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About This Study

The San Francisco Bay Area's economy has experienced rapid growth, particularly in high technology industries. The East Bay, with a significant portion of high growth companies, has contributed to and benefited from the creation of thousands of jobs and the resulting prosperity.

The sponsors of this project, the Economic Development Alliance for Business (EDAB), the City of Oakland, and the Contra Costa Economic Partnership, take an active role in promoting economic prosperity, attracting investment, retaining and creating jobs, and collaboratively addressing obstacles and the opportunities for the benefit of the East Bay.

In the process of systematically examining the region's economic base, these groups identified telecommunications as an industry that represents very high, sustainable growth in the future, provides some of the most desirable jobs in the world, and has a significant presence in the East Bay.

Success, however, has its price in terms of intense competition for qualified workers, significant increases in the cost of living, and increasing commute times and traffic congestion. The East Bay faces the challenge of facilitating the growth of existing companies, attracting, and nurturing new companies, while minimizing the negative impacts of high growth which could strangle future success.

This study was undertaken to understand the importance of the telecom industry to the East Bay and to evaluate the East Bay's attractiveness as a "cluster" within which telecom companies can succeed and to which additional telecom companies will be attracted.

About the Sponsors

Economic Development Alliance for Business (EDAB)

In September 1990, Alameda County established the countywide Economic Development Alliance for Business (EDAB) to enhance the competitive economic position of the East Bay and its member municipalities. The program is a public-private partnership funded by the county, cities, special districts, labor and the private sector. The program's principal focus is on business attraction and retention, regulatory coordination, science and technology. Both the Governor's Council on California Competitiveness, and the State Assembly's ADEP Commission, have cited the EDAB Program as the most successful in the State of California.

In order to improve the region's business climate, the business retention/attraction program has effectively coordinated countywide efforts to streamline regulatory approval processes. The program has initiated an active technology transfer program in clusters of industry and environmental and biotech technologies.

Along with its continuing efforts at revitalizing the county's urban core through a County Community Reinvestment Policy, recent actions to establish and expand health industries underscore the leadership role that EDAB has taken in stimulating the development of new industries while addressing the needs of urban centers in its transition.

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Contra Costa County Economic Partnership

The Contra Costa Economic Partnership is a coalition of business, government and education leaders formed to promote economic vitality in Contra Costa County. Its objective is to retain and expand existing business, while providing a climate to attract high-wage jobs and emerging technology companies.

The Contra Costa Economic Partnership's strategy calls for streamlining the permit process, developing a long-term plan to retain business and attract new industry, linking education and training to required job skills, improving the infrastructure, and developing new jobs and affordable housing near employment centers.

City of Oakland Community and Economic Development Agency

In 1997 the Oakland City Council adopted an Economic Development Strategy to create "a place for people and a place for business." This strategy identifies five targeted industries: Bioscience/Biotechnology, Software/Multimedia, Food Processing, Transportation, and Telecommunications as growing industries in which Oakland has a strategic advantage.

The Economic Development Division of the Community and Economic Development Agency creates more opportunities for commerce by (1) retaining, expanding, and attracting businesses; (2) managing the revitalization of neighborhood commercial corridors; (3) marketing the City of Oakland as a site for business development; (4) arranging special events for the City; (5) providing guidance to businesses seeking financing for their enterprises; (6) coordinating workforce development services on behalf of business, job training/placement agencies, and potential employees; and (7) coordinating a major segment of the City's effort to establish a "community-oriented government" effort known as Oakland's "Service Delivery System."

About the Researchers

The COMPASS Group

The Compass Group

The Compass Group is a leading Silicon Valley business research and consulting firm that provides marketing, organizational and business development programs for high performing businesses and public sector organizations. Emphasis is on custom research studies which help clients better understand the threats and opportunities presented in their markets, products, competitors, technology or changing organizational environment. The Group has a special practice in labor market analyses, workforce development and economic development studies.

Dennis G. White, President of The Compass Group, managed this project, participated in the focus groups and edited the final report. A 25-year veteran of the information technology business, he has held executive level positions including Marketing VP for Tymnet, a value-added data network, and Director of Marketing for British Telecom North America. He has been responsible for the development and implementation of business strategies, marketing programs, company acquisitions, venture capital start-ups, turnaround situations and business opportunity evaluation for small, medium, and Fortune 500 companies. He has served as a facilitator for management teams and has conducted strategy development workshops in the U.S., Europe, Japan and Korea. Mr. White has taught graduate-level courses in organizational behavior and has been a presenter at numerous industry forums, including those sponsored by ADAPSO, EDIA, IIA, IDC, and the Yankee Group. He holds a B.S. degree in Engineering from Northwestern University and an MBA from Washington University in St. Louis.

Jewel Savadelis was Principal Researcher and wrote this report. She has provided consulting services to a wide range of clients that include the Mitre Corporation, TRW Systems, Polaroid Corporation, and British Telecommunications.

She holds a B.S.in Psychology (Phi Beta Kappa) and an M.S. in Educational Psychology & Statistics (Highest Honors) from Pennsylvania State University and an M.B.A. from the Harvard Business School where she studied under Professor Michael Porter (founder of industry cluster economic theory).

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City of Oakland: William Claggett, Executive Director, Community and Economic Development Agency
Albert Lopez, Associate - Business Attraction & Retention
Lisa Sullivan, Project Manager III, Community and Economic Development Agency

Contra Costa Economic Partnership: Linda Best, Executive Director

Fremont Focus Group: (host: Rosie Rios, Fremont City Economic Development Manager)

Connie VanLieu	Employment Representative	Premisys Communications
Roxie Vogt	Director HR	Premisys Communications
David Hillstrom	President	Infolane Corporation
Mike Mattock	Mgr. Construction & Engineering	Nextlink
Valerie Ginn	Director HR	AdiCom Wireless
Janet Migliore	Director HR	NetsWork

Oakland Focus Group: (host: Albert Lopez, City of Oakland)

John Barron	President	Barron Communications
Tim Westphal	Sales	Inreach Internet
Frank Wishom	Managing Principal	F2 Technologies
Frank Tucker	President	Tucker Technology
Mollie Gilbert	Telco Bldg. Property Manager	Ballo Properties
Stacy Larsen*	Pacific Area Facilities Manager	Nextel

San Ramon Focus Group: (host: April Gray, San Ramon City Economic Development Manager)

Jeffrey Simmons	Regional Staffing Manager	Pac Bell Wireless
Sandy Stimson	Manager HR	Westech Communications
Michael Golden	Chairman/CTO	WarpSpeed Communications
Cynthia Gomez-Jackson	Director HR	GTE Wireless
Glen Anderson*	VP Network Engineering	Pac Bell

Others:

Bronwyn White	Account Manager	Technical Staff Recruiters
Van Power	Principal	Arledge/Power Real Estate
Joe Gross	Director	Oakland Communications Tech Cluster

* Participation by telephone interview

I

Introduction

A Study Purpose and Scope

The Compass Group was retained by the Economic Development Alliance for Business (EDAB) and their co-sponsors the Contra Costa Economic Partnership and the City of Oakland to conduct a study of the East Bay telecommunications industry and the infrastructure support required to maintain and expand it.

This study draws upon data from focus groups, interviews, and previously conducted studies to present an understanding of the East Bay telecom industry and the importance of its role within the context of the East Bay economy. This study evaluates the East Bay's viability as a site within which telecom companies can continue to succeed and to which additional telecom companies will be attracted.

The purposes of this study are:

- To review past studies of the East Bay telecom industry;
- To understand the East Bay telecom industry's role within the domestic and international telecom market;
- To analyze the current demographics and future requirements of the labor market of the East Bay telecom industry;
- To analyze the infrastructure support required to maintain, grow and expand the industry; and
- To recommend actions which will increase the competitive advantages of the East Bay telecom industry.

B Definitions

Telecommunications Industry

The industry is composed of three main sectors. They are:
- Service providers (local telephone, long distance, network access, wireless, satellite and data communications),
- Equipment manufacturers (wireline and wireless), and
- Internet companies (networking, Internet service providers, security and portals).

Exhibit I-1 lists the Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) codes used in this report.

Radio Broadcasting Stations (SIC 4832), Television Broadcasting Stations (SIC 4833) and Cable and Other Pay TV Services (SIC 4841) were excluded from this study because these companies do not *primarily* (1) provide telecommunications services to customers or (2) produce telecommunication equipment that is used by telecommunication service providers or customers. Broadcasting and Cable TV companies are starting to provide the same high bandwidth data services that local phone companies currently provide. However, this service contributed less than 1% ($650 million of $84.2 billion revenues) of broadcasting services and cable TV revenues in 1997.

EXHIBIT I-1

Telecom SIC and NAICS Codes

1987 SIC	1987 SIC Description	1997 NAICS	1997 NAICS Description
	TELECOM EQUIPMENT		
3661	Telephone and Telegraph Apparatus		
	Telephone and Telegraph Apparatus, Except Consumer External Modems	33421	Telephone Apparatus Manufacturing
	Consumer External Modems	334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing
3663	Radio and Television Broadcasting and Communications Equipment	33422	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
3669	Communications Equipment, NEC	33429	Other Communications Equipment Manufacturing

EXHIBIT I-1

Telecom SIC and NAICS Codes (continued)

1987 SIC	1987 SIC Description	1997 NAICS	1997 NAICS Description
	TELECOM SERVICES		
4812	Radiotelephone Communications		
	Paging Carriers	513321	Paging
	Cellular Carriers	513322	Cellular and Other Wireless Telecommunications
	Paging and Cellular Resellers	51333	Telecommunications Resellers
4813	Telephone Communications, Except Radiotelephone		
	Except Resellers	51331	Wired Telecommunications Carriers
	Wired Resellers	51333	Telecommunications Resellers
	Satellite Resellers	51334	Satellite Telecommunications
4822	Telegraph and Other Message Communications	51331	Wired Telecommunications Carriers
4899	Communications Services, NEC		
	Ship-to-Shore Broadcasting Communications	513322	Cellular and Other Wireless Telecommunications
	Satellite Communications	51334	Satellite Telecommunications
	Except Taxi Cab Dispatch Ship-to-Shore Communications and Satellite Communications	51339	Other Telecommunications
	INTERNET SERVICES		
4813	Internet Access Services Internet Email Services Internet Videoconferencing	51331	Internet Access Services Internet Email Services Internet Videoconferencing
7375	Internet Data Aggregation Internet Transaction/Security Web Site Administration Web Page Design Services Internet Hosting Services Internet Consulting Services	514191	Internet Data Aggregation Internet Transaction/Security Web Site Administration Web Page Design Services Internet Hosting Services Internet Consulting Services
	Digital Signature Services	52239	Digital Signature Services
	TELECOM SYSTEM DESIGN, INSTALLATION & MAINTENANCE		
7375	Business Consulting Services (telecom)	54133	Telecom engineering srvcs

Source: US Census Bureau, http://www.census.gov:80/epcd/naics/NSIC3D.HTM

C
Study Methodology

The research approach included both primary and secondary sources of data collection. The latter was used to identify the quantitative demographics of East Bay telecom employers and guide focus group design. The former (focus groups) was used to take a realtime, trench level reading of what was working and not working for East Bay telecom employers.

