The Telecommunications Industry in Massachusetts:

A Time of Transition

A REPORT DEVELOPED FOR THE MASSACHUSETTS TELECOMMUNICATIONS COUNCIL BY PROFESSOR CRAIG MOORE, UMASS AMHERST, ISENBERG SCHOOL OF MANAGEMENT,

WITH ECONOMIC RESEARCH SUPPORT PROVIDED BY THE UNIVERSITY OF MASSACHUSETTS DONAHUE INSTITUTE

November 2002

From Alexander Graham Bell's first telephone call to the origins of the Internet, Massachusetts is, and has been, at the forefront of innovative telecommunications technology for more than a century. Perhaps even more important than the technology, however, is the expertise of telecommunications companies in Massachusetts in bringing new products and services to consumers and businesses around the world. These companies provide employment for thousands of workers, and enable communications services that improve the way we all work, live and play.

In the mid- to late-1990s the telecommunications sector experienced explosive growth. While recently we have seen a slowdown, we remain a vibrant and a critical sector in the overall Massachusetts economic landscape. In fact, in 2002, telecommunications companies in Massachusetts directly employ over 130,000 workers in more than 6,200 locations. If we count indirect employment, the impact of the telecommunications sector is much, much larger. These innovative companies are critical to the Massachusetts economy, and are positioned to respond to growing demand as the economy rebounds.

This report provides valuable insight into the composition of our industry today, and good perspective on its current state of transition. As new cutting edge technology is researched and new products and services introduced to the market, in tandem with public policy that promotes competition, I am confident that the telecommunications industry will continue to flourish in Massachusetts.

Ron Sege

Chairman of the Board, Massachusetts Telecommunications Council

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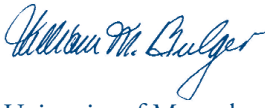
The University of Massachusetts is pleased to be a partner with the Massachusetts Telecommunications Council in the publication of "The Telecommunications Industry in Massachusetts: A Time of Transition." The report was developed for the Council by Professor Craig Moore of the Isenberg School of Management on the University's Amherst campus with research support from the UMass Donahue Institute.

The University is committed to fulfilling its responsibility to provide objective and relevant analysis of issues facing the Commonwealth, and this report advances that mission. Our knowledge- and innovation-based economy, and the highly educated people employed within it, represent a competitive advantage for Massachusetts. As this report makes clear, telecommunications continues to be one of the cornerstones of this economy.

President William M. Bulger



University of Massachusetts

TABLE OF CONTENTS

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. In 1996, the Council released a comprehensive study of the Massachusetts telecommunications industry titled *Connection to the Future*. This was the first attempt at defining this important and growing Massachusetts industry. It established a baseline profile that would allow the Council to track growth and change within the industry. *Connection to the Future* defined the telecommunications industry as those companies that sold products and services that were primarily involved with facilitating communication between people and machines. This included manufacturers of telecommunications products and companies that offered communication services. Using this definition, *Connection to the Future* found that employment in the telecommunications industry grew from 56,411 in 1993 to 90,876 in 1996.[1]

Today, despite the economic uncertainty confronting the telecommunications industry nationally and regionally, traditional telecommunications products and services continue to converge with computerized communications technology, shaping the future of the new economy. This technological convergence, along with fundamental changes in the economic environment, contributes to a major transition in the telecommunications industry both in Massachusetts and nationally.

Although it has recently become clear that the rapid growth the industry experienced during much of the 1990s has slowed considerably, 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 industry 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.

Further, the importance of the telecommunications industry in Massachusetts extends well beyond its direct economic impact. Innovative advances in telecommunications played a large role in driving the growth of all other segments 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.

[1] Craig Moore, Connection to the Future, UMass Economic Project (1996).

EXECUTIVE SUMMARY

In 1993 the Massachusetts Telecommunications Council was formed, and new business investment and employment in the telecommunications industry began to take off. It is therefore a good benchmark year from which to view the changes in telecommunications in Massachusetts.

There are seven segments used to define telecommunications in this study. They are: *communications services*, which includes companies that offer users access to communications; c*ommunications 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.

In 1993, 56,411 people were employed in companies that were primarily involved in producing telecommunications products and offering communications services. By the second quarter of 1996, the number had grown to 90,876. By the second quarter of 2002, applying the definition used in 1996, that number grew to 131,790. By almost any measure, the telecommunications industry has become and continues to be a major part of the Massachusetts economy.

As recently as the late 1990s, telecommunications equipment sales were growing, overall industry performance was high, and the largest problem facing companies seemed to be finding enough skilled labor. Since that time, *communications services*—the largest segment of the industry, with 37 percent of telecommunications employment in 2002 — has experienced slow but steady growth in spite of the recent recession. This growth has been fueled by accelerating demand by wireline, wireless, and Internet users.

During the past few years, however, the second largest segment of the industry—*communications equipment manufacturing*—has experienced a significant decline. This segment, which includes developers as well as manufacturers, is in the midst of a period of consolidation and restructuring. Several large Massachusetts telecommunications firms announced layoffs and many small and medium-sized companies were unable to stay in business in a declining economy with limited sources of funds.

This dramatic decrease in demand for telecommunications equipment has led to job losses for a large number of workers in telecommunications manufacturing. Some of these workers, however, have been rehired by contract manufacturers, who are increasingly playing an important role in telecommunications. Thus, layoffs in one firm that make the front page of the newspaper may have been offset to a small degree by hiring by contract manufacturers.

Although the immediate future of the manufacturing segment of the industry is uncertain, in the long run the substantial human and technological assets that are present in Massachusetts will position this segment of the industry for a rapid recovery when the anticipated future demand for communications infrastructure and services materializes.

The third largest segment of the industry—*telecommunications software*—grew steadily until last year. Employment in this segment has declined by 1,116 employees (4.3 percent) since 2001. Telecommunications software employment in Massachusetts has grown 66 percent since 1998, however, providing Massachusetts with the second largest telecommunications software employment base in the nation. The telecommunications *systems integration* segment, supported by growth of the communications services and software segments, has also experienced steady employment growth since 1998.

Employment in the telecommunications industry in Massachusetts as a whole has continued to grow, albeit at a significantly lower rate than during the boom years of the late 1990s. The Massachusetts telecommunications industry's continued resilience, in spite of the many challenges of the current economic climate, is a reflection of the substantial investments in human and technical assets made by the industry during the boom years. It underscores the industry's importance to the overall Massachusetts economy.

Major Findings: The Scale and Scope of the Massachusetts Telecommunications Industry

- In 2002, the telecommunications industry in Massachusetts provides more than 131,790 jobs. This does not include people working in telecommunications jobs for firms in other sectors of the economy, such as financial services or health care.

- Employment in all telecommunications companies has increased by over 37,802 since the second quarter of 1998. That is a growth rate of 40 percent in the past four years.

- The largest segment within the Massachusetts telecommunications industry is communications services, which includes wireline, wireless, and Internet services providers. In 1998 24,660 people were employed in that segment. Today that figure has grown to 49,135, a growth rate of just under 100 percent.

- Communications equipment manufacturing has lost its share of employment in the telecommunications industry, falling from 26 percent in 1998, to 18 percent in 2002, a loss of nearly 1,600 jobs. In the past year it has experienced a 6 percent decrease in employment. This segment has experienced a significant decline in the past few years and is in the midst of a period of consolidation and restructuring.

