, And Trade Corporations

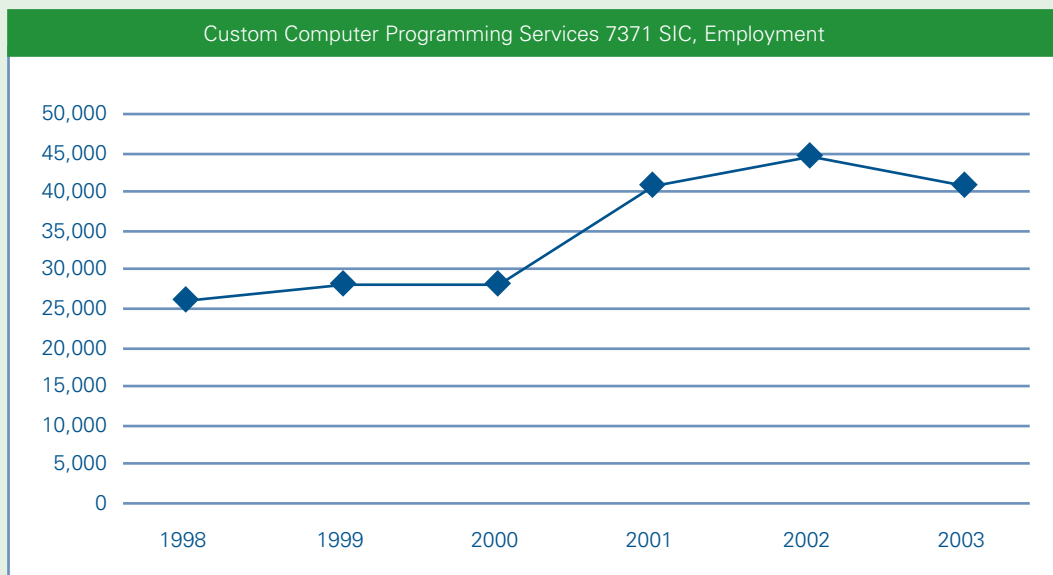
Communications Software

This segment includes companies that develop software created to manage communications within the network and by computers or other devices connected to the network. Examples of communications software firms in Massachusetts include: Chaoticom, Netezza, and Unveil Technologies. The communications software segment of the telecommunications industry has grown considerably over the last five years. While there were only 734 business locations in 1998, there were 1,038 five years later, a 41 percent increase. In the last year, however, this segment lost 64 establishments. Employment figures tell a similar story. From 1998 to 2003, employment in the software segment increased from 13,370 to 19,088—or by 43 percent—but since it reached its peak of 23,298 in 2001, employment has declined. Between the second quarter of 2002 and the second quarter of 2003 the number of workers in this segment dropped by 14 percent.

AN EMERGING SEGMENT OF THE TELECOMMUNICATIONS INDUSTRY?

The convergence of the information technology and telecommunications industries is increasingly visible and is reflected in the companies which make up the custom computer programming sector in Massachusetts (SIC 7371). While this industry sector is not included in the definition of the telecommunications industry used in this report, its connection and significance to the industry is growing.

The information technology (IT) industry provides many services, including training software end users and systems administrators, integrated systems design, computer maintenance and repair, including hardware and peripheral installations, upgrades, replacements, and troubleshooting of hardware, and software programming and consulting. Custom Programming Services (SIC 7371) provides computer programming services on a contract or fee basis; computer design and analysis; modifications of custom software; and training in the use of custom software. In Massachusetts, employment in this sector has increased from 25,982 in 1998 to 40,688 in 2003, although employment declined by 3,698 between the second quarter of 2002 and the second quarter of 2003.



Sitara Networks is but one example of the over 2,000 Massachusetts business locations that Dun and Bradstreet classifies as part of this category. Sitara Networks creates software that allows companies to efficiently manage the flow of data over networks, including VOIP, which is relevant to both telecom and non-telecom network managers alike.

The robust growth of custom programming services in Massachusetts highlights the fact that increasingly, computer programmers and software designers are critical elements of both the information technology and telecommunications industries in Massachusetts.

Systems Integration

A number of firms in the telecommunications industry in Massachusetts enable their customers to make the best use of telecommunications equipment software and services by packaging these products and services along with specialized training and other services. Known as “systems integrators”, these firms provide their clients with solutions to the myriad of challenges confronting firms that operate in a rapidly changing technological environment. Examples of systems integration firms in Massachusetts include: Global Link Communications, Intellinet and StarGen.