Secondary research was conducted on a custom database from Dun & Bradstreet of all Alameda and Contra Costa county telecom firms, whether headquarters or branch offices, within the SIC codes listed in Exhibit I-1. Approximately 370 companies were identified. The Compass Group believes that only a portion of companies with less than five employees were identified because some companies may be so new or so small that they do not show up in many databases.

Additionally, searches were made in three publicly available databases: CorpTech, Rich's Business Directory, and Webster's Business Database, and from city business license records in Fremont, Oakland, and San Ramon. An additional 70 firms were identified. The primary reason they were not included in the Dun & Bradstreet database is because the classification of companies by SIC codes is open to interpretation by people applying them.

For example, Ascend Communications (recently purchased by Lucent) is considered a telecom equipment manufacturer (3661) in some databases, but a computer peripheral equipment manufacturer (3577) in the Dun & Bradstreet database. Internet Service Providers (ISPs) and Internet Web Design Services are relatively new lines of business that are classified under 4813 or 7373, Business Consulting Services. A concerted effort was made to identify all telecom companies with over 100 employees, regardless of their nominal SIC code.

The Compass Group also commissioned a custom database from the Employment Development Department of all Alameda and Contra Costa county telecom firms' number of workers by occupation, and wage and salary data.

Three employer focus groups were conducted, one in each of the three mini-cluster areas (Oakland, San Ramon, and Fremont). Topics covered included mindset (re location identity), site selection criteria, and infrastructure strengths and weaknesses. These focus groups lasted 2 1/2 hours and included 17 people representing 15 different companies (five in each of the three areas, see Acknowledgements on page ix). While this

may appear to be a numerically small number of people and firms on which to base research, The Compass Group is confident of its findings based on the following:

- Focus group participants included all sizes of firms as well as most of the major employers in each area.
- Company representatives had direct and relevant experience with location and workforce issues and were highly qualified to respond to study questions.
- None of the focus group participant responses were outside the norm, or raised unanswered questions.
- Focus group findings, individually and collectively, were consistent with prior research studies performed by The Compass Group, McKinsey, A.T. Kearney, and others (see Chapter II - Review of Previous Studies and the Bibliography).

Cluster Economics

Clusters, as defined by Dr. Michael Porter of the Harvard Business School, are geographic concentrations of interconnected companies, suppliers, business service firms in related industries, and associated institutions such as universities, vocational trainers, research laboratories, venture capitalists and financial institutions, government agencies, and collaborative community groups. When a critical mass of interrelated organizations is located in one geographic region, it often leads to unusual competitive success.

Clusters are enhanced by a highly trained and flexible workforce; efficient hard infrastructure such as highways and mass transit; access to important local resources and information; and excellent continuing communication between telecom firms and government, schools and research groups. When these elements are in place, they act as stimuli to new business formation and cluster expansion.

Exhibit I-2 lists members of the Bay Area telecom cluster. The extent to which these key variables are present in the East Bay telecom cluster, and the consequences of missing factors, is explored in detail in Chapter V, Location Factors Analysis.

EXHIBIT I-2

Participants in Bay Area Telecom Cluster

Type of Institution	Examples
Telecomm Equipment Firms and Service Providers	3COM, AirTouch, Adaptec, Allied Telesyn International, Ascend Commun, Aspect Telecomm, AT&T, Cisco, Digital Microwave, GTE Wireless, Harris Corp Microwave Commun, Lockheed, Loral Space Systems, Lucent Technologies, Madge Networks, NEC Electronics, Network Equipment, Nextel, Nortel Networks, Pacific Bell, Premisys Commun, Sprint PCS, Texas Instruments Broadband Access Group + 100's of smaller firms
Major Universities and National Labs	Stanford University, UC Berkeley, Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Sandia National Laboratory
Research Laboratories	CA State at Hayward – TELCOT Institute, Stanford Univ Communication Satellite Planning Center, Stanford Univ Space Systems Development Lab, UC Berkeley (8 laboratories)
Regional Universities	California State at Hayward, Golden Gate University, San Francisco State University, San Jose State University, Santa Clara University
East Bay Vocational Training Centers	Access USA Computer Training Centre, ACTech Institute, Cal State Univ, Hayward-Contra Costa Campus, Alameda Computer Center, College of Alameda, Computer Training Institute, Continental Training Center, Contra Costa College, Diablo Valley College, East Bay Institute of Business, Foundation College, Frederick Taylor University, Heald Business College, Heald College – School of Technology, Laney College, Los Medanos College, Martinez Adult Education & Training Center, Merritt College, Mt. Diablo Adult Education, Mt. Diablo Vocational Services Training, National Training Institute, Northwestern Polytechnic Institute, Pittsburg Adult Education Center, Regional Occupational Program of Contra Costa County, School of Technology, Software Advanced Technologies Institute, St. Mary's College, Unitek Network Education, UC California – Berkeley Extension in San Ramon, University of Phoenix, UC San Francisco – San Ramon, Vista Community College, West Contra Costa Adult Education, Worldwide Educational Services
Suppliers	Semiconductor manufacturers such as Intel, AMD, LSI Logic
Vendors	Subassembly, test and measurement firms, and software firms
Venture Capitalists	175 firms at Sand Hill Road in Menlo Park
Collaborative Groups Address common constraints, problems and opportunities	American Electronics Association, Association of Bay Area Governments (ABAG), Bay Area Council, Bay Area Economic Forum (and sub-group Telecommunications Infrastructure Partnership), Bay Area Regional Technology Alliance (BARTA), City of Oakland Telecommunications Policy Commission, Contra Costa County Telecommunications Focus Group, Contra Costa County Economic Partnership, Economic Development Alliance for Business (EDAB), Greater Oakland International Trade Center (GOITC), Joint Venture Silicon Valley Network, Northern California Manufacturing Extension Center (NCMEC), NOVA PIC, Oakland Chamber of Commerce Telecomm and Technology Committee, Oakland Private Industry Council, San Francisco Telecommunications Commission, Semiconductor Industry Association, Silicon Valley Capital Network, Silicon Valley Manufacturing Group, Smart Communities, Smart Valley, Technology Network, and Telecommunications Policy Committee, City of Oakland
Government	All Bay Area City and County Governments, FCC
Links to other major clusters	Biosciences, Environmental Technology, Computers and Electronics, Multimedia, Movie and TV Production, Banking and Finance, Business Services, Tourism
Customers	Bay Area consumers are the most "linked" in the nation.

II

Review of Previous Studies

Exhibit II-1 summarizes five studies previously conducted on telecommunications in the East Bay or on the San Francisco Bay Area. Each study evaluated different aspects of the telecom industry including the definition, size, growth, and industry trends of the U.S. telecom industry; description, size, growth, and constraints of the East Bay telecom industry; and local infrastructure issues.

A

Global and U.S. Telecommunications Industry

Most previous studies characterized the size and growth of the worldwide and the US telecom markets and their driving forces to some degree. Any discrepancies, which arise, can be attributed to the definition of telecom (which companies are included and excluded), to the geographic area included, to the year in which data was collected, and to the thoroughness with which the data was collected.

The telecom industry is heterogeneous. It is composed of such well-established, stable growth sectors as long-distance and local telephone service, and telephone and PBX products. There is a plethora of well-documented, accurate, and consistent data in these areas.

However, newer, fast-growth sectors such as wireless services (phone and paging), local area networks, Internet services and products, data communications services, and fiber optics are less well documented in terms of size and growth. Although these sectors represent less than 25% of total industry revenues of $500 billion, they are providing 80% of the growth and will play an increasingly important role in the Bay Area's and the US's economy in the next decade. Estimates of size and growth are contradictory and vary widely. Where appropriate, ranges are provided.

This study supplements previous studies' data with the following reports:

- Gale Group, *US Market Trends and Forecasts*, 1999
- US Census Bureau, *The Official Statistics*, December, 1998
- US Dept of Commerce, *Annual Survey of Communication Services*, 1997
- US Dept of Commerce, *Annual Survey of Manufactures*, 1996

- Standard & Poor's *Communications Equipment Industry Survey*, December, 1998
- Standard & Poor's *Wireless Industry Survey*, October 1997
- Jack Plunkett, *Plunkett's InfoTech Industry Almanac*, 1996
- Gale Research, *US Industry Profiles: the Leading 100*, 1995

B
East Bay Telecommunications Industry

Most previous studies identified the total number of companies and number of employees within the telecom industry in the East Bay. The Market Feasibility Study for a Telecommunications Incubator by the Craft Consulting Group, 1998 did a particularly thorough job. The criteria for data in the Craft study was the standard for this study, e.g. the number of telecom companies, the number and types of employees. This standardization facilitates comparison between data in both studies.

Because more than 60% of the telecom companies are very small (fewer than five employees), it is difficult to capture all of them, even when several excellent database sources are combined. Larger companies are sometimes not captured due to mergers and acquisitions by entities outside the Bay Area, e.g. SBC's acquisition of Pacific Bell. Different databases may classify companies under different SIC codes. Some databases specialize in smaller emerging growth companies and omit some large companies.

The primary source used in this study is the Dun & Bradstreet (D&B) database. It has been collecting such data for over 100 years, contains over 50,000,000 companies, and contacts each company in the data base directly (does not use secondary sources). D&B has been a core member of the committee that determines SIC and NAICS codes. And, companies may be more inclined to answer D&B's survey because the information is used to measure a company's creditworthiness and bond rating. Other sources that have been used are CorpTech, Rich's Business Guide, Webster's Business Guide, and local city business license records.

This study uses best efforts to capture all telecom companies in the East Bay. Focus groups and industry experts were consulted to ensure that major companies have not been omitted.

In addition to the work previous studies have completed, this study applies Dr. Michael Porter's concepts of cluster analysis to the East Bay telecom industry (see page 11). This will entail understanding the nature of the telecom companies' businesses in order to describe the interrelationships

among companies and other entities. From this data, conclusions are drawn and recommendations made which can enhance the viability of the East Bay telecom industry.

C
Location Variables

All of the previous studies touched on issues that determine a city's economic, political, and social attractiveness to businesses that currently are or could potentially locate in the Bay Area. Strengths to be touted and weaknesses that need to be addressed were covered in the previous studies. Major weaknesses identified were transportation congestion, inadequate skilled workforce, and lack of collaboration.