- Although venture capital investment has slowed considerably, it remains above the levels experienced during most of the 1990s. According to a PriceWaterhouseCoopers/Venture Economics/National Venture Capital Association MoneyTree survey, the total amount of venture capital that has been invested in telecommunications in Massachusetts since 1995 is $12.8 billion.

- Based on employment figures, Massachusetts has improved its ranking among the top states in the major segments of the telecommunications industry, including communications services and software. Nationally, Massachusetts ranks second in telecommunications software employment.

- Much of the growth in Massachusetts' telecommunications employment has been driven by smaller businesses. Since 1998, 80 percent of telecommunications job growth has been in firms with fewer than 250 employees. In this same period, 87 percent of new telecommunications companies have fewer than 50 employees.

- Focus groups and discussions with industry leaders on the future success of the telecommunications industry, identified four consistent themes: broadband deployment, workforce development, research and development, and taxation. There was a general consensus that these issues could greatly impact the future growth of telecommunications in Massachusetts.

INTRODUCTION

Today, the telecommunications industry is in a period of transition. The industry experienced a great expansion during the 1990s but has recently entered a period of reorganization, consolidation, and adjusted expectations. Until recently, venture capital poured into the telecommunications industry as companies ramped up capacity and investors scurried to participate in the industry's rapid growth. This was followed by accelerated construction of fiber networks and a large increase in communications equipment inventory. By 2000, in the face of decreasing demand, sales began to decline, investment waned, and companies in many segments of the telecommunications industry went bankrupt.

The first part of this report tracks changes in telecommunications business establishments and employment from 1993 through 2002, with a particular focus on the experience of the industry in Massachusetts since 1998. The industry is defined to include communications services, communications equipment manufacturing, telecommunications software, systems integration, telecommunications wholesale trade, retail trade, and telecommunications construction.

The primary data source for this study is iMarket, a product of Dun and Bradstreet. It is derived from various sources, such as credit reporting data, other public sources of information, and data directly gathered by Dun and Bradstreet from individual companies. This data can be sorted by Standard Industrial Classification codes. Its main advantages are that it is current and covers companies of all sizes.[2]

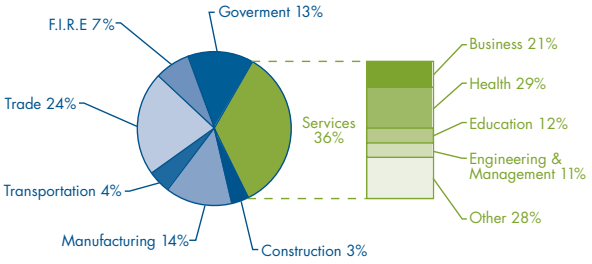
[2] Data from the other sources, such as the ES-202 data from the Department of Employment and Training (DET), are not as current and do not cover small companies with only a few employees. This is a critical factor in the analysis of this industry, as many companies in this sector are partnerships, 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 primary basis for DET employment estimates are based on this data series).

In the second part of the report, a more qualitative approach is taken. Focus groups and discussions with industry executives were conducted and participants were encouraged to identify issues that may impact the future success of the industry in Massachusetts.

THE MASSACHUSETTS ECONOMY

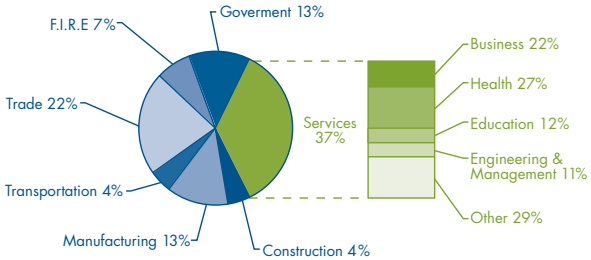
The Massachusetts economy has undergone an extensive restructuring that began in the early 1990s and continued at a brisk pace until recently. According to the Bureau of Labor Statistics, the number of people employed in the Commonwealth grew from 3,178,700 to 3,334,900 between 1998 and 2001. Manufacturing employment continues to fall in proportion to total jobs, while the service sector keeps expanding. Manufacturing, while decreasing employment by 24,700 jobs, lost share from 14 to 13 percent during this period. This shift of employment from manufacturing to services cuts across all industries and is a national and regional trend.[3]

EMPLOYMENT 1998



Source: Bureau of Labor Statistics, Total Non-Farm Employment, seasonally adjusted

EMPLOYMENT 2001



Source: Bureau of Labor Statistics, Total Non-Farm Employment, seasonally adjusted

Statewide employment grew in total by 156,200, with more than half of that growth in services. The service sector increased its share of jobs from 36 to 37 percent between 1998 and 2001, adding 93,900 employees. Health, business, education, and professional services are still the dominant categories within the service sector. The growth in business services employment has been driven, in part, by a steady increase in demand for telecommunications services.

Concurrent with the shift toward a service economy, the Commonwealth has also shifted to a more diversified industrial base that emphasizes technology. Whereas defense contractors and mini-computers dominated the state economy in the 1980s, medical technology, financial services, and information technology now dominate. The telecommunications industry has played a key role in this transition as companies invested in networks that facilitated communication among suppliers, customers, and businesses.

[3] 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.

These changes have been accompanied by a change in business practices in the Commonwealth. High-technology manufacturing employers generally and telecommunications equipment producers in particular have increasingly been outsourcing production to contract manufacturers. This has resulted in large numbers of layoffs, which are widely covered by the press, while the hiring of some of these employees by contract manufacturers and the steady expansion of other, smaller telecommunications companies in the state receives less recognition.

INDUSTRY DEFINITION AND DATA

The telecommunications industry produces products and services that are used to send and receive information between people and machines at different locations. The information can be in the form of voice or audio, images or video, data, or any combination. The most common examples are telephone services, wireline, wireless and cable, and the Internet. Some of the most important communications services include data transfers used in financial transactions, medical services, government administration, distance learning, and a host of other activities. These information services rely on networks that connect people. The telecommunications industry includes all the companies that play a role in building and maintaining these networks and providing the products and services that are offered over them.

The companies in the telecommunications industry vary greatly in their focus and size. Some large companies offer a complete range of equipment and services and own and manage their own networks. Other companies are niche businesses that offer specialized components or services. Many firms that manufacture hardware, for example, also write software that is used with the equipment and provide support and technical services. The integrative nature of the telecommunications world presents a challenge to anyone trying to analyze it because of the variety of business models and combination of products and services offered. A true definition of the telecommunications industry requires selecting many different types of industries from different sectors of the economy.

This analysis defines the telecommunications industry sector as being made up of industries from 23 Standard Industrial Classifications, which are aggregated into seven major segments. These are communications services, communications equipment manufacturing, software, systems integration, wholesale trade, retail trade, and construction.