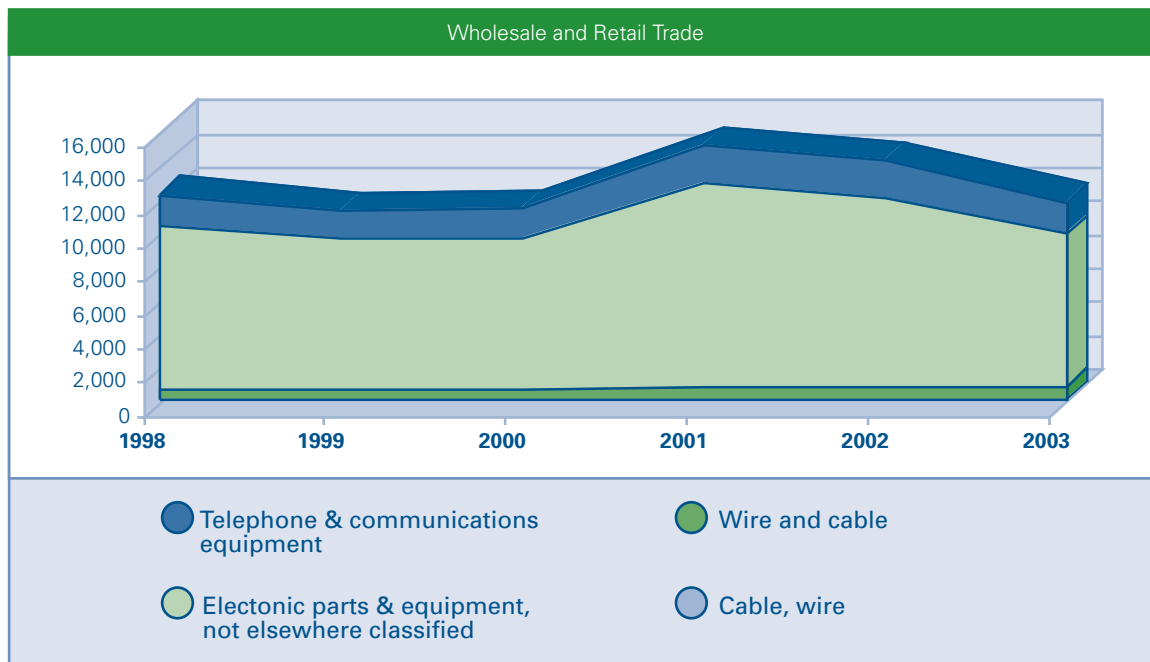
There are currently 16,764 people working at 910 business locations in the systems integration segment of the telecommunications industry in Massachusetts. While the number of business locations increased by 218, or by 32 percent, between 1998 and 2002, this upward trend has changed course in the last year. The number of systems integrations establishments in Massachusetts has declined by 23, or 2.5 percent in the past year. The trend in employment in this segment has been similar. Systems integration employment grew from 17,797 in 1998 to 19,017 in 2002, or by nearly 7 percent, but has declined by 12 percent to 16,764 in the past year.

Wholesale and Retail Trade

Like many other segments in the Massachusetts telecommunications industry, both the wholesale and retail trade of communications equipment and devices enjoyed growth between 1998 and 2002 but experienced employment declines in the past year. Together these segments employed 14,398 people in 2002, but this figure dropped to 11,872 by the second quarter of 2003. Collectively, these segments have lost 2,526 jobs and 48 business locations in the past year.

Employment in the wholesale trade segment increased by nearly 1,683, or 16 percent, between 1998 and 2002 but then dropped precipitously in the last year by 2,198, or 18 percent. Electronic parts and equipment (NEC) is by far the largest category in wholesale trade, and it has borne the brunt of the recent employment losses. The other two categories experienced very modest losses in employment during this same period.

The story for retail trade mirrors that of wholesale trade. Between 1998 and 2002, employment rose from 1,865 to 2,205, but nearly all of these gains have disappeared in the past year as employment in this segment declined to 1,877 in 2003.