All studies agreed that the Bay Area was well positioned in the telecom arena, but that due to changes in a fast moving industry, it needs to vigilantly protect its competitive advantages. Other US cities are aggressively competing for this highly favored industry with high growth prospects and high profitability that lead to newly created skilled jobs and tax revenues.

This study supplements previous studies' data by putting the Bay Area's characteristics into context. These factors were rank-ordered by local focus groups of telecom company executives. The results are used to provide recommendations for strengthening the East Bay telecom industry's competitive position.

Additional reports that were used in this study include:

- Ernst & Young, T*he Ernst & Young Almanac and Guide to US Business Cities*, 1994
- Corporation for Enterprise Development, 1*998 Development Report Card for the States*, 1998
- Bay Area Economic Forum, T*he Bay Area: Leading the Transition to a Knowledge-Based Economy*, 1996
- A.T. Kearney, *Internet Cluster Analysis*, 1999
- Michael Porter, *On Competition*, 1998

D
Occupations and Labor Market

In a fast-growing industry, new jobs and job titles are being created which have not yet been incorporated into standard census surveys. These jobs include local area network managers, Internet web site designers, network control technicians, telecom technicians and telecom engineers. Previous

surveys undercount these occupations, subsume them under other headings such as electrical engineer or computer programmer, or ignore them entirely. Surveys conducted as recently as last year did not include these job titles.

Several of the previous studies provided salary and wage information, identified critical occupations, career profiles and career paths, training requirements, recruitment techniques, as well as workforce shortages for the San Francisco Bay Area. This study updates the following information within the newer job titles for the East Bay:

- Current # employees and wages/salary for selected occupations
- Occupational forecast (Employment Development Dept estimates) for each critical occupation
- Growth and turnover expectations (EDD and employer estimates) for selected occupations
- Identify workforce shortages and occupations which are difficult to recruit

The study will further add to the base of knowledge with the following:

- Identification of critical occupations
- Reason for vacancies (turnover, promotion, creation of new jobs)
- Training and work experience required
- Local sources of training
- Recruitment methods

This study will supplement previous studies' data with the following reports:

- Employment Development Department, *Labor Supply in Information Technology Occupations*, 1998
- California Cooperative Occupational Information System, *Occupational Outlook Reports*, 1996-1998
- A.T. Kearney, *Workforce Initiative Study*, May, 18, 1999

Exhibit II-1
Review of Five Previous Telecommunications Studies

Topics	Telcom Industry Cluster Analysis, 1999	Telcom Industry Cluster (BADCAT), 1996	Telcom Industry Labor Market Analysis, 1996	Potential for Multimedia and Telcom Industries at Closing Military Bases, 1996	Market Feasibility Study for Contra Costa Telcom Incubator, 1998	Conversation with Multimedia Industry, 1998
PURPOSE OF STUDY	Conduct employment and labor market analysis, and infrastructure analysis of East Bay telcom industry	Evaluate economic opportunities for telcom industry cluster	Enhance quality and utility of telcom labor market information	Evaluate suitability of military base facilities for small telcom and multimedia firms	Assess feasibility of developing telcom incubator	Recommend actions to enhance collaboration in multimedia industry
US TELCOM INDUS						
Definition of Telcom	Comprehensive definition				Brief definition	
SIC Codes	Complete listing and explanation of changes	Qualitative treatment	Qualitative treatment		Complete listing	
US Telcom Industry Size & Growth Estimates	$430 billion revenues, 1997; Summary of previous studies + additional information	$155 billion revenues, 1993	$155 billion revenues, 1993		10%/yr growth over next 5-10 yr.	
Industry Trends	Summary of previous studies + additional information	Increasing demand Incr in global communications Fiberoptics Wireless comm High bandwidth services Changing nature of work Decentralized bus operations New, expanding applications Deregulation Increasing competition Rapid technology change Emergence of internet Converging technologies Oppy for exports expanded Need for skilled workforce	Increasing demand Deregulation Increasing competition Converging technologies Mergers among firms	Increasing demand Strong local demand for internet services New, expanding applications Deregulation Rapid technology change Emergence of internet	Increasing demand Decline in prices Deregulation Increasing competition Rapid technology change Emergence of internet Converging technologies Mergers among firms	
LOCAL TELCOM INDUSTRY						
East Bay Telcom Industry	# firms in East Bay by size (# empl and revenues); # employees in each SIC code by occupation; Avg salary for selected Occupations; Job turnover, growth trends; Qualitative data on workforce; Multiplier effect	334 Bay Area firms (Corptech) 17,000 employees; Avg salary $55,000/yr (no growth figures)	334 Bay Area Firms (Corptech)	475 Alameda companies; 10,500 employees Avg salary $52,000/yr 6.3%/yr AAGR 1991-1995	1184 Bay Area firms (D&B) 6% workforce 13% wages 16% mkt value 326 East Bay companies; 15,000 employees; (no salary data) 29% growth 1995-2000	
Definition of Industry Cluster	Comprehensive definition					
Composition of East Bay Clusters	Diagram of components; Geographic distribution of major clusters; Composition of clusters; Critical relationships within clusters	Diagram of components; Leading sectors in each county		Diagram of components	Geographic distribution of concentrations of firms	
Critical Occupations	Identify telcom occupations, wages, growth potential, etc.	Identify telcom occupations	Identify telcom occup'ns, skill profiles; career paths, etc.			

Exhibit II-1
Review of Five Previous Telecommunications Studies
(continued)

	Telcom Industry Cluster Analysis, 1999	Telcom Industry Cluster (BADCAT), 1996	Telcom Industry Labor Market Analysis, 1996	Potential for Multimedia and Telcom Industries at Closing Military Bases, 1996	Market Feasibility Study for Contra Costa Telcom Incubator, 1998	Conversation with Multimedia Industry, 1998
INFRASTRUCTURE ISSUES						
Competitor Regions	Comparison with top 10 cities on 20 variables	List Only: LA, NY, Washington DC, Chicago, SF Bay Area, Atlanta, Dallas, Philadelphia, Boston, Seattle				
Location Factors	Comparison of 10 major cities with telcom clusters on 25 site selection criteria + input from focus groups	Access to specialized knowledge at national labs and universities Skilled telcom workforce Quality of life Local market demand for telcom Proximity to Silicon Valley Access to venture capital				Skilled workforce training Favorable business climate Intellectual property law Consistent taxation Build infrastructure Connectivity Facilities Zoning Industry/community involvement
East Bay Constraints	Focus group input	Underinvestment in physical infrastructure Lack connectivity Lack sufficient skilled workforce Lack collaboration Lack dialogue on gov't policy		Congested commute Alameda access problematic Poor permit process Poor image (remote, uninteresting)		
Recommendations	Focus group input	Educate community leaders Develop economic development strategies Expand export markets Improve infrastructure Develop incubators Analyze base facilities for telcom use Streamline permit process Stimulate local investment and capital access Develop workforce training		Transport and accessibility Connectivity Cultural personality Collaboration and networking Affordable housing Educated workforce Physical infrastructure Taxes and regulations Quality of life		
Key Participants in Cluster	Summary of previous studies + additional information	Universities & training centers Financial institutions Business Government	Universities & training centers Financial institutions Business Government			
OTHER						
East Bay Context	E Bay Context EDAB Context	Benefits of cluster to East Bay Create jobs Increase exports Retrain base personnel Support other ind'y clusters			Incubator feasibility	Key Issues in Bay Area MM Industry; Marketing MM Industry; Small Business Skills

III

Telecommunications Industry Overview

The worldwide telecommunications industry generated $1,150 billion in revenues in 1997 and is expected to sustain at least a 10 percent growth rate through 2000[1]. Approximately three-quarters of the revenues are generated by telecommunications services firms and about one-quarter by telecommunications equipment firms. No one country dominates the industry. Rather, companies headquartered in France, Germany, Sweden, Finland, Japan, Canada and the U.S. share the market.

The U.S. telecommunications industry generated $335 billion in revenues in 1997, almost a third of worldwide revenues. Between 1996 and 1997, revenues grew between 8 and 10 percent.

About 34,000 firms in the U.S., which employ 1.2 million workers, comprise the U.S. telecom industry. The payroll was $61 billion, a 7.4 percent gain in

EXHIBIT III-1

Worldwide Telecommunications Revenues, 1997 ($ Billion)

	Worldwide	U.S.	% U.S. Growth
Communications Equipment	**$250**	**$75**	**15%**
Wireline	170	50	5%
Wireless	80	25	35%
Communications Services	**$900**	**$250**	**13%**
Long Distance	360	100	8%
Local Phone	215	60	10%
Network Access	145	40	20%
Wireless	145	40	20%
Data Communication	35	10	25%
TOTAL	**$1,150**	**$335**	**13.4%**

Sources:
Standard & Poor's Industry Survey, Communications Equipment, December, 1998
Standard & Poor's Industry Survey, Telecommunications: Wireline, September, 1998
Standard & Poor's Industry Survey, Telecommunications: Wireless, December, 1998

[1]All industry estimates and forecasts in this chapter are extracted from four Standard & Poor's Industry Surveys unless otherwise noted. They are Communications Equipment, December, 1998, Telecommunications: Wireline, September, 1998, Telecommunications: Wireless, December, 1998, and Computers: Consumer Services and the Internet, October 15, 1998.

1997 over 1996. The revenues generated by U.S. telecommunications service providers and telecommunications equipment firms were 75 and 25 percent, respectively, closely matching the worldwide pattern.

Communications equipment providers manufacture network equipment (switching and transmission equipment such as bridges, routers, gateways, and modems; fiber optic cable; and wireless equipment such as satellite or cellular), or customer premises equipment (wired or wireless telephones, PBXs) for telecommunication service providers.

Communications service providers offer voice or data services via wire, fiber optics, cable or wireless to end-users. Service providers include firms offering local phone service, long distance, cellular, mobile radio, satellite, data communication, Internet access and information processing.