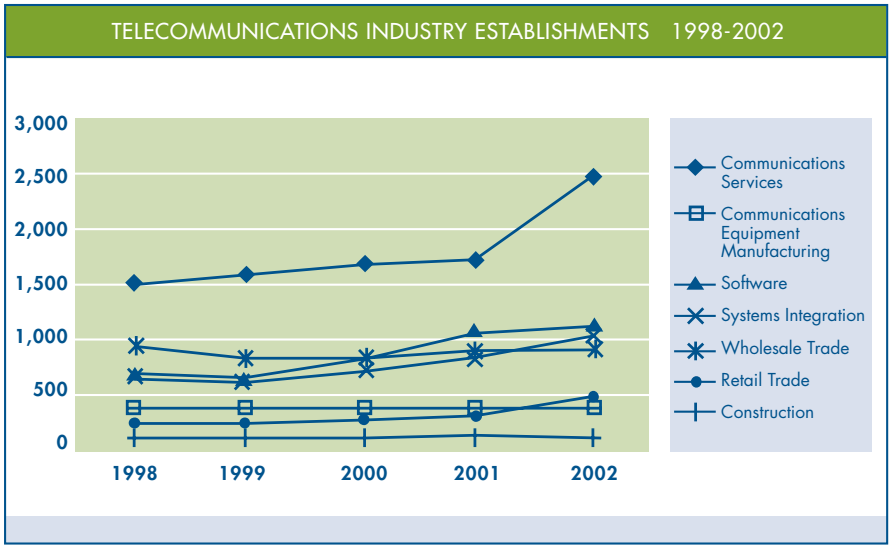
The table on the next page illustrates the major segments along with the subcategories of the Standard Industrial Classification (SIC) codes used to quantify the industry.[4] Appendix A contains a list of the SIC and corresponding North American Industrial Classification System (NAICS) codes used in this study. Appendix B provides a sampling of companies in each segment.

[4] Note that the SIC codes were developed when our economy was primarily manufacturing based. As the balance has shifted from products to services in the past few decades, these codes are sometimes less reflective of what companies actually do. The new North American Industrial Classification System (NAICS) has recently been adopted for economic analysis, but it has not existed long enough to establish a good basis for analysis. It is therefore not yet feasible to conduct a historical analysis based on NAICS codes. This new coding system is organized around the new economy, and in the future it will provide a more accurate picture of sectors like telecommunications.

TELECOMMUNICATIONS INDUSTRY SECTORS
Communications Services
Radiotelephone communication Telephone communication, except radio Telegraph and other communications Television broadcasting stations Cable and other pay television services Communication services, nec Telephone services Telephone set repair Telecommunications equipment repair (except telephones) Communications consulting
Communications Equipment Manufacturing
Communication wire Computer peripheral equipment, nec Telephone and telegraph apparatus Radio and t.v. communications equipment Communications equipment, nec
Software
Prepackaged software
Systems Integration
Computer integrated systems design
Wholesale Trade
Cable, wire Wire and Cable Electronic parts and equipment, nec
Retail Trade
Telephone and communications equipment
Construction
Communication line and transmission tower construction Communications specialization

In 1993 there were approximately 1,306 business establishments in Massachusetts where people were engaged in activities that were primarily involved with the telecommunications industry.[5] By 1996 this had grown to 3,061—a remarkable 134 percent increase. The figures for 1998 show 4,586 employment locations, and the latest figure from the second quarter of 2002 is 6,293.

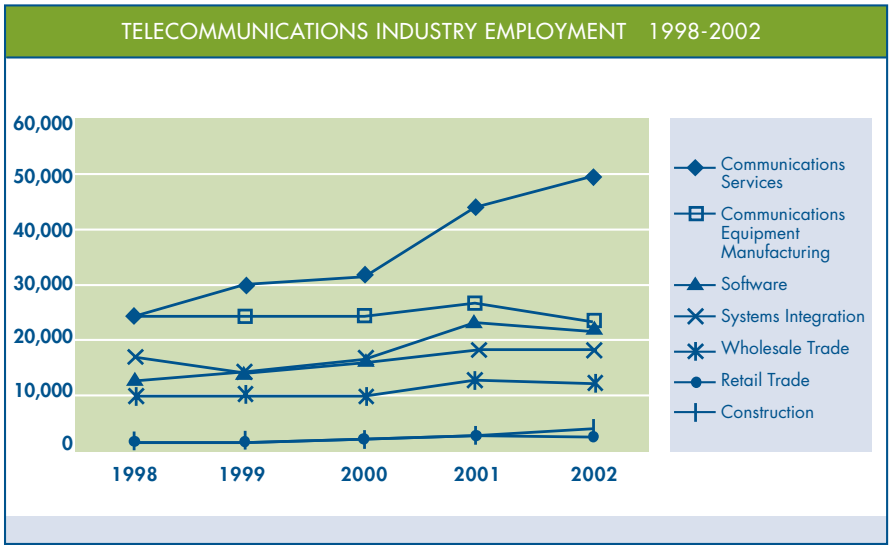
[5] Establishments include companies and their individual facilities. Only establishments where the primary SIC code was identified as being in the industry were included in this study. This means that some locations that were involved in telecommunications businesses as a secondary focus were not included. This tends to understate total employment.



Employment figures for these establishments also reflect strong growth. From 1993 to 1996 employment in the telecommunications industry grew from 56,411 to 90,876, or 61 percent. In the second quarter of 1998 the number of telecommunications jobs was 93,988, and it now stands at 131,790 in the second quarter of 2002. This is an increase of 40 percent since 1998.

Telecommunications Industry Segment	Establishments						% Change
	1993	1998	1999	2000	2001	2002	98 - 02
Communications Services	460	1,492	1,556	1,680	1,708	2,442	64%
Communications Equipment Manufacturing	147	343	340	332	339	351	2%
Software	100	734	744	792	1,059	1,102	50%
Systems Integration	297	692	707	725	864	933	35%
Wholesale Trade	129	923	856	834	880	878	-5%
Retail Trade		237	229	240	302	382	61%
Construction	173	165	174	176	200	205	24%
Total	**1,306**	**4,586**	**4,606**	**4,779**	**5,352**	**6,293**	**37%**

Note: The SIC definition varies slightly between 1993 and the later dates



The largest segment of the telecommunications industry is communications services. It accounts for about 37 percent of all telecommunications jobs in 2002. Communications equipment manufacturing has lost its share of employment, falling from 26 percent in 1998 to 18 percent in 2002, and has lost almost 1,600 jobs during the past year. Telecommunications software gained more than 8,500 jobs, increasing its share from 14 percent of the industry to 17 percent in 2002. Systems integration also experienced growth, but its share in the industry dropped from 19 percent of employment in 1998 to 14 percent now. Both wholesale and retail trade have experienced similar rates of employment growth since 1998 (16 and 18 percent respectively), while construction employment has more than doubled since 1998 but still remains a relatively modest source of telecommunications employment.

Telecommunications Industry Segment	Employment						% Change
	1993	**1998**	**1999**	**2000**	**2001**	**2002**	**98 - 02**
Communications Services	14,291	24,660	29,674	31,663	43,885	49,135	99%
Communications Equipment Manufacturing	29,240	24,392	24,140	24,138	25,736	24,137	-1%
Software	3,236	13,370	15,937	16,557	23,298	22,182	66%
Systems Integration	6,337	17,797	15,186	16,954	18,902	19,017	7%
Wholesale Trade	1,593	10,510	9,780	9,791	13,025	12,193	16%
Retail Trade		1,865	1,564	1,757	2,237	2,205	18%
Construction	1,714	1,394	1,615	1,645	2,349	2,921	110%
Total	**56,411**	**93,988**	**97,896**	**102,505**	**129,432**	**131,790**	**40%**

Note: The SIC definition varies slightly between 1993 and the later dates

Communications Services

Communications services includes companies that offer users access to communications networks and the various software products that make them useful. This segment includes long distance and local telephone service, cable television, and Internet access. It also includes many sophisticated services, such as interactive video conferencing, instant stock quotes and securities trading, and the location and dispatch of emergency resources. The range of services continues to grow.