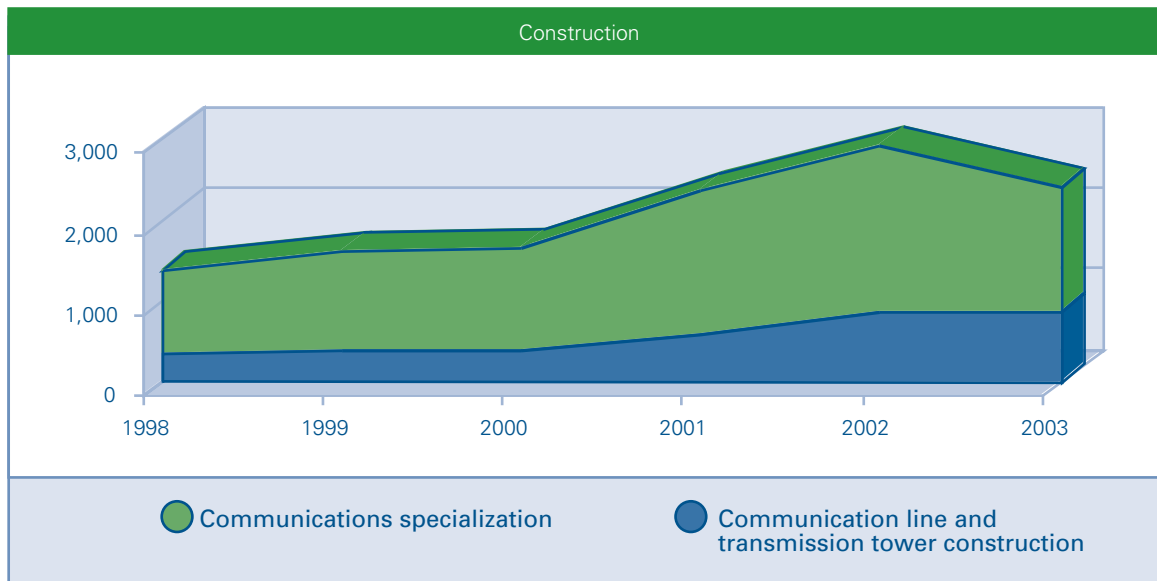


| SIC | Wholesale Trade | Employment | | | | | | % Change |
|-----------|--|------------|--------|--------|--------|--------|--------|----------|
| | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 98-03 |
| 5051.0102 | Cable, wire | 122 | 122 | 119 | 129 | 129 | 121 | -1% |
| 5063.03 | Wire and cable | 616 | 627 | 608 | 701 | 801 | 797 | 29% |
| 5065 | Electronic parts & equipt., not elsewhere classified | 9,772 | 9,031 | 9,064 | 12,195 | 11,263 | 9,077 | -7% |
| | Sub-total | 10,510 | 9,780 | 9,791 | 13,025 | 12,193 | 9,995 | -5% |
| SIC | Retail Trade | Employment | | | | | | % Change |
| 5999.06 | Telephone & communications equipment | 1,865 | 1,564 | 1,757 | 2,237 | 2,205 | 1,877 | 1% |
| | Total | 12,375 | 11,344 | 11,548 | 15,262 | 14,398 | 11,872 | -4% |

Telecommunications Construction

The final segment of the telecommunications industry in Massachusetts is telecommunications construction. Firms in this segment of the industry assemble and install the towers and cable required by the networks of telecommunications service providers and other users of telecommunications equipment.

The experience of the telecommunications construction segment is consistent with what has been seen in the other segments of the industry in Massachusetts. In 1998, 165 establishments employed 1,394 people in this segment. By 2002, 205 establishments employed 2,921 people. Between 2002 and 2003 the number of establishments dropped by 12, or 6 percent, and the number of employees fell by 505, or 17 percent.



| SIC | Construction | Employment | | | | | | % Change |
|---------|--|------------|-------|-------|-------|-------|-------|----------|
| | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 98-03 |
| 1623.02 | Communication line and transmission tower construction | 369 | 387 | 410 | 599 | 862 | 869 | 136% |
| 1731.03 | Communications specialization | 1,025 | 1,228 | 1,235 | 1,750 | 2,059 | 1,547 | 51% |
| | Total | 1,394 | 1,615 | 1,645 | 2,349 | 2,921 | 2,416 | 73% |

NATIONAL STANDING

A good way to measure the relative performance of the telecommunications industry in Massachusetts is to examine how the telecommunications industry in Massachusetts compares with the larger U.S. industry. Essentially, declines in the telecommunications industry in Massachusetts employment have been in line with those experienced by the industry nationally. From 1998 to 2002 the Commonwealth's share of total national telecommunications employment stayed relatively constant, slipping slightly from 3.3 to 3.2 percent. In the past year its employment share slipped an additional 0.2 of a percentage point to 3.0 percent.