A
Global Telecommunications Equipment Industry

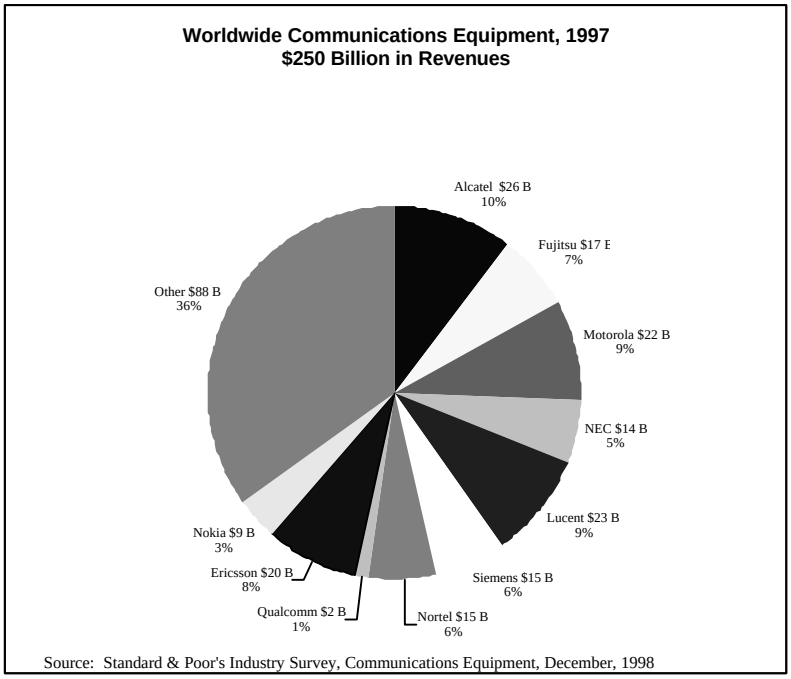
The global telecommunications equipment market was $250 billion in 1997 of which $75 billion was generated by U.S. firms. Standard & Poor's forecast for growth is 10 percent annually through 2000 with the data communications and wireless segments showing the strongest growth.

Because economies of scale and significant funding of leading-edge research and development are critical in this industry, it is dominated by a handful of large global players. The key players are Alcatel (France), Ericsson (Sweden), Lucent, Motorola and Qualcomm (U.S.), Nortel (Canada), Nokia (Finland), Fujitsu and NEC (Japan), and Siemens (Germany) (please refer to Exhibit III-2). Revenues for these ten companies amounted to $162 billion in 1997, nearly 65 percent of the total market.

The major U.S. customers for telecommunications equipment are the long distance providers (AT&T, MCI/Worldcom and Sprint), local service providers (five regional Bell operating companies: Ameritech, Bell Atlantic, BellSouth, SBC Communications/Pacific Bell and US West, plus GTE) and various wireless operators (AirTouch Communications and Nextel).

There are two major categories of equipment used in telecom networks: wireline and wireless. Both types of equipment can transmit voice and data.

EXHIBIT III-2



Source: Standard & Poor's Industry Survey, Communications Equipment, December, 1998

Wireline Equipment

Wireline includes traditional network infrastructure equipment such as switching and transmission equipment used by telecommunication service providers (telcos). It also includes the faster-growing newer technologies such as fiber optics and high speed digital access and transmission equipment. Worldwide wireline revenues totaled about $170 billion in 1997, and grew at the rate of 5 percent per year. Although wireline equipment sales represent almost 70 percent of the total equipment market, this segment accounts for slightly less than 25 percent of the growth.

In addition to infrastructure equipment, telecommunications equipment includes customer premises equipment (CPE), which refers to privately owned telecom equipment that is attached to the telecom network. The largest CPE sectors are private branch exchanges (PBXs) which include voice processing equipment, video communication equipment, call center systems, telephones, key systems, fax machines and modems. PBXs and key systems are equipment that route calls within organizations.

Wireless Technologies

Demand for wireless technologies has exploded since its commercial introduction in 1983. As with wireline, wireless communications equipment falls into two categories: wireless infrastructure network equipment and wireless handsets. Wireless infrastructure that includes wireless local loop

(WLL), paging and two-way radio dispatch, and satellite systems, reached about $40 billion in 1997. Wireless handsets also reached almost $40 billion in 1997.

Because prices are declining and more functions are being added to handsets, the wireless equipment market is growing at 35 percent per year, one of the fastest growing segments in the telecommunications equipment industry.

Wireless local loop (WLL) systems provide fixed (as opposed to mobile) telephone services. Voice messages are transmitted by radio waves from the telco network to a fixed telephone. The major advantage of WLL is that there is no need to install copper or fiber wiring. WLL systems will have between 197 and 266 million subscribers by 2006. Developing nations, which have poorly developed wireline infrastructure, will represent 84 percent of the total. With AT&T's announcement that it is developing a proprietary WLL system to enter new markets, the U.S. may also see a rise in popularity of WLL systems.

Most of the companies that produce wireless infrastructure equipment make cellular and PCS mobile phone handsets and pagers. Ericsson, Motorola, Nokia, Nortel, Qualcomm and Samsung collectively share 80 percent of the PCS market. Motorola dominates the paging market.

Most of the growth in telecom infrastructure equipment is expected to come from improvements in capacity of current equipment and_ development of new types of equipment which will improve the quality and speed of data communications at a fraction of the cost.

New Technologies

Today's telecom network infrastructure was not designed for high volume data communications. Telephone lines were developed in the 1930's for brief voice conversations. As capacity of existing networks is strained due to increasing demand, additional bandwidth is required.

To handle the demand, telcos are trying to increase the bandwidth of existing equipment and add new equipment with greater capacity which operates at higher speeds.

Telcos are converting to digital technology to increase line capacity. Fewer than 5 percent of the access lines being used by the telcos have been converted to digital from analog technology.

The transition to digital communications has been accompanied by a shift from copper wire to fiber optic cable. A standard three inch copper cable can transmit 14,400 conversations. A half-inch thick fiber optic cable containing

72 pairs of fibers can transmit 3.5 million conversations, a capacity of almost 250 times more than copper lines in a fraction of the space. In the U.S., fiber optic cables carry most of the long distance phone traffic. As other nations upgrade their pre-World War II infrastructures, fiber optics will be the cable of choice.

The worldwide market for fiber optic equipment was $9 billion in 1997, up 19 percent from 1996. Approximately 19 million strand-miles of fiber optic cable were installed in the U.S. in 1997 and 6,000 strand-miles are laid every day.

But even adding fiber optics at this pace is not sufficient to meet demand and "fiber exhaust" can occur. To combat fiber exhaust, dense wavelength division multiplexing (DWDM) is being used to increase the capacity of fiber optic infrastructures by using multiple lasers that operate at different wavelengths on the same fiber strand.

In copper wire infrastructures, Integrated Services Digital Network (ISDN) technology can be used to increase the speed of transmission by two- to four-fold over regular telephone lines. This also allows other types of transmitted data to be carried such as high-resolution video teleconferencing.

Circuit-switched networks are currently used for most voice traffic. This ties up the entire circuit for the length of the call. Packet-based networks, however, break the data into small packets, which allows the same network to simultaneously carry multiple conversations, video or data transmissions. The total market for packet-based services is expected to grow from $3.3 billion in 1997 (an increase of 64 percent from 1996) to over $10.5 billion in 2001, a rate exceeding 50 percent per year.

Most residential Internet users employ dial-up modems to access the Internet over existing copper wires at a maximum rate of 56 kilobits per second. Digital Subscriber Lines (DSL) and cable modems are being introduced which will increase bandwidth to 8,000 to 10,000 kilobits per second (referred to as 8 to 10 megabits), a 160-fold increase in speed.

DSL in its fastest form is asymmetric digital subscriber line, ADSL, which is in beta testing phases. Major firms such as Ameritech, Bell Atlantic, US West, Sprint, MCI and GTE are all planning to add DSL services. Over 2 million DSL modems are expected to be in use by 2001.

B

U.S. Telecommunications Service Providers

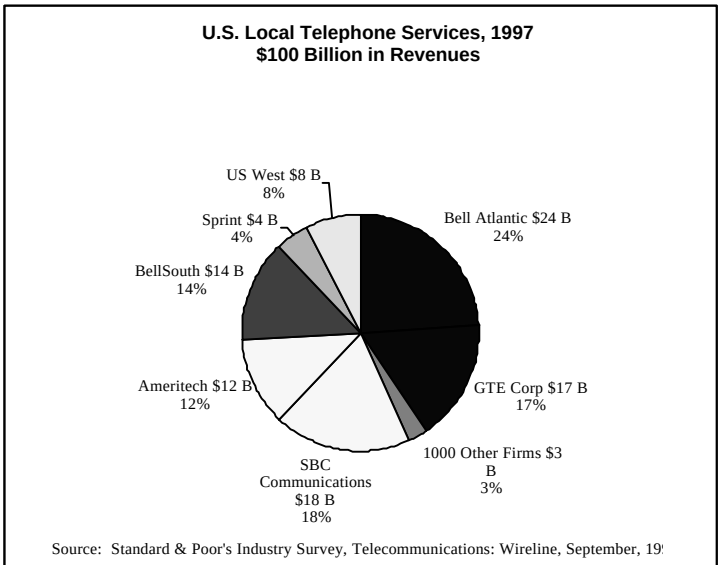
The global telecommunications services market composed of long distance, local phone and wireless firms, was $900 billion in 1997 of which $250 billion was U.S.-based. Growth is forecast at 15 percent annually through 2000 with the data communications and wireless segments showing the strongest growth of over 20 percent.

Since 1996, the U.S. wireline service industry has been characterized by continuing deregulation, increasing competition, and an emphasis on data communication and digital technology. The distinction between different communication and transmission industries is becoming increasingly blurred. Companies are branching out into cable TV, cellular telephone and satellite communications. Demand for wireless and data communications services is driving telcos to build or acquire capacity at a frenzied rate.

Local Telephone Service

Because there are substantial economies of scale, both the local phone service and the long distance markets are dominated by a handful of firms. In the $100 billion U.S. local phone service market, five Baby Bells and GTE dominate with 97 percent of the market. About 1000 small local phone service firms fill out the remaining 3 percent of the market. The sector is currently consolidating with mergers in progress between SBC and Ameritech and between Bell Atlantic and GTE Corp.
Local telcos perform basic services: hook up customers to the network, provide local telephone service, and connect local customers to long distance carriers.

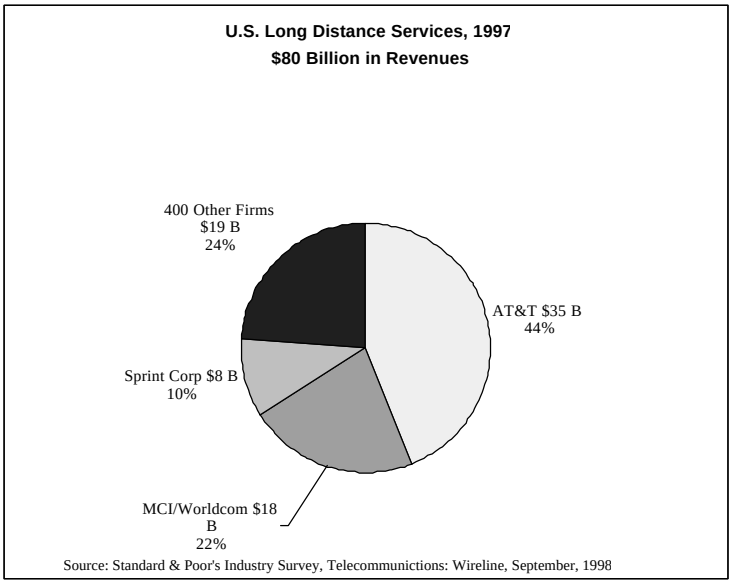
EXHIBIT III-3



Long Distance Service

Four players dominate with 78 percent of the $80 billion U.S. long distance market (AT&T, MCI/Worldcom, GTE, Sprint). The remainder, 24 percent of the market, is served by 400 small firms. If long distance companies are to offer basic local service to customers, they will have to heavily invest in or purchase firms that have access to local infrastructure. These long distance firms have national reputations for excellent service and are competitively tough after years of price wars.