All of these services and the networks themselves require large numbers of support people. The companies in this part of the communication services segment provide technical support to solve problems with hardware and software, technicians who repair and upgrade equipment, and consultants who help organize and manage large amounts of data.

This segment is the largest employer within the Massachusetts telecommunications industry. It employs approximately 49,135 people, with 27,447 of them working for telephone services firms. Employment in communication services has almost doubled since 1998, growing by 24,475 workers. The highest growth in employment has been in telephone services and cable television.

The vitality of this segment of the telecommunications industry is directly related to the number of customers using communications services. The more people served, the larger the networks and the more employees needed to build, maintain, and service these networks. Although Massachusetts is a relatively small state in population and geography, it employs a larger proportion of people in this segment than other top states active in telecommunications.

SIC	Communications Services	Employment					% Change
		1998	1999	2000	2001	2002	
4812	Radiotelephone communication	2,669	2,873	3,338	4,207	5,127	92%
4813	Telephone communication, except radio	11,550	13,887	15,671	24,509	27,447	138%
4822	Telegraph and other communications	352	672	359	235	333	-5%
4833	Television broadcasting stations	1,355	1,558	1,667	1,623	1,664	23%
4841	Cable and other pay television services	3,681	2,947	3,120	3,713	5,656	54%
4899	Communication services, nec	547	2,123	2,233	2,860	2,783	409%
7389.1	Telephone services	3,020	4,041	3,846	4,514	3,924	30%
7629.0302	Telephone set repair	81	76	31	100	64	-21%
7629.9905	Telecom. Equip. Repair (not phones)	47	46	46	76	82	74%
8748.03	Communications Consulting	1,358	1,451	1,352	2,048	2,055	51%
	Total	**24,660**	**29,674**	**31,663**	**43,885**	**49,135**	**99%**

Communications Equipment Manufacturing

Regardless of the medium that carries the information, equipment is needed to direct its messages between points in the network. Companies in the communications equipment manufacturing segment include the developers and manufacturers of various routers, multiplexors, and switches, as well as terminal equipment such as telephones, pagers, and communications PDAs.

There were 29,240 people employed at 147 locations in communications equipment manufacturing in Massachusetts in 1993.[6] This increased to 32,686 by the second quarter of 1996. By 1998, however, employment had fallen to 24,392, and it has settled at 24,137 in the second quarter of 2002. The long-term decline was greatest in telephone and telegraph apparatus manufacturing, falling from a high of 19,301 workers in 1993 to 15,227 in 1996 and then rebounding and reaching a plateau of 8,138 workers in the second quarter of 2002.

Even as employment in communications equipment manufacturing has declined, there has been an increased outsourcing of production work to contract manufacturers by some of the Commonwealth's large telecommunications companies. These contract manufacturers make many electronic devices, not exclusively telecommunications. Consequently, they are not necessarily categorized by data sources as being in the telecommunications industry even though they manufacture telecommunications equipment on a regular basis.

The second largest category within computer equipment manufacturing is computer peripheral equipment. While employment growth peaked in 2001 for the computer peripheral equipment companies associated with telecommunications, the overall growth rate for this group of companies has been 13% since 1998.

Radio and television employment has declined, as it has for other communications devices not elsewhere classified.[7] Radio and television broadcasting equipment manufacturing had 71 locations and employed 9,007 people in 1993. By 1996 there were 105 facilities, with 15,957 workers. By 1998 this fell to 86 locations with 9,003 employees. There are approximately 101 locations, employing only 5,375 people, in the second quarter of 2002. The average size of the facility as measured by total employment is shrinking.

Communications wire manufacturing is the smallest sector in the telecommunications manufacturing segment, with only 13 facilities and 1,367 employees in the second quarter of 2002. It started with 15 locations in 1993 and employed 932 workers. Employment levels in this sector remained fairly steady through 2000, but jumped significantly in 2001 and have remained stable through the second quarter of 2002.

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[6] There is a slight difference between SIC codes used in the earlier study and this later study; however, this change in definition did not significantly affect the overall trends in employment.

[7] The SIC category for communications equipment, not elsewhere classified (nec), was not included in the 1996 industry definition.

Communications Equipment Manufacturing Employment—challenging times

The Bureau of Labor Statistics (BLS) reports that communications equipment manufacturing in Massachusetts has experienced a precipitous drop-off in employment in the first half of 2002. By comparison, with a somewhat longer term view, this analysis, based on Dun and Bradstreet iMarket data, indicates that communications equipment manufacturing suffered a modest 1 percent decrease in employment from 1998 to the second quarter of 2002. In the past year, however, this segment of the industry has experienced a 6 percent employment decline, a loss of nearly 1,600 jobs. The national story is even worse: BLS reports that employment in communications equipment manufacturing has dropped by approximately 70,000 workers—or 25 percent—from January 2001 to July 2002.

While state-level sales data are not available, a recently released U.S. Census Bureau report indicates that communications equipment sales in the United States fell 32 percent between the second quarter of 2001 and the second quarter of 2002.[8] This represents a $10 billion decline in sales over the past year. A review of recent export data suggests that Massachusetts telecommunications equipment firms have likely experienced similar declines in output.

State-level data developed by the Massachusetts Institute for Social and Economic Research (MISER) documents a dramatic decline in the value of three major categories of telecommunications equipment exported to other countries from Massachusetts between July 2001 and July 2002. During this period the value of these exports declined by more than $670 million.[9]

This segment of the industry is in the midst of a highly volatile period. Accordingly, the employment data presented here must be interpreted with some caution. The data contained in this report reflect employment reported by individual firms through the second quarter of 2002. It is quite likely that the employment situation in this industry segment has continued to deteriorate through the third quarter. What is clear, however, is that the manufacturing segment of the industry has experienced a significant decline and is in the midst of a period of consolidation and restructuring.

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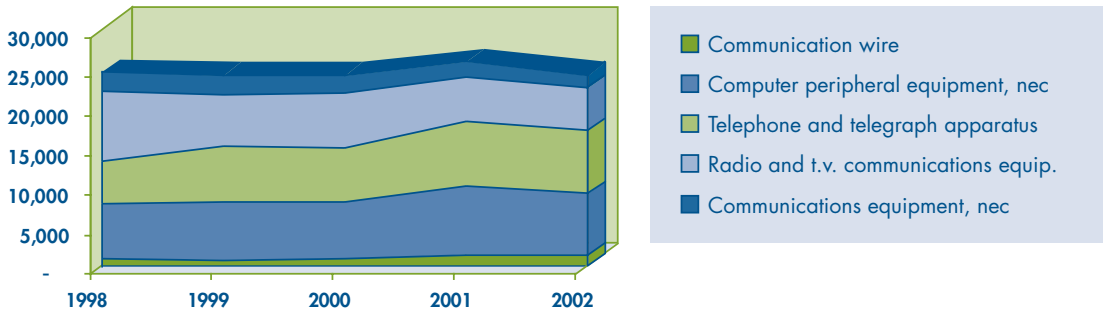
[8] U.S.Census Bureau, Economics and Statistics Administration, Quarterly Financial Report for Manufacturing, Mining and Trade Corporations (Washington, D.C.: Government Printing Office, September 2002).