| Massachusetts | | | | U.S. Industry | | | Massachusetts | | |
|--|--------|---------|---------|---------------|-----------|-----------|---------------|----------|----------|
| Telecommunications Segment | 1998 | 2002 | 2003 | 1998 | 2002 | 2003 | Share 98 | Share 02 | Share 03 |
| Communications Services | 24,706 | 49,767 | 38,801 | 1,374,441 | 2,246,831 | 1,942,356 | 1.8% | 2.2% | 2.0% |
| Communications Equipment Manufacturing | 25,213 | 25,101 | 21,086 | 513,625 | 531,353 | 444,876 | 4.9% | 4.7% | 4.7% |
| Communications Software | 13,370 | 22,182 | 19,088 | 197,739 | 338,458 | 317,073 | 6.8% | 6.6% | 6.0% |
| Systems Integration | 17,797 | 19,017 | 16,764 | 282,472 | 487,488 | 409,503 | 6.3% | 3.9% | 4.1% |
| Wholesale Trade | 10,510 | 12,193 | 9,995 | 282,750 | 326,278 | 285,387 | 3.7% | 3.7% | 3.5% |
| Retail Trade | 1,865 | 2,205 | 1,877 | 77,658 | 122,771 | 121,084 | 2.4% | 1.8% | 1.6% |
| Construction | 1,394 | 2,921 | 2,416 | 104,073 | 159,635 | 146,636 | 1.3% | 1.8% | 1.6% |
| Total | 94,855 | 133,386 | 110,027 | 2,832,758 | 4,212,814 | 3,666,915 | 3.3% | 3.2% | 3.0% |

In relation to other states, Massachusetts has always been a major telecommunications employer, consistently ranking among the top states in each of the industry segments. Unfortunately, the state's rankings slipped in nearly every segment over the last year, suggesting that while Massachusetts has fared well as compared to many other states in the nation, our competitive position has slipped somewhat as compared to competitor states.

| MA National Rank by Employment | | | |
|--|------|------|------|
| Sector | 1998 | 2002 | 2003 |
| Construction | 26 | 18 | 20 |
| Communications Equipment Manufacturing | 6 | 5 | 7 |
| Communications Services | 18 | 15 | 16 |
| Wholesale Trade | 7 | 6 | 8 |
| Retail Trade | 12 | 19 | 20 |
| Communications Software | 3 | 2 | 3 |
| Systems Integration | 4 | 8 | 8 |

SHARE AND RANKINGS BY SEGMENT

Communications services, the largest segment of the telecommunications industry in Massachusetts, reflected the nationwide decline in employment and essentially maintained its share of national employment, rising 0.4 of a percent between 1998 and 2002 and declining by 0.2 of a percent between 2002 and 2003. In 1998, Massachusetts was ranked 18th of all states in this segment, its rank went up in 2002 to 15th but it declined in 2003 to 16th of all states. Top ranked states in this segment in 2003 were California (with 210,529 jobs), Texas (with 204,495 jobs) and New York (with 116,527 jobs).

While slipping in rank, communications equipment manufacturing held its ground in terms of its share of national employment in the last year. Equipment manufacturing employment declined in Massachusetts from 2002 to 2003, but its national share stayed level at 4.7 percent.

Massachusetts' rank in this segment in 1998 was number six in the nation. Its rank increased to fifth in the nation by 2002 but it slipped in 2003 to number seven in the nation. As seen in the communications services rankings, California, Texas, and New York were first, second and third respectively.

Communications equipment manufacturing employment has declined precipitously in the country as a whole, with over 100,000 jobs eliminated this past year. In terms of the scale of its loss, Massachusetts did better than Texas and New Jersey between 2002 and 2003. These states lost over 30 percent of their communications equipment jobs, while Massachusetts lost 16 percent of its jobs. So even with its job losses in the segment over the past year, Massachusetts has not been as hard hit as some states during this difficult period.

The Commonwealth's national share of communications software employment declined slightly in the past year. In 2002, Massachusetts had 22,182 jobs and 6.6 percent of the national share, but with last years' 14 percent decline in communications software jobs, its share of national employment slipped to 6.0 percent. In terms of 1998 rank, Massachusetts was the third ranked state in this segment behind California and Texas. In 2002, Massachusetts ranked second in the nation with Texas third, but by 2003 its position slipped to number three.

The state share of the systems integration segment increased in the last year, climbing from 3.9 percent in 2002 to its current share of 4.1 percent. Over the last five years, the Commonwealth's national employment share in this segment dropped from 6.3 percent to 4.1 percent. In terms of national rank, the state ranked fourth in 1998. By 2002, its rank had slipped to eighth overall and this rank stayed the same in 2003. California, Texas and Virginia are the top employers of all states in this segment.

Due to an 18 percent decline in wholesale trade jobs in this segment between 2002 and 2003, Massachusetts slipped in national rank to number eight overall. California, Texas and New York are the top ranked states in this segment in 2003.

California, Texas and Florida are the top three ranked states in Retail Trade in 2003. Massachusetts' standing in this segment declined from number twelve of all states in 1998 to number 19 in 2002. The Commonwealth's 2003 ranking in the retail trade segment slipped further to number 20 overall.