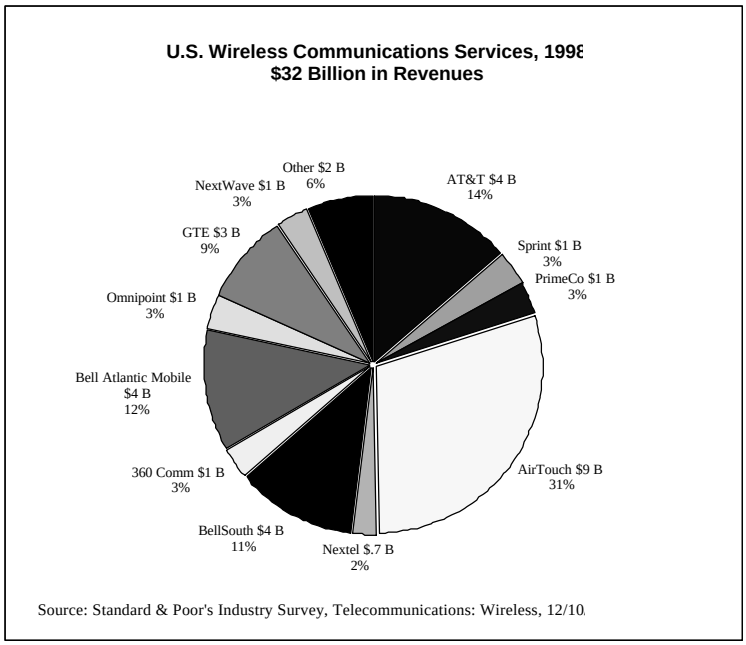
EXHIBIT III-4



Wireless Service

The $40 billion U.S. wireless market is still in the formative stages and is more fragmented than the long distance and local phone service markets. Five firms which hold 77 percent of the wireless service market are AirTouch, AT&T Wireless Services, BellSouth, Bell Atlantic, and GTE. San Francisco-based AirTouch, which holds the largest share (33 percent), is the only firm that focuses solely on wireless markets, both domestic and international.

EXHIBIT III-5



Rapid growth in wireless telephony has attracted competitors from outside the traditional telecom industry. Software giant Microsoft, as well as Internet players such as America Online and computer companies like Sun Microsystems, are partners in joint ventures.

With today's trends toward convergence of voice, data and visual communications, cable companies and Internet access providers are potential new entrants. Even power providers such as electric utilities with established equipment sites, power plants, and customer bases may enter.

Wireless communication has penetrated only 4 percent of the worldwide market. Leading U.S. companies have been actively building foreign business, with none more active than AirTouch. AirTouch has a large potential worldwide base of subscribers after its acquisition of US West's domestic cellular business and its purchase of a stake in PrimeCo PCS. It is the largest cellular provider in Europe and is currently doing business in Japan, South Korea and India.

The U.S. is the largest market for wireless with a 21 percent penetration rate of potential subscribers followed by Japan with a 14 percent penetration rate.

The number of worldwide subscribers grew 44 percent from 1997 to 1998 to 300 million and is expected to continue at the same rate. The number of U.S. wireless subscribers grew even faster. It jumped from 28 million in 1995 to 64 million in 1998, an increase of 128 percent. Despite this rapid growth, the U.S. penetration level is at a low 21 percent, allowing for plenty of growth.

The U.S. wireless voice market is expected to increase to a 35 percent penetration rate (100 million subscribers) by the end of 2000.

The force that drives the wireless market is personal communications service (PCS), a two-way digital wireless communications system. PCS offers consumers mobility, faster and less expensive service. It makes the transmission of voice, data and fax communications, plus caller ID, call waiting, voice, mail and other enhancements available from a single handset. The PCS operates at a higher frequency than older wireless services and so can operate at lower power levels, using capacity more efficiently. As networks expand, costs decline, and devices shrink, the consumer will increasingly use a wireless device for most calls. Currently, the major disadvantage of wireless is price—it runs 20 to 50 percent more than wireline.

Cable Systems

The 1996 Telecommunications Act has spurred cable providers to enter the telecommunications market. With established connections to 65 percent of U.S. homes, cable networks have access to a significant installed base of customers. Long distance carriers view cable operators as a means of providing them with the vital last link to customers. To accomplish this goal, AT&T purchased the largest cable company, TCI in 1997.

Cable companies' hybrid fiber optic/coaxial cable systems offer the greater bandwidth that is needed for interactive video applications. Cable modems can receive data 50 times faster than ISDN transmissions. However, cable was originally designed as a 1-way delivery vehicle. In order to provide 2-way communication, a cable operator must add switching capabilities to allow signals to be sent from the customer to the cable network. Only 10 percent of the U.S. cable infrastructure can handle 2-way traffic. In addition, cable companies' poor service reputation is a competitive disadvantage.

Despite the potential, as of 1999, revenues from telecom type services (voice and data communications) represent less than 5 percent of cable operators' revenues. Therefore, they are not included in this study.

Satellite Communication Systems

Another entry in the wireless industry is satellite communications. Satellite systems will make wireless services such as voice, data, fax or paging available to subscribers anywhere in the world.

Global satellite launches began in 1997. Since then Iridium and Globalstar have taken a wide lead. The initial wave of satellite services is aimed at data

EXHIBIT III-6

Planned Global Satellite Systems

Leading Firm	Investment $ Billion	Type	Start Date
Iridium (Motorola)	5.0	66 satellites in LEO	1998
GlobalStar (Loral)	2.5	48 satellites in LEO	1999
ICO Global (Inmarsat)	4.6	12 satellites in MEO	2000
Odyssey (TRW)	3.2	12 satellites in MEO	2001
Skybridge (Alcatel, Loral)	3.9	64 satellites in LEO	2001
Teledesic (Craig McCaw and Bill Gates)	9.0	288 satellites in LEO	2002
Celestri (Motorola)	12.9	63 satellites in LEO	2002
Expressway (Hughes)	4.0	14 geostationary satellites	2003

Source: Standard & Poor's Industry Survey, Communications Equipment, December, 1998
LEO=low earth orbit
MEO=medium earth orbit

rather than voice communications, and more at commercial than personal service. It is a high risk, capital-intensive strategy as evidenced by Iridium's recent bankruptcy filing.

At this time, handsets are bulky and expensive ($700) in comparison with cellular phones and service is often poor in highly populated areas or areas with large buildings. Widespread public use of these satellite services is not expected for five to ten years. Therefore, although included in the study as part of the telecom industry for the sake of completeness, satellite communication systems represent a negligible portion of the current market.

C
Internet: A Heterogeneous Phenomena

The Internet is a not itself a separate industry sector in the SIC or NAICS sense. Rather, it is an enabling technology used internally and externally by companies in other industries. Only those firms which were created by the existence of the Internet and provide Internet-unique telecom services and equipment are considered here.

This study includes companies that play a direct role in determining Internet functions: networking, access, security and portals. Electronic commerce, arguably classified as retail and wholesale, are excluded. And software, which comprises a wide range of non-Internet products, is also excluded.

Networking Equipment

Networking companies provide the equipment that links computers in the Internet such as routers, hubs and switches. Cisco (San Jose) has 73 percent of the market and Bay Networks (Santa Clara), which was acquired by Nortel in April, 1999, holds an 11 percent share.

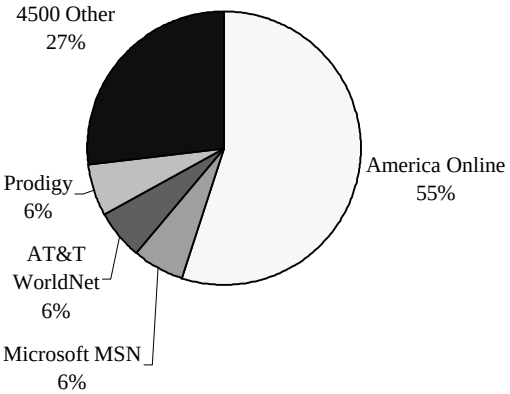
Remote access concentrators allow remote users to connect to the Internet through Internet Service Providers. They link employees and customers to an organization's internal network. 3COM (Santa Clara) and Ascend Communications (Alameda), which was recently acquired by Lucent Technologies, hold 38 and 34 percent of the market, respectively. Cisco's share of this market is 17 percent.

Internet Access Providers

When a consumer or business accesses the Internet, they dial into the local point of presence (POP) of an Internet service provider (ISP). The ISP market includes market leader America Online (which acquired Compuserve in September 1997) which has a 55 percent share of total subscribers, followed by Microsoft's MSN, AT&T's WorldNet and Prodigy, each with 6 percent of the market. Almost 4,500 ISPs comprise the remainder of the market.

EXHIBIT III-7

U.S. Internet Service Providers, 1998



Standard & Poor's Industry Survey, Telecommunications: Wireless, December, 1998

The ISP market is expected to expand from $11 billion in 1997 to $38 billion in 2002 while it continues to undergo consolidation.

EXHIBIT III-8

Major Acquisitions and Alliances Among Internet Service Providers

Date	Organization	Acquisition/Alliance
09/97	Worldcom	Purchased AOL's networking business
1996	Worldcom	Purchased UUNet
10/97	ICG Communications	Purchased Netcom Online Comm (5th largest ISP)
05/97	GTE	Purchased BBN
1995-1998	Mindspring	Purchased small ISPs to boost subscriber base from 12,000 to 390,000
--	Earthlink	Alliance with Sprint to acquire 130,000 Internet customers and for future advertising to Sprint customers

Source: San Jose Mercury News

Security

Various products, which ensure the safety of networks and transactions, comprise the Internet security sector. They are anti-virus, firewall, encryption and authentication products.

Security Dynamics Technology is the leading authentication and encryption provider. Check Point Software is the leading firewall manufacturer that controls the level of access a user is granted. Cisco, the leading router manufacturer, is entering the firewall market, as firewalls are often built into existing routers.

Digital certificates are digital identification measures that uniquely identify the user. The certificate can allow a person to sign a message digitally or encrypt a message so that only the proper recipient can decode it. The digital signatures market is dominated by Verisign, GTE, CyberTrust and Entrust (spun off by Nortel in late 1997).