[9] See http://www1.miser.umass.edu/trade/mahs6.html.

COMMUNICATIONS EQUIPMENT MANUFACTURING



SIC	Communications Equipment Manufacturing	Employment					% Change
		1998	1999	2000	2001	2002	98-02
3357.01	Communication wire	935	764	849	1,366	1,367	46%
3577	Computer peripheral equipment, nec	6,811	7,267	7,174	8,631	7,674	13%
3661	Telephone and telegraph apparatus	5,393	7,187	6,954	8,162	8,138	51%
3663	Radio and t.v. communications equip.	9,003	6,296	6,826	5,706	5,375	-40%
3669.99	Communications equipment, nec	2,250	2,626	2,335 -	1,871	1,583	-30%
	Total	**24,392**	**24,140**	**24,138**	**25,736**	**24,137**	**-1%**

Telecommunications Software

Most of the equipment that sends, directs, and receives information is coordinated by software created to manage communications within the network and by computers or other devices connected to the network. Software includes a wide array of applications and services that help people use the information and data they send and receive. An Internet browser, and a program that manages your e-mail, as well as the switching software that directs phone calls, are good examples of communications software.

The definition of communications software has evolved over time. The original definition of the telecommunications industry included a complex set of sub-categories within software.[10] The definition is now somewhat broader, but it has remained consistent over the past five years. In 1993, there were approximately 100 locations employing some 3,236 people in telecommunications software. By 1996 this had increased to 453 locations with 10,655 workers. The figures from 1998 through 2002 show growth from 13,370 to 22,182 people—an increase of 66 percent in four years. This segment of the industry continues to grow at a strong pace, although with a moderate decline in employment between 2001 and 2002.

[10] Some of these eight-digit SIC codes have been redefined, but these changes in definition did not significantly affect the overall trends in employment and sales.

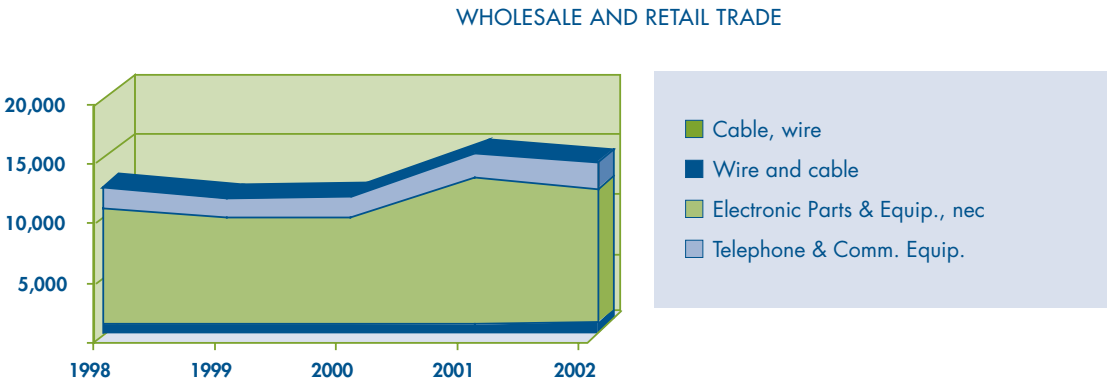
Systems Integration

A significant number of telecommunications companies in Massachusetts specialize in the integration of hardware, software, human resources, and communications services into networks. They design solutions for communications needs by finding the right combination of these elements.

There are 19,017 people working for 933 establishments in the systems integration segment of the telecommunications industry. This is up only slightly from 17,797 employees in 1998. This was the youngest and fastest-growing segment of the telecommunications industry in the period from 1993 to 1996, and employment has continued to grow steadily through 2002.

Wholesale and Retail Trade

Wholesale trade involving communications equipment and devices is a relatively small segment of the telecommunications industry that has grown over the past decade. It went from only 923 locations employing 10,510 people in 1998 to 878 locations with 12,193 workers in 2002.



SIC	Wholesale Trade	Employment					% Change
		1998	**1999**	**2000**	**2001**	**2002**	
5051.0102	Cable, wire	122	122	119	129	129	6%
5063.03	Wire and cable	616	627	608	701	801	30%
5065	Electronic Parts & Equip., nec	9,772	9,031	9,064	12,195	11,263	15%
	Sub-total	**10,510**	**9,780**	**9,791**	**13,025**	**12,193**	**16%**
SIC	Retail Trade	Employment					% Change
5999.06	Telephone & Comm. Equip.	1,865	1,564	1,757	2,237	2,205	18%
	Total	**12,375**	**11,344**	**11,548**	**15,262**	**14,398**	**16%**

Retail trade involving telephone and communications equipment was not included in the original definition of the industry in 1996. It is included in this study as more telecommunications products and services are now sold through retail channels and this segment of the industry has grown to a significant size.

Telecommunications Construction

The final segment of the telecommunications sector is construction of telecommunications services and infrastructure. This segment includes employment in firms that build towers and other facilities and lay cable. In 1998, there were 165 companies whose primary business was telecommunications construction. They employed 1,394 people. In the second quarter of 2002 there are 205 companies, employing 2,921 workers. In Massachusetts, many additional companies that build telecommunications facilities are not considered part of this segment because telecommunications is not their primary specialty. Consequently, their employment and revenues related to telecommunications are not counted.

THE MASSACHUSETTS TELECOMMUNICATIONS INDUSTRY IN A NATIONAL CONTEXT

Since 1998, the Commonwealth's share of national telecommunications employment has suffered a modest decline from 3.3 percent to 3.2 percent. In communications services and construction, however, the Commonwealth's share of national employment has grown. Because this is the largest segment of the state's telecommunications industry, these gains are significant for the Massachusetts economy.

Telecommunications Segment	Massachusetts		U.S. Industry		Massachusetts	
	1998	2002	1998	2002	Share 98	Share 02
Communications Services	24,660	49,135	1,368,461	2,223,310	1.8%	2.2%
Communications Equipment Manufacturing	24,392	24,137	499,570	513,639	4.9%	4.7%
Software	13,370	22,182	197,739	338,458	6.8%	6.6%
Systems Integration	17,797	19,017	282,472	487,488	6.3%	3.9%
Wholesale Trade	10,510	12,193	282,750	326,278	3.7%	3.7%
Retail Trade	1,865	2,205	77,658	122,771	2.4%	1.8%
Construction	1,394	2,921	104,073	159,635	1.3%	1.8%
Total	**93,988**	**131,790**	**2,812,723**	**4,171,579**	**3.3%**	**3.2%**

The largest loss of share was in systems integration, an area that was the fastest-growing part of the industry from 1993 to 1996. Manufacturing experienced a slight loss, as its employment declined statewide but increased nationally. Overall, there were no large shifts in employment share within individual segments. The trends in the industry as a whole are reflected in the changing pattern of employment within Massachusetts.

In relation to other states, Massachusetts is a major player. Even with its small population, it consistently ranks among the top states in employment in major industry segments.