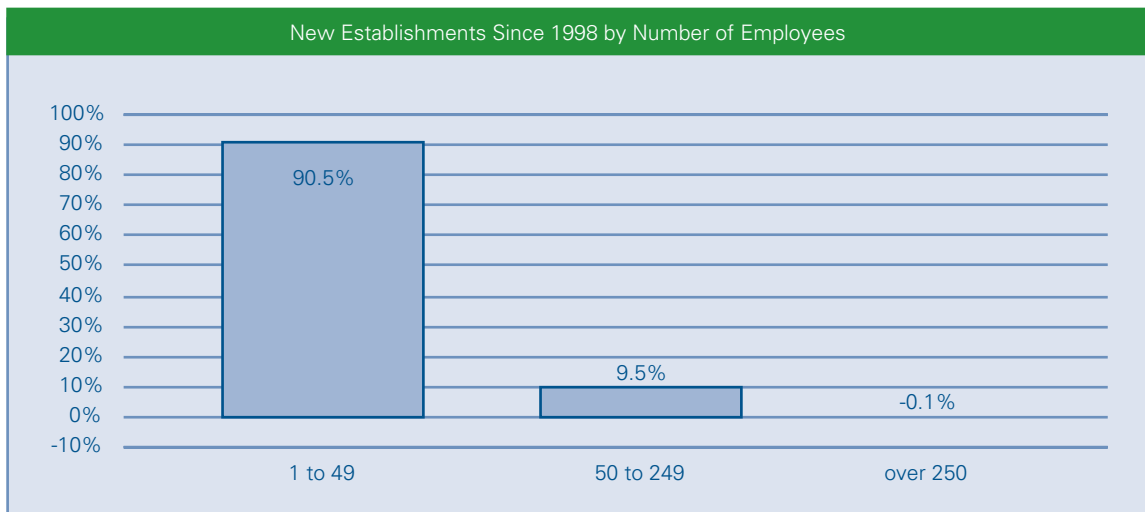
The national ranking of Massachusetts also slipped between 2002 and 2003 in Communications-related Construction - from 18th to 20th overall. Texas, California and Florida are the top ranked states in this sector.

THE SIGNIFICANT ROLE OF SMALL BUSINESS

From 1998 to 2002, employment in the Massachusetts telecommunications industry grew steadily in large measure because of the success of smaller firms. In those four years, 82 percent of new job growth occurred in firms with fewer than 250 employees. This represented 31,384 new jobs¹⁶.

| Telecommunications Employment by Business Size 1998-2003 | | | | | | |
|--|--------|--------|--------|----------------------|----------------------|----------------------|
| | 1998 | 2002 | 2003 | New Employment 98-02 | New Employment 02-03 | New Employment 98-03 |
| 1 to 49 | 26,316 | 34,555 | 32,960 | 8,239 | -1,595 | 6,644 |
| 50 to 249 | 24,915 | 48,060 | 39,644 | 23,145 | -8,416 | 14,729 |
| 250 to 999 | 25,124 | 31,543 | 28,694 | 6,419 | -2,849 | 3,570 |
| 1000 to 4999 | 18,500 | 19,228 | 8,729 | 728 | -10,499 | -9,771 |