Internet security companies are consolidating in response to customer demands for one-stop shopping. Network Associates (Santa Clara) is the leading "conglomerate" and has assembled firewall, encryption, authentication and anti-virus products through acquisition. Platinum Technology and Axent Technologies pursue a similar strategy.

Electronic Commerce

Electronic commerce, or e-commerce, is defined as financial transactions conducted over the Internet. It has generated excitement because the $8 billion market almost tripled to $21 billion from 1997 to 1998 and is expected to continue to double or triple each year, over the next several years, to reach $333 billion by 2002.

The business-to-business e-commerce segment includes electronic data interchange (EDI) which is dominated by IBM, GE Information Services and Sterling Commerce. CyberCash and First Virtual Holdings serve both business and consumer markets.

CheckFree Corp dominates the electronic bill payment sector with a 75 percent market share. TransPoint and Oracle Corp are market participants and Intuit is entering the Internet-based financial services market.

Pioneering retailers have built virtual stores on the Internet, providing an alternative to shopping in traditional stores. Many specialize in one area such as Amazon.com that sells books, CDNow, 1-800-Flowers, or I-GO-GOLF.

Portals

Portals are sites at which consumers begin their online sessions. They can store personal information and preferences of the type of information they would like to receive. The portal business evolved from navigation sites such as Infoseek, Lycos, Excite and Yahoo. Navigation is now just one of many services offered at these sites that include email and chat rooms. Netscape, one of the largest portals, recently merged with America Online and Microsoft is strengthening its portal business.

Over 70 million U.S. adults used the Internet regularly in 1998, up from 3.5 million in 1996. This represents half the worldwide users. About half of the largest U.S. and European organizations have developed internal corporate Internets, or “Intranets”. The phenomenal growth of the Internet has strained the existing network infrastructure, as mentioned in previous sections on telecommunications equipment.

D
Global Industry Trends

Increased Demand for Communication Services

Both wireline and wireless networks carry almost 30 times as much voice traffic as data communications. By 2010 voice traffic will represent about 10 percent of communications and data communications will account for 90 percent. This remarkable reversal is due to the global economy's increasing dependence on a company's ability to move data, driven by:

- Growth in the power and global presence of personal computers
- Exponential growth in the use of the Internet
- Increasing power of databases
- Increasing use and power of networks
- Increasing amount of telecommuting

There is also an increasing demand for data communications outside the workplace from:

- Increasing development of interactive, on-demand entertainment
- Greater use of the Internet for personal use
- Increase in use of personal fax/email
- Increased use of personal finance applications

Growing corporate use of the Internet to communicate with suppliers, customers and employees adds an enormous strain to the system. The increasing use of multimedia attachments, more complex web sites, and larger files being downloaded also consume bandwidth.

The number of Internet users worldwide doubled from 1996 to 1998 to 140 million users. This number will more than double again to 330 million users by 2002. The amount of time spent on the Internet rose 50 percent from 1.9 billion hours per month in 1997 to 3 billion hours per month in 1998. The number of Internet servers has expanded almost 10-fold from 3.2 million in 1994 to 37 million in 1998. Yet, less than 1 percent of the information used in the world today is delivered via Internet. There is a tremendous potential for development.

Deregulation

The Telecommunications Act of 1996 has profoundly changed the telecommunications service industry by allowing local phone companies, long distance carriers and cable TV operators to enter each other's markets. Distinctions are already blurring between local and long distance carriers.

The major result of this legislation over the past three years has been the consolidation of dominant firms to enhance service offerings, cover broader regions, and improve cost efficiencies, in an effort to offer all services to all customers (Exhibit III-9).

EXHIBIT III-9

Recent Communication Service Provider Deals

Partners	Date	News Item
AT&T, British Telecom	In process	AT&T gains access to international markets ($10 Billion)
SBC, Ameritech	In process	Creates end-to-end national local network ($62 Billion)
Bell Atlantic, GTE	07/98	Creates local network from Maine to Virginia + gains international wireless capability ($53 Billion)
WorldCom, MCI	07/98	Combines strength in long distance, local and Internet markets ($51 Billion)
AT&T Teleport Communications	07/98	AT&T enters local service market ($11 Billion)
AT&T, TCI	06/98	AT&T acquires cable and high speed Internet capability ($48 Billion)
Bell Atlantic, NYNEX	1997	Creates regional local network ($23 Billion)
SBC, Pacific Telesis	1997	Creates local network in TX and CA $(17 Billion)
MCI WorldCom	4/7/99	Acquired Nextel for $33B to enter US wireless market
MCI WorldCom	5/29/99	Acquired SkyTel, wireless data carrier
AT&T	NA	Acquired cable companies (#2 TCI, #4 MediaOne for $58B) to offer services over broadband networks to become #1 cable operator
Sprint	5/4/99	Acquired Videotron USA and Transworld Telecom to offer local and long-distance services
BellSouth	4/20/99	Acquired 10% of Qwest, #4 long-distance carrier

US West, Global Crossing	5/17/99	May merge to build global fiber optic telecom network
Qwest, Frontier, US West	6/15/99	Qwest bid for US West and Frontier Corp
Microsoft, Nextel	5/11/99	Microsoft invested $600MM in Nextel to give mobile phone users access to Microsoft's Internet services
Microsoft, OmniBrowse	6/15/99	Microsoft acquired OmniBrowse to boost MSN mobile service
Microsoft, Cable & Wireless	5/13/99	Microsoft negotiating with UK's #2 telcom firm, Cable & Wireless for 30% share for $4 B
Microsoft, Motorola	1/12/99	Microsoft to invesst $500MM in Motorola

Source: San Jose Mercury News.

The1996 Telecommunications Act has sparked competition in the past two years. Smaller long distance companies have increased their share of the market from 17 to 24 and cable operators have more than doubled their customers to 5 million.

In 1997 the World Trade Organization adopted an agreement to open telecom markets which were previously state-run operations. The 69 countries that signed the agreement comprise 90 percent of global telco revenues. Most of the member nations guaranteed freer access to their markets for international services, allowed foreign ownership or control of telecom services and facilities, and adopted pro-competitive regulatory policies. The agreement has accelerated the pace at which state-owned telecom companies are being privatized. These changes will create new markets and increase competition that will increase purchases of telecommunications equipment.

With local phone and long distance services growing at modest rates of 8 to 10 percent, many U.S. telcos are looking overseas to boost revenues. Latin America and Western Europe are likely locations for increasing competition. To date two major international alliances have been formed: Global One with Sprint, Deutsche Telekom and France Telecom and World-Partners with AT&T and 30 partners in Europe and Asia. But it is a double-edged sword. Just as U.S. firms plan to compete abroad, several European and other foreign firms may establish U.S. operating companies to provide domestic long distance and international services.

E
Bay Area Telecom Industry Trends

Telecom Industry Experiencing Explosive Growth

Various implications can be drawn from national trends for the Bay Area telecom industry. The first is that there is an enormous opportunity for

explosive growth within existing companies and among emerging companies in the Bay Area. Due to this growth, large numbers of skilled telecom workers are needed, as well as more housing, and more infrastructure to support the telecom workers. Chapter VI will explore labor issues related to the East Bay telecom industry in greater depth.

EXHIBIT III-10

Examples of Recent Local Workforce Expansion

Company	Date	News Item
Pac Bell	3/12/99	Hiring 900 new workers in Bay Area in 1999 to add more phone lines and high-speed Internet access; may be hard to find qualified customer service reps and service technicians
Cisco	3/2/99	Expanding into Coyote Valley to accommodate 20,000 additional workers over next 20 years

Source: San Jose Mercury News.

Large Companies Dominate

Telecom companies in the Bay Area reflect the patterns in the U.S. and global telecom industries: a few major companies dominate. Bay Area telecom firms are dominant particularly in the telecommunications equipment markets. Three Bay Area firms, Cisco, 3COM and BayNetworks/Nortel hold 80 percent of the global market for routers. Within the U.S. wireless communications service market, AirTouch/Vodafone has a 31 percent market share, more than twice the share of the next largest firm. And, 20 percent of the Bay Area telecom firms employ 80 percent of the workers.

The implication for the Bay Area is that if these large firms continue to grow, or if they acquire smaller firms, additional skilled telecom jobs will be created in the Bay Area.

Although all of the major communication services firms have branch offices here, none of their corporate headquarters are located in the Bay Area. Pac Bell was acquired by SBC, which is headquartered in Texas. If lower labor and operating costs are more critical to a communication service company's success than acquiring skilled engineers, it is possible that jobs in communication service firms will migrate out of the Bay Area in certain operational areas to lower-cost cities.

Successful Companies Collaborate

The most profitable high-tech companies are also the most successful collaborators. These firms form creative partnerships that enjoy significant competitive advantages of size or unique market offerings.

Andersen Consulting's two-year study of more than 250 electronics company business units found that the best-performing companies collaborate more than twice as often, with more types of partners, and with more sophistication than less-successful companies (referenced in *San Jose Mercury News*, January 31, 1999). In many cases, collaborative strategy is what determines which companies survive in the uncertain and rapidly changing telecom industry.

Bay Area telecom firms have actively engaged in partnerships. The high concentration of potential partners in one location may be one reason that firms are attracted to the Bay Area.

EXHIBIT III-11

Alliance Formed By Local Telecom Firms

Company	Date	News Item
Motorola, Cisco	2/8/99	Motorola and Cisco formed alliance to build largest wireless Internet global network; acquired fixed wireless unit of Bosch Telecomm
Alcatel, 3COM	3/18/99	Alcatel and 3COM will offer hand-held computer and cellular phones
Siemens, 3COM	3/4/99	Siemens negotiating for 3COM unit that sells networking equipment
3COM, Aether Technologies	6/18/99	Formed a new company, OpenSky (Palo Alto), for accessing email, the Internet and corporate-network info through wireless technology; service will be available by 12/99

Source: San Jose Mercury News.

Small Companies Innovate

The telecom industry is developing new technologies at an astonishing rate. Smaller firms have historically been the industry innovators because of their ability to respond quickly to opportunities. The Bay Area is world-renowned for its rich entrepreneurial environment and resulting innovation in high technology.

Because of the proliferation of start-up telecom and other high-tech firms, 40 percent of U.S. venture capital has been and will continue to be attracted to the Bay Area. Far-sighted local governments have initiated telecom

incubators to nurture fledgling telecom firms in the East Bay. The Oakland communications incubator is operational and the San Ramon telecom incubator is in the planning stage.

However, in order to maintain its competitive leadership, the Bay Area needs to address issues related to the rapid growth arising from its economic success, such as traffic congestion, expensive housing, and loss of highly skilled workers to areas with better quality of life.

Summary of Implications

Exhibit III-12 summarizes four major trends and their implications for the Bay Area.