MA NATIONAL RANK BY EMPLOYMENT		
Sector	**1998**	**2002**
Construction	26	18
Communications Equipment Manufacturing	6	6
Communications Services	18	15
Wholesale Trade	7	6
Retail Trade	12	19
Software	3	2
Systems Integration	4	8

In communications services, the industry's largest segment, Massachusetts moved up from 18 to 15. The Commonwealth's rank for telephone and telegraph apparatus manufacturing moved up from 10 in 1998 to 6 in 2002, while radio and TV equipment manufacturing fell from 6 to 8. In software, the Commonwealth's national ranking improved from 3 to 2. Systems integration employment in Massachusetts decreased in national ranking during the past four years, falling from 4 to 8.

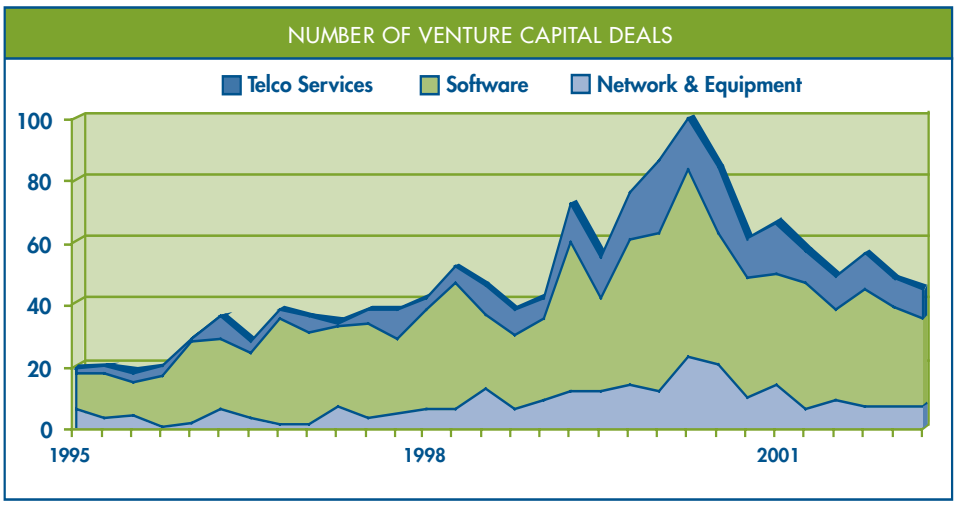
THE CYCLE OF CAPITAL INVESTMENT

Venture capital played a critical role in launching the growth of the telecommunications industry. A cycle of rapid expansion followed by consolidation and restructuring is reflected in a decade of venture capital activity.

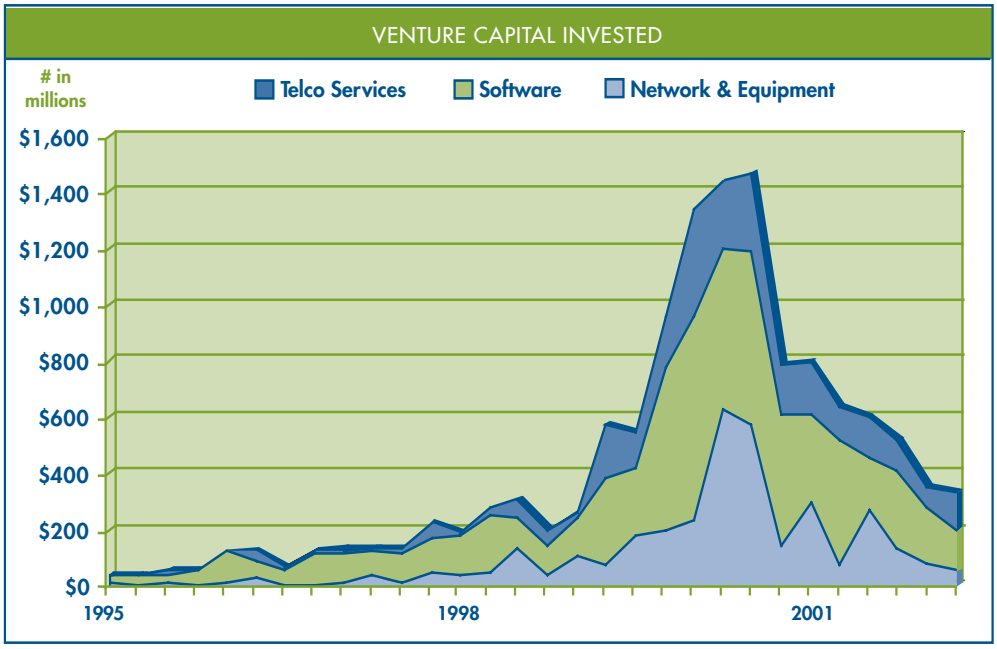
Growth in venture capital investment reached a peak in mid–2000, then declined abruptly. In the second quarter of 1999, just over half a billion dollars was invested in telecommunications. This almost doubled in the third quarter and climbed to more than $1.3 billion in early 2000, peaking that year at over $1.4 billion. By the last quarter of 2000, however, investments from venture capital began to slip, dropping to $327.5 million by the second quarter of 2002.

In spite of the rapid decline of investment in telecommunications software companies, telecommunications services, and companies that make equipment, produce related software, and offer telecommunications services, venture capital has thus far managed to hold above 1998 levels. In all, roughly 12.8 billion venture-capital dollars have been invested in the Massachusetts telecommunications industry since 1995.[11]

[11] Data cited in this section are from the PricewaterhouseCoopers/Venture Economics/National Venture Capital Association MoneyTree Survey.



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



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

THE SIGNIFICANT ROLE OF SMALL BUSINESS

The continued employment growth of the Massachusetts telecommunications industry in spite of recent years' challenges has been driven in large measure by the success of smaller firms. From 1998 to 2002, 80 percent of new job growth took place in firms with fewer than 250 employees. This represents more than 30,000 new jobs. Over this same period, smaller firms increased their share of total telecommunications employment.

Smaller businesses are also responsible for the majority of new telecommunications business establishments. Since 1998, 87 percent of more than 1,700 new establishments had fewer than 50 employees.

Growth in all kinds of small businesses across the Commonwealth is linked to the availability of good telecommunications services. A recent study in Berkshire County showed the strong impact of new fiberoptic cable on small technology enterprise business growth, even in rural areas.

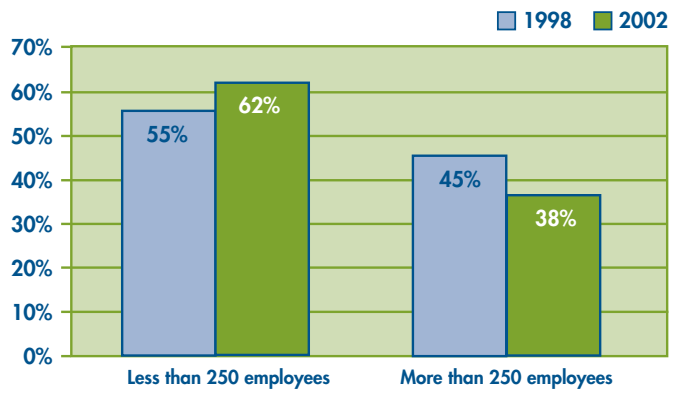
Some of the growth in small businesses likely came from people who lost jobs and began consulting or doing home-based telecommunications work. In other cases, larger companies outsourced business services. Some small business growth is the result of new opportunities made possible by the availability of broadband services, allowing people to establish their own companies. Some segments of the telecommunications industry lend themselves to networks of smaller companies working and interacting together, rather than being organized as traditional large firms.[12]