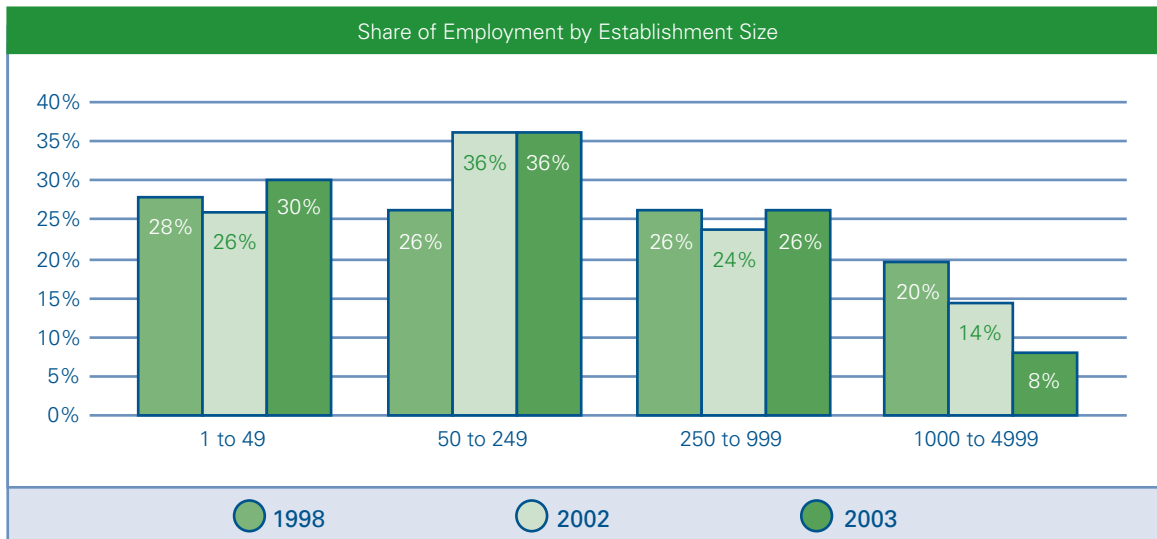
In the last year, firms of all sizes in the Massachusetts telecommunications industry suffered losses in employment, though larger firms seem to have borne a greater share of the impact. Between 2002 and 2003, telecommunications firms with 1,000 to 4,999 employees lost 55 percent of their workers; slightly smaller firms, those with 250 to 999 employees, lost 9 percent of their workers; and firms with 50 to 249 employees lost 17.5 percent of their workers. Very small firms, those with fewer than 50 employees, performed relatively better, shedding 4.6 percent of their workers in the last year. As a result, very small firms gained a larger share of the Commonwealth's telecommunications employment, increasing from 26 percent to 30 percent in the last year. Meanwhile, firms with 1,000 employees or more experienced a sharp decline in their share of employment which has fallen from 14 percent to 8 percent in the past year.



¹⁶ The Telecommunications Industry in Massachusetts: A Time of Transition: Mass Telecommunications Council. 2002.

| Telecommunications Establishments by Size 1998-2003 | | | | | | |
|---|-------|-------|-------|------------------------------|------------------------------|------------------------------|
| | 1998 | 2002 | 2003 | New Business Locations 98-02 | New Business Locations 02-03 | New Business Locations 98-03 |
| Small (1 to 49) | 4,289 | 5,818 | 5,611 | 1,529 | -207 | 1,322 |
| Medium (50 to 250) | 260 | 472 | 399 | 212 | -73 | 139 |
| Large (More than 250) | 72 | 89 | 71 | 17 | -18 | -1 |
| Total | 4,621 | 6,379 | 6,081 | 1,758 | -298 | 1,460 |

Over the last five years, smaller firms have continued to be the major success story in the Massachusetts telecommunications industry. Between 1998 and 2003, firms with 50 to 249 employees experienced employment increases of 59 percent, while employment in firms with fewer than 50 workers grew 25.2 percent.

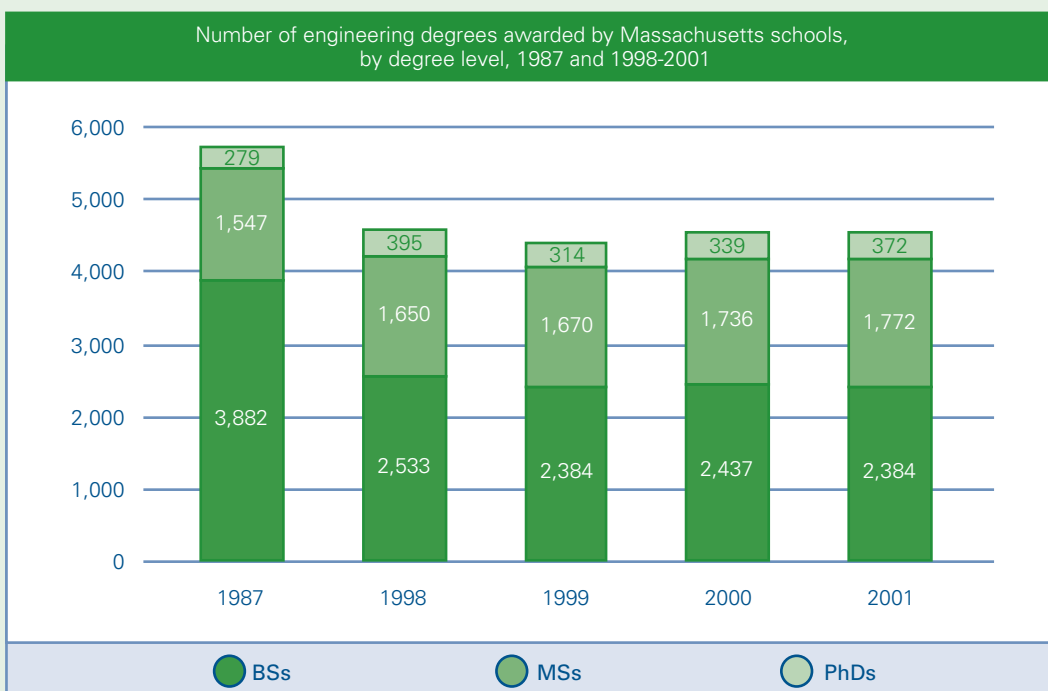


THE ENGINEERING PIPELINE

The need for engineers and computer scientists is especially critical in certain segments of the telecommunications industry. The communications equipment segment as well as the computer software and related IT services segment are among those in the state with the largest concentrations of IT and related scientific workers, including engineers.