EXHIBIT III-12

Implications of Industry Trends for Bay Area

Industry Trend	Implications for Bay Area
Explosive industry growth	Need more skilled workers; Need to provide more infrastructure to support influx of new workers
Large service providers seek low cost labor and low real estate costs	Bay Area is vulnerable; large service providers may leave area or export non-location specific functions out of the area
Critical mass of firms will continue to collaborate, merge with and acquire each other	There will be disruption in workforce; need a way to redeploy skilled workers and attract more highly skilled workers if, on balance, more are required
Bay Area will continue to attract small, innovative companies	Need to understand and cater to unique needs of small companies which provide a disproportionate share of growth and which may grow into major employers

IV

East Bay Telecommunications Industry

A East Bay Employer Demographics

The East Bay has about 440 telecom firms (36% of Bay Area telecom firms), employing approximately 30,000 workers (40%), paying them $1.2 billion (28%) and generating revenues of $6 billion (25%). Concentrations of telecom firms are located in three regions: the Oakland/880 corridor area, the Tri Valley/680 corridor, and the Fremont/880 corridor. Exhibit IV-1 contrasts these figures with Bay Area and U.S. figures.

EXHIBIT IV-1

U.S. and Local Telecommunications Markets, 1997

	U.S.	Bay Area	East Bay
# Telecom Firms	**34,000**	**1,200**	**440**
# Telecom Employees	1,200,000	75,000	30,000
Payroll	$43.4 Billion	$4.3 Billion	$1.2 Billion
Revenues	**$335 Billion**	**$24 Billion**	**$6 Billion**

Sources:
Standard & Poor's Industry Survey, Communications Equipment, December, 1998
Standard & Poor's Industry Survey, Telecommunications: Wireline, September, 1998
Standard & Poor's Industry Survey, Telecommunications: Wireless, December, 1998
Employment Development Department, 1999
Dun & Bradstreet, 1999

Exhibit IV-2 breaks these figures down into number of companies by employee size in each of the three East Bay telecom concentration areas and Exhibit IV-3 shows the figures graphically. These figures are based upon data from a Dun & Bradstreet custom database developed for this study. Additional firms were added to the database from city business licenses in each of the three areas.

The Compass Group believes that almost all East Bay telecom firms with over 250 employees have been identified. But, only a portion of companies with less than ten employees have been identified because many companies are so new or so small that they are not yet listed in standard databases.
Larger firms may have been missed because the SIC classification of the company's primary line of business might be open to interpretation. For

example, a company might be classified under SIC code 7375, "Business Consultant", rather than SIC code 4813 "Internet Service Provider, and so would not have been "picked up". In such cases, it was not practical to search through thousands of East Bay business consultants to find the few which consult solely to telecom firms.

Telecom system design, installation and maintenance firms are also classified under SIC code 7375. A special search was made for those firms with over 100 employees and they were included in the database. This picked up firms such as NetsWork, formerly PEDCOM, (375 employees) and VanStar Corp (603 employees).

EXHIBIT IV-2

Number of East Bay Telecom Companies by Employee Size, Dun & Bradstreet Data, 1999

Type of Company	# Empl	# Co's	1-9	10-19	20-49	50-99	100-249	250-499	500-999	1000+
Oakland/880										
Communications Equipment	4,358	24	10	5	3	5	0	0	0	1
Commun Service Providers	1,688	83	58	11	5	6	0	2	1	0
Other	194	8	3	2	1	2	0	0	0	0
Sub-Total	6,240	115	71	18	9	13	0	2	1	1
Tri Valley/680										
Communications Equipment	2,106	43	23	4	6	5	2	3	0	0
Commun Service Providers	12,952	103	55	11	19	8	5	3	0	2
Other	1,614	49	31	3	7	4	3	0	1	0
Sub-Total	16,672	195	109	18	32	17	10	6	1	2
Fremont/880										
Communications Equipment	3,938	49	10	9	15	6	7	0	2	0
Commun Service Providers	1,405	65	41	6	8	7	3	0	0	0
Other	997	15	4	2	1	6	1	1	0	0
Sub-Total	6,340	129	55	17	24	19	11	1	2	0
TOTAL, East Bay Telecom	29,252	439	235	53	65	49	21	9	4	3
% of East Bay, All Industries	3.5%	0.8%	0.6%	0.1%	1.4%	2.7%	2.2%	4.2%	5.8%	6.8%

Source: Dun & Bradstreet database, 1999 and city business license records.

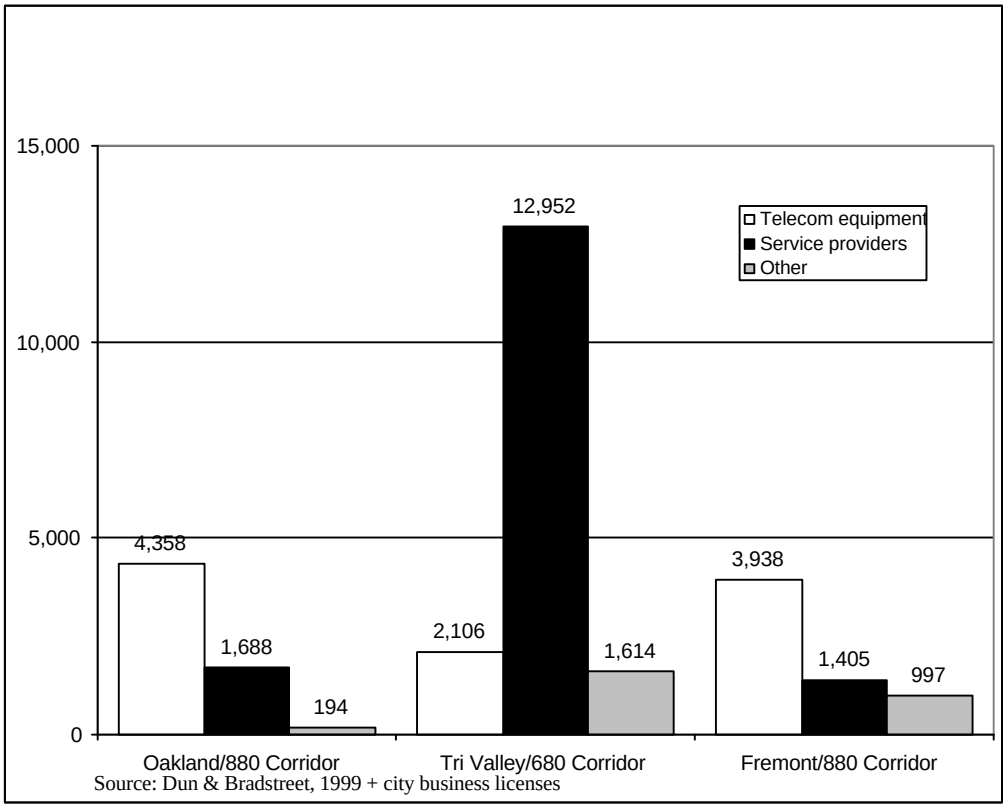
Another example is Ascend Communications (recently purchased by Lucent) which primarily manufactures telecom equipment, but is listed under SIC code 3577, computer manufacturer. A concerted effort was made to identify telecom companies with over 100 employees, and decide on an individual basis whether they should be included in the database, regardless of their nominal SIC code.

The Tri Valley/880 corridor is centered in San Ramon and includes Pleasanton, Danville, Dublin, and Livermore. Pleasant Hill, Concord and Walnut Creek to the north are also included. The Fremont/880 corridor,

centered in Fremont, includes Newark, Hayward and Union City. And the Oakland/880 corridor centered in Oakland, includes Alameda, Berkeley, Emeryville, and San Leandro.

EXHIBIT IV-3

Number of East Bay Telecom Companies by Employee Size, Dun & Bradstreet Data, 1999 (For Oakland/880 Corridor, Tri Valley/680 Corridor, and Fremont/880 Corridor)



Source: Dun & Bradstreet, 1999 + city business licenses

Type of Firm	Oakland/880 Corridor	Tri Valley/ 680 Corridor	Fremont/ 880 Corridor	Total
Telecom Equipment	4,358	2,106	3,938	10,402
Service Providers	1,688	12,952	1,405	16,045
Other	194	1,614	997	2,805
Total	6,240	16,672	6,340	29,252

*Other includes Internet business services and telecom system design, installation and maintenance firms.

As a source of confirmation, data from the US Department of Commerce Bureau of Census was examined (Exhibit IV-4). There was strong agreement between the two sources of information.

The Bureau of Census estimated there were about 24,000 East Bay telecom employees in 1996. The Dun & Bradstreet + business license

database estimated about 29,000 in 1999. The discrepancy is roughly equal to the "Other" category which was included in the D&B database. This group contains telecom consulting firms (such as NetsWork, VanStar Corp) and telecom equipment firms classified as computer equipment manufacturers such as Ascend Communications/Lucent.

EXHIBIT IV-4

Number of East Bay Telecom Companies by Employee Size, U.S. Bureau of Census Data, 1996

			Number of Companies By Size								
Category	**# Empl**	**Payroll (000)**	**# Firms**	**1-9**	**10-19**	**20-49**	**50-99**	**100-249**	**250-499**	**500-999**	**1000+**
East Bay, Telecom Only	23,973	1,186,550	348	194	46	45	34	21	14	2	2
East Bay Empl, All Industries	825,846	27,906,503	54,815	40,043	43,941	4,751	1,801	960	216	69	44

Sources: US Department of Commerce, Economic and Statistical Administration, Bureau of the Census, County Business Patterns, 1996, CBP/96-6.

Exhibit IV-5 graphically shows that most (54 percent) of East Bay telecom firms are very small (less than ten employees) and the proportion decreases with size. Exhibit IV-6 shows the majority of East Bay telecom

employees (56 percent) work for large firms (greater than 500 employees).