NEW EMPLOYMENT SINCE 1998 BY ESTABLISHMENT SIZE

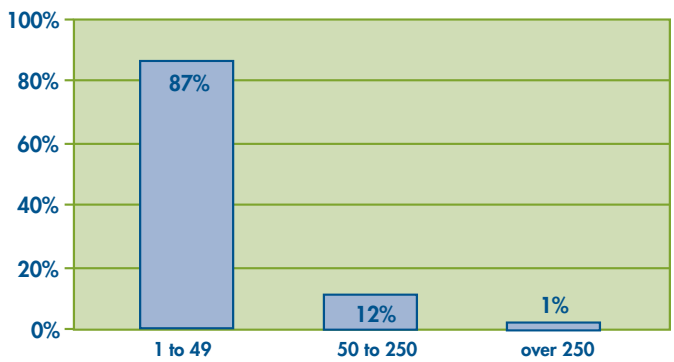
TELECOMMUNICATIONS EMPLOYMENT BY BUSINESS SIZE 1998-2002

	Fewer than 250 employees	More than 250 employees	Total
1998	51,320	42,668	93,988
2002	81,629	50,161	131,790
New Employment	30,309	7,493	37,802

SHARE OF EMPLOYMENT BY ESTABLISHMENT SIZE



NEW ESTABLISHMENTS SINCE 1998 BY NUMBER OF EMPLOYEES



TELECOMMUNICATIONS ESTABLISHMENTS BY SIZE 1998-2002

	Small	Medium	Large	
	1-49	50-250	More than 250	Total
1998	4,254	257	71	4,582
2002	5,741	463	85	6,289
New Businesses	1,487	206	14	1,707

[12] Loveland, Rebecca and Steven Ellis, 2002, Technology Enterprise in Berkshire County: Economic Analysis. Amherst, MA: The Donahue Institute.

ISSUES THAT IMPACT THE FUTURE OF TELECOMMUNICATIONS IN THE STATE

Five focus groups were convened to assess factors impacting the state's telecommunications industry. Each group included six to ten CEOs from telecommunications companies in Massachusetts. Additionally, several discussions with industry leaders were conducted. The following issues consistently arose.

Broadband Deployment

Many would argue that Massachusetts is a leader in broadband deployment and access, but access is far from universal. Increasing deployment of broadband infrastructure could spur economic development and strengthen the Commonwealth as a center for other industry sectors. Further deployment is needed because:

- Most home-based businesses and telecommuters cannot compete without high-speed access to data, transactions, and communications. Several CEO's felt that employees who are able to work at home, using high-bandwidth IT services, have the highest productivity.

- Good healthcare is now more available in remote places, as specialists can diagnose patients and provide vital information electronically.

- Telecommunications hardware sales are driven largely by purchases from companies building networks (e.g., telephone and cable companies). Accelerating broadband service deployment would boost lagging hardware sales and generate jobs.

- As access to broadband services expands, investment in new products and applications will increase, generating jobs and boosting the state economy.

Focus group members suggested that fair market competition would result in the growth of telecommunications across the state. This competition must be fostered on the supply side by offering the market a choice of broadband-services providers, while ensuring incumbent carriers a fair price for their wires. The demand side must also drive the process; consumers and businesses must be offered innovative and cost-saving applications that require broadband capacity.

In underserved markets, industry and government need to work together on strategies to accelerate deployment, including cable and DSL. These strategies might include financial and/or tax incentives for capital spending by carriers, or new approaches to how the industry is regulated.

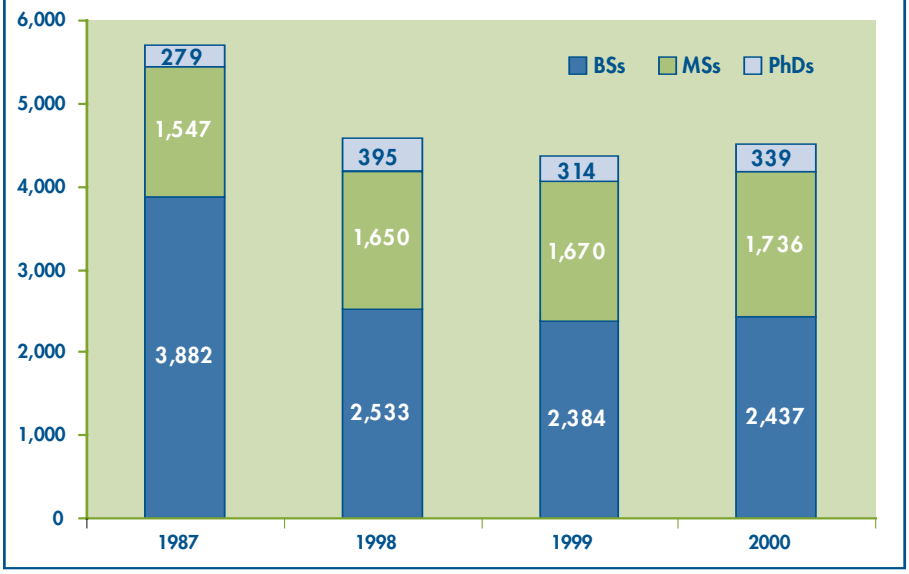
Making Massachusetts a showcase for universal broadband access could result in a significant regional competitive advantage. The investment in this new infrastructure will expand the productivity of workers and, as history shows, will spawn new businesses. It will improve education and training, supporting the new knowledge-based economy and keep Massachusetts among the leaders in this key industry.

Human Resources

Human resources development is a key issue for the industry and for the Commonwealth. A technically savvy, literate workforce is essential in the fast-changing telecommunications industry. It is critical, even during challenging economic times, that the K-16 education system provides the highly skilled workers necessary to sustain a knowledge-based economy.

Several executives in the telecommunications industry emphasize the importance of engineers. Unfortunately the number of engineering professionals is decreasing. Among Massachusetts students taking the SAT in 2001, only 6 percent expressed an interest in engineering, and just 6 percent were considering careers in computer science. Furthermore, only about half of all engineers that graduate from colleges and universities in Massachusetts stay here to pursue careers.[13]

NUMBER OF ENGINEERING DEGREES AWARDED BY MASSACHUSETTS SCHOOLS, BY DEGREE LEVEL, 1987, 1998, 1999, AND 2000



Source: American Association of Engineering Societies, as featured in the Massachusetts Technology Collaborative Index of the Massachusetts Innovation Economy 2001 report

[13] Massachusetts Technology Collaborative, 2001 Index of the Massachusetts Innovation Economy

In an effort to address our industry's workforce needs in the K-12 system, the following three major areas need to be addressed:

Increase professional development by:

- Encouraging the integration of proven technology into curriculum development, training, or mentoring activities done with Federal funds, such as those from the new education law, No Child Left Behind.

Provide sufficient funding to schools by:

- Supporting broad-based predictable state funding, such as the four-year grants in the Capital Needs Investment Trust Fund, which are intended to go to all districts that show progress toward the DOE's Technology Benchmark Standards.

- Supporting collaboration and partnerships between the business world and schools to prepare students to be part of the 21st century workforce

- Using state guidelines, such as the Foundation Budget Formula and the Technology Benchmark Standards, to suggest adequate levels of local funding.

Enhance regulatory frameworks that address such issues as:

- Designing schools that are better suited to accommodate best practice in instruction such as different grouping structures, project-based learning, and technology.