In spite of the heavy reliance of leading industries in Massachusetts on engineers and computer scientists, the Massachusetts engineering pipeline is filled with leaks. A recent study found that a significant number of students in Massachusetts who enroll in undergraduate engineering and science programs are forced to drop out due to the lack of math skills¹

The output of the pipeline of engineers in Massachusetts is also a cause for concern. The total number of engineering degrees awarded in Massachusetts has remained relatively flat since 1998.



Source: American Association of Engineering Societies, as featured in the Massachusetts Technology Collaborative Index of the Massachusetts Innovation Economy 2002 report.

Between 2000 and 2001, the total number of engineering degrees awarded in Massachusetts rose 0.4 percent, compared to a 3.3 percent increase nationally. Strikingly, the number of undergraduate engineering degrees awarded in Massachusetts decreased 2.2 percent between 2000 and 2001, while increasing by 2.5 percent in the US during this same period.

¹ Fogg, W. Neil; and Harrington, P. May, 2003. The Math Proficiencies of College-Bound High School Seniors: Selected Findings from an Analysis of Math SAT-1 Data for New England States. In *Fueling the Pipeline: Attracting and Educating Math and Science Students, Conference Report*, 13-18. EMC Corporation.

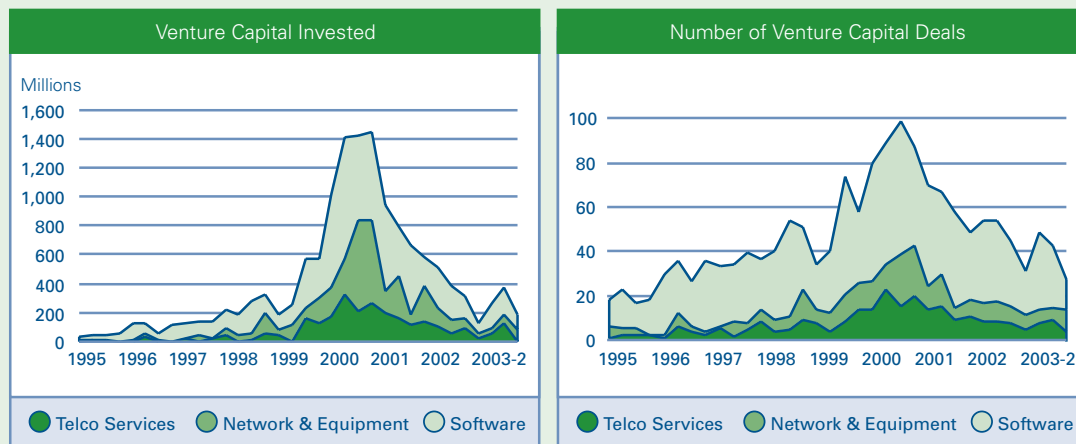
² Massachusetts Technology Collaborative, 2002. Engineering and Computer Science Degrees, Scientists and Engineers in the Labor Force. In 2002 Index of the Innovation Economy, Section 23.

RECENT TRENDS IN VENTURE CAPITAL FUNDING

Over the past decade, Venture capital invested in the Massachusetts telecommunications industry has demonstrated periods of growth, followed by decline. Venture capital, with its cyclic expansion and restructuring, has been a driving force behind the growth of the telecommunications industry.

Reflective of such cyclical activity, growth in venture capital investment sharply declined by the last quarter of 2000, immediately following its peak in the second quarter of 2000. Between the second quarter of 1999 and the first quarter of 2000, investment in telecommunications (telecommunications services, software, and network & equipment) rose dramatically from \$579.5 million to a peak of over \$1.45 billion.

This expansion persisted into the third quarter of 2000, but ended dramatically when the high tech "bubble" burst in the last quarter of 2000 and Venture Capital investment plummeted to \$947.3 million. Declines continued into the third quarter of 2002, falling to a low of \$135.7 million. Investment in Massachusetts telecommunications grew over the next two quarters, but then declined again, dropping to \$190.9 million in the second quarter of 2003.