- Encouraging the implementation of ongoing, standards-driven, technology infused, school-based professional development that research suggests is most effective.[14]

At the post secondary level, it is critical that we continue to support initiatives that promote IT training for all students.[15] Additionally, we must encourage students to pursue degrees in the engineering and computer science field. Scholarship and Internship programs are an excellent way to stimulate interest in these areas.

Business leadership and support, coupled with government initiatives, will enhance the quality of people available to work in the telecommunications industry and improve all sectors of the economy throughout the state. The MTC supports a continuing commitment to workforce development by business and government.

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[14] These policy statements were developed by Business and Education for Schools and Technology (BEST), a nonprofit, bipartisan advocacy group.

[15] Providing funding for programs like the Commonwealth Information Technology Initiative (CITI) is critical and will insure students are graduating from the public higher education system with strong technical skills.

Research and Development

Without a consistent flow of new ideas and products, the telecommunications industry would remain stagnant. New technology can mean success for a small company or rejuvenate a mature one. Entrepreneurship is critical to stimulating the Massachusetts innovation economy.

The Commonwealth's telecommunications companies generally dedicate a higher share of operating expenses to research and development than do their non-tech counterparts. (Companies in the innovation services cluster in Massachusetts spend $46,500 per employee on R&D, and software and communications services companies spend $36,556 per employee. By comparison, the figure for the textiles and apparel industry is $8,293, and that for defense is $5,623.[15]) This investment in Research and Development strengthens the economy in several ways. First, the value of products and services as they are marketed and sold is high, relative to material costs of the components. Second, the innovation of development-oriented companies brings value to the entire supply chain, so growth in these companies often spawns innovation outside their doors. Finally, innovations that begin in the laboratory often have a multiplier effect; a company can apply an invention to multiple products and services.

An innovative workforce has brought established companies to the state. Industry leaders and policymakers must continue to attract development-oriented companies and ensure that the environment that nurtured today's technology companies persists. Further, the entrepreneurial environment must be maintained (e.g., the establishment of mentoring boards, sufficient access to funding, etc.). Finally, where policymakers can direct funding to research within companies, it is clear that those dollars will ultimately strengthen the Massachusetts economy.[16]

Taxation

As the telecommunications sector struggles to regain its footing, many feel that any effort to bolster sagging tax revenues by taxing Internet use or services would have serious negative repercussions. Certain proposals, including taxes on equipment deployed, sales taxes, and taxes on services, could result in enterprise or carrier telecommunications buyers relocating facilitates where the tax environment is more attractive. By impacting the cost of doing business and stifling customer demand, such taxes would only slow the sector's recovery.

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[16] The Massachusetts Technology Collaborative Index of the Massachusetts Innovation Economy 2001 report.

[17] The MTC supports regional university/industry consortium activities such as the two National Science Foundation Partnerships For Innovation awards to the Regional Technology Alliance for the Pioneer Valley and the University Consortium at TeleCom City. Regional initiatives of this kind will help foster innovation and technology transfer from Massachusetts research intensive universities to the private sector and will help strengthen and promote the image of Massachusetts as a global leader in the telecommunications cluster.

CONCLUSIONS

The telecommunications industry is going through a consolidation and restructuring process that is typical of industries impacted by technology. Technological change has become so rapid that it often leads to speculation and unrealistic expectations in the early stages of growth. This is often followed by a shakeout of companies, when there has been too much investment relative to the actual demand of the market. The current situation in the telecommunications industry has been exacerbated by negative publicity concerning accounting practices.

Many companies continue to wrestle with finding a profitable business model for selling value-added services. Larger companies are focusing on their core business and outsourcing more to cut costs. Small businesses are spreading their wings and experimenting with new ways to network and serve new markets. The opportunities and consequences of change will send ripples through the entire sector. This transition will continue for the next few years and be shaped by new technologies, changes in government regulations, and international events. Competition may eventually lead to a more efficient solution, but the process of achieving it is often difficult and disruptive for investors, employees, and customers.

In spite of its much-publicized troubles, the telecommunications industry in Massachusetts is still growing, albeit at a significantly lower rate than during the mid-1990s. Communications services has experienced slow but steady growth since 1998, in spite of the recent recession. Though telecommunications software segment has lost 1,116 employees (a 5 percent decline) since 2001, it has grown 66 percent since 1998.

Analysis suggests that the telecommunications industry will continue to be a critical part of the Massachusetts economy as a major source of employment and income. This sector, along with the Commonwealth's world-class research universities, is expected to remain an important spawning ground for many new businesses and technological innovations.

The short-term future of the telecommunications industry is uncertain, given the current state of the economy. In the long term, however, the industry will most likely be sustained by innovation in Massachusetts and elsewhere. Slumping sales of the past two years should improve as the business cycle picks up. Broadband services will expand and drive the development of new products and services. Recent experience has tempered expectations for telecommunications and other technology-oriented industries. But if one looks at long-term trends in telecommunications employment, it is quite reasonable to expect that this sector of the economy will be a major force in the future of the Commonwealth and the nation.

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	3357-01	335929	Other Communication and Energy Wire 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, NEC	3669-99	33429	Other Communications Equipment Manufacturing
Computer Peripheral Equipment, NEC	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, NEC	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	Cable Networks
		51322	Cable and Other Program Distribution
Communications Services, NEC	4899	51339	Other Telecommunications
		51334	Satellite Telecommunications
		513322	Cellular and Other Wireless Telecommunications
Telephone services, answering services, telemarketing, etc	7389-10	561499	All Other Business Support Services
		561421	Telephone Answering Services
		561422	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

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, NEC	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. SOFTWARE			
Prepackaged Software	7372	51121	Software Publishers
		334611	Software Reproducing
VII. SYSTEMS INTEGRATION			
Computer Integrated Systems Design	7373	541512	Computer Systems Design Services

APPENDIX B: TELECOMMUNICATIONS INDUSTRY CLUSTER: REPRESENTATIVE EMPLOYERS

	Representative Employers
I. Communications Services	Genuity, Inc.
	J & L Cable, Inc.
	Verizon New England, Inc.
	Cingular Wireless
	Akamai Technologies Inc
	MRM Partners Worldwide
	EDS Personal Communications Corporation
	General Dynamics Communication Systems
II. Communications Equipment Manufacturing	Comverse Network Systems, Inc.
	Nortel Networks, Inc.
	Motorola, Inc.
	BBN Technologies
	General Dynamics Communication Systems
III. Software	MRO Software, Inc.
	Mathworks, Inc.
	Lotus Development Corporation
	Oracle Corporation
	Parametric Technology Corporation
IV. Systems Integration	Nortel Networks, Inc.
	TASC, Inc.
	QualxServ, LLC
	CorpSoft, Inc.
	BBN Systems & Technologies (Genuity, Inc.)
	Stream International, Inc.
	REBAR, Inc.

V. Wholesale Trade	Nextel Communications, Inc.
	FAI Electronics Corporation
	Future Electronics Corporation
	Avnet, Inc.
	Converge, LLC
VI. Retail Trade	Adtech, Inc.
	BellSouth Communications
	NextiraOne
	Voicenet Communications
	WilTel Communications, LLC
VII. Construction	Orius Central Office Services Group
	Adesta Communications, Inc.
	ACT Cable
	Tri Wire Engineering Solutions, Inc.
	Verizon New England, Inc.