Source: PriceWaterhouseCoopers/Venture Economics/National Venture Capital Association MoneyTree Survey

CONCLUSIONS

Although the immediate future of the telecommunications industry in Massachusetts is difficult to predict, signs are beginning to emerge that suggest that the economic downturn that has contributed to the dramatic reduction in demand for telecommunications products and services is nearly over. Nationally, investment in information and processing equipment is on the rise, orders for computers and electronic products are growing, and inventories are low suggesting that the long awaited increase in demand for technology products is at hand.

In the past year employment in the telecommunications industry in Massachusetts has declined by 23,359, or 17.5 percent. These losses, however, do not change the fact that industry employment has increased by 15,172, or 16 percent since the second quarter of 1998 and that the industry continues to provide employment to 110,027 Massachusetts workers.

What is clear is that the substantial human and technological assets that are present in Massachusetts position the telecommunications industry well for growth when the anticipated future demand for communications infrastructure and services materializes.

Appendix A: Telecommunications Industry Definition SIC and NAICS Code Detail

| | SIC | NAICS | |
|---|-----------|--------|---|
| I. CONSTRUCTION | | | |
| Communication line and transmission tower construction | 1623-02 | 23492 | Power and Communication Transmission Line Construction |
| Communications specialization | 1731-03 | 23531 | Electrical Contractors |
| II. COMMUNICATIONS EQUIPMENT MANUFACTURING | | | |
| Communications energy wire Wire Manufacturing | 3357-01 | 335929 | Other Communication and Energy |
| Computer Terminals | 3575-0000 | 334113 | Computer Terminal Manufacturing |
| Telephone and Telegraph Apparatus | 3661 | 33421 | Telephone Apparatus Manufacturing |
| Radio & TV communications equipment | 3663 | 33422 | Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing |
| Communications Equipment, Not Elsewhere Classified | 3669-99 | 33429 | Other Communications Equipment Manufacturing |
| Computer Peripheral Equipment, Not Elsewhere Classified | 3577 | 334418 | Printed Circuit Assembly (Electronic Assembly) Manufacturing |
| | | 334613 | Magnetic and Optical Recording Media Manufacturing |
| | | 334119 | Other Computer Peripheral Equipment Manufacturing |
| III. COMMUNICATIONS SERVICES | | | |
| Radio Communications, Not Elsewhere Classified | 4812 | 51333 | Telecommunications Resellers |
| Telephone Communications, Except Radiotelephone | 4813 | 51331 | Wired Telecommunications Carriers |
| | | 51333 | Telecommunications Resellers |
| | | 51334 | Satellite Telecommunications |
| Telegraph & other communications | 4822 | 51331 | Wired Telecommunications Carriers |
| Television Broadcasting Stations | 4833 | 51312 | Television Broadcasting |

| | | | |
|---|-----------|----------------------------|---|
| Cable and Other Pay Television Services | 4841 | 51321 51322 | Cable Networks Cable and Other Program Distribution |
| Communications Services, Not Elsewhere Classified | 4899 | 51339 51334 513322 | Other Telecommunications Satellite Telecommunications Cellular and Other Wireless Telecommunications |
| Telephone services, answering services, telemarketing, etc | 7389-10 | 561499 561421 561422 | All Other Business Support Services Telephone Answering Services Telemarketing Bureaus |
| Telecommunication equipment repair (except telephones) | 7629-9905 | 811212 | Computer and Office Machine Repair and Maintenance |
| Telephone set repair | 7629-0302 | 811213 | Communication Equipment Repair and Maintenance |
| Communications consulting | 8748-03 | 541618 | Other Management Consulting Services |
| Communication services | 8999-0800 | 54169 514199 | Other Scientific and Technical Consulting Services All Other Information Services (pt) |
| IV. WHOLESALE TRADE | | | |
| Cable, wire | 5051-0102 | 42151 | Metals Service Centers and Offices |
| Wire and cable | 5063-03 | 42161 | Electrical Apparatus and Equipment, Wiring Supplies, and Construction Material Wholesalers |
| Electronic Parts and Equipment, Not Elsewhere Classified | 5065 | 42169 | Other Electronic Parts and Equipment Wholesalers |
| V. RETAIL TRADE | | | |
| Telephone and communication equipment | 5999-06 | 443112 | Radio, Television, and Other Electronics Stores |
| VI. COMMUNICATION SOFTWARE | | | |
| Prepackaged Software | 7372 | 51121 334611 | Software Publishers Software Reproducing |
| VII. SYSTEMS INTEGRATION | | | |
| Computer Integrated Systems Design | 7373 | 541512 | Computer Systems Design Services |

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