EXHIBIT IV-5

Number of East Bay Telecom Companies by Employee Size, 1999 (Bar Graph)

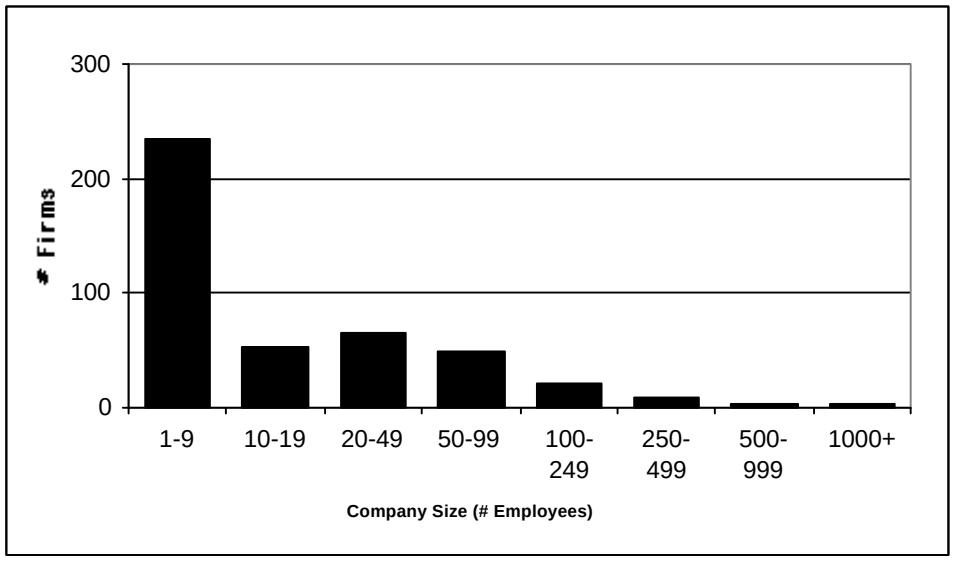
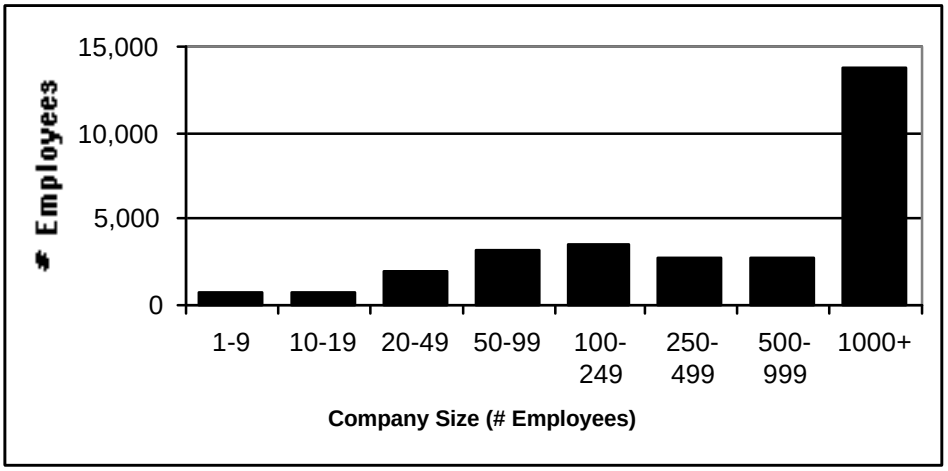


EXHIBIT IV-6

Number of East Bay Telecom Employees by Company Size, 1999 (Bar Graph)



Bay Area telecom equipment manufacturers are located predominantly in Silicon Valley (Sunnyvale and Santa Clara) and Bay Area telecom service providers are located predominantly in the San Ramon area.

B
Employer Mindset

Employers were asked with which geographic region they identified. Results in Exhibit IV-7 show that employers in the Tri Valley/880 corridor refer to themselves as doing business 'in the San Francisco Bay Area'. Many of these firms are international companies which deal with large customers for whom the benefit of doing business with a major company located in a major, sophisticated city has value.

Many Fremont/880 corridor area employers, on the other hand, found more value in identifying their base of operations as Silicon Valley. Being from Silicon Valley enhances their ability to attract venture capital, allows these predominantly equipment manufacturers to strike better deals with electronics suppliers, and enhances their reputations with customers.

Oakland/880 corridor employers did not agree on a mindset.

EXHIBIT IV-7

Geographic Identification by Employers

Area	Oakland/ 880 Corridor	Tri Valley/ 680 Corridor	Fremont/ 880 Corridor
U.S.	1		
Northern California	1		
San Francisco Area	1	4	1
East Bay			1
Silicon Valley			3
Individual Cluster	1	1	
None	1		

Source: Employer focus groups, 1999

C
East Bay Telecom Concentrations

Tri Valley/880 Corridor – a Vibrant Telecom Area

The Tri Valley/680 corridor employs 56 percent of all telecom workers in the East Bay. Most of these telecom workers are employed by communication service providers centered in the San Ramon area. In fact, 81 percent of the East Bay's telecom service workers are employed in this area. This constitutes a mini-cluster independent from the telecom equipment manufacturers located in the Fremont/880 corridor.

In 1970 Western Electric purchased 1,733 acres of the Bishop Ranch and proposed a "new town" complete with a variety of housing, green belts, stores and light industry. The development of Bishop Ranch Business Park in 1982 transformed the San Ramon area and neighboring cities from

a bedroom community for major employment centers in San Francisco, Oakland, and Silicon Valley into a significant regional employment center.

The Bishop Ranch Business Park consists of 580 acres of land with 5.9 million square feet of office space. The office park houses 200 companies including Pacific Bell and AT&T. It is expected that over 16,000 jobs will be added within the next 15 years. This represents a 58% increase over the current 27,643 jobs in San Ramon. The City is an affluent community with the estimated average household income in 1990 of $79,245. This compares to a county-wide average of $59,432.

Over the past 20 years, companies around the Bay have selected the San Ramon area for its suburban location, convenient transportation system, more affordable office space, more affordable housing (30% less), and more affordable highly educated workers, when compared with Silicon Valley. They will continue to do so as long as there is room to expand.

Most of the companies in the San Ramon area started there. It is a moderately rare occurrence when a firm relocates from outside the area, although it does happen. Ten years ago, Triad Systems made headlines when it moved from Silicon Valley. Last year, Accpac International, a business software company moved from Santa Clara to Pleasanton. At least two focus group participants mentioned their firm plans to move from Fremont to Pleasanton.

Several Silicon Valley firms have recently opened satellite offices in the Tri Valley/680 area such as LSI Logic, Cadence Design Systems, Remedy, and Cisco. These satellite offices allow local residents to work close to home, at least several days a week. Many employers in the focus groups were favorably disposed to this alternative. Many companies feel that the convenience the satellite centers afford is important in attracting and retaining engineers and other information technology workers who are in high demand.

A telecom incubator in the planning stages is scheduled to begin operations within the year in the San Ramon area. This will foster the formation and growth of young communication and information technology companies, strengthen the region's economic base, and promote creation of high value, sustainable jobs for local residents.

Most of the movement and innovative activities mentioned above involve smaller, entrepreneurial, firms which are growing at 20 percent or more each year. The larger telecom service providers such as AT&T, Pac Bell, and Sprint, have grown at a relatively sluggish pace in the last five years. Layoffs during that period at PacBell and AT&T have held growth down.

Despite the stunning growth and increasing maturity of this burgeoning cluster, the Tri Valley/680 corridor is still highly dependent upon the venture capital cluster located on Sand Hill Road (Menlo Park) and on the computer and electronic equipment (supplier) cluster located in Silicon Valley.

Fremont/880 Corridor – An Extension of Silicon Valley

Fremont, Hayward, and surrounding cities contain 29 percent of all East Bay telecom firms, and 22 percent of the workers. Six firms with 200 to 900 employees account for approximately half of telecom employment in that area: Network Equipment Technologies (900), SMART Modular Technologies (750), PEDCOM (375), Premisys Communications (200), SSE Telecom (200) and CeLAN Technology (200). About 120 smaller firms employ 3,000 workers.

Although the Fremont/880 corridor contains 43 percent of the telecom equipment firms, it employs a disproportionately large 59 percent of the workers in telecom equipment firms in the East Bay.

Most employers in this area do not think in terms of artificial geographical boundaries, but in terms of proximity to the largest concentration of electronics firms in the world. This mini-cluster is located four miles away from Santa Clara County which employs about 8 percent of all telecom equipment workers in the U.S.

Many of the largest firms assemble and manufacture high tech and telecom products. About 6 percent of the labor force is engaged in the telecom industry. Employers draw on a local, highly educated workforce.

Because of its prime location near Silicon Valley, new residential or industrial space will sell or lease for premium rates, only about 5 percent lower than Silicon Valley. But, in contrast to Silicon Valley, the Fremont/880 corridor still has room to build over 5,000 new homes and about 33 million square feet of commercial and industrial space. Although commercial construction is ongoing in Silicon Valley, most projects are limited to erecting one building sandwiched in between two other buildings. The Fremont area is in a unique position to be able to offer companies enough space to build contiguous buildings, or campuses.

The Fremont/880 corridor is served by BART (Bay Area Rapid Transit) and ACE (Altamont Commuter Express). However, employers in the focus group complained about inadequate transportation from the station to the workplace. Employers felt that a high proportion of their workers

might consider taking mass transit if subsidized vans ran from the station to the office during morning and evening commute times.

The Fremont/880 corridor will continue to attract new businesses because it is on the expanding edge of Silicon Valley. Witness MCI Worldcom's recently announced plans for a 200,000 square foot regional network center in Newark.

Oakland/880 Corridor – A Telecom Cluster in the Making

Mayor Jerry Brown's initiatives, and those of others (witness Alameda's Silicon Island Technology Consortium), have created a high tech business renaissance in the Oakland/880 corridor. These efforts target a wide range of technology-based businesses and entrepreneurial activity, rather than have a single industry (e.g. telecom) focus. As a result, the Oakland/880 corridor cannot yet lay claim to having a telecom cluster in the same sense as the TriValley/680 and Fremont/880 corridors.

The Oakland area is headquarters to Ascend Communications/Lucent which employs 3,750 and Pacific Bell with 500 employees. Approximately 110 other small telecom firms, which collectively employ 1,600 employees, are located in the Oakland area. About 3.5 percent of the workforce is engaged by telecom firms.

Attraction and retention of telecommunications firms remains a key priority to Oakland. Promising telecom start-ups such as Zhone (an Ascend spin-off) offer the promise of a future cluster of telecom firms. Recently, Oakland initiated a Communications Technology incubator to support 25 start-ups with affordable office space, business advice, and financing assistance. Only a small portion of its firms fit the telecom definition used in this study.

There is no rallying point or specific core of companies offering similar services or products in the Oakland area as is the case in the Tri Valley/680 corridor (telecom service providers) or in the Fremont/880 corridor (telecom equipment manufacturers). Thus, this is not a cluster, but a location in which one or two predominant employers are located.

Oakland is the 8th largest city in California and is located at the center of the Bay Area's regional public transportation system. Its government has a favorable attitude toward business, which has been noted by employers within and outside of Oakland. More than any other area, Oakland focus

group participants exhibited a strong sense of civic pride and commitment to making things work rather than leave.

If the Oakland area is to market its attraction to telecommunications companies, it will need to continue making progress on image issues, upgrade the skills of its workforce, and target companies which are predisposed to urban locations.

V

Employer Location Factors Analysis

The economic success of the telecom industry in the East Bay is based on its ability to create and sustain economic prosperity by attracting highly skilled workers and financial resources.

The East Bay represents over 6 percent of the California market for goods and services and provides more than 825,000 jobs, about a quarter of the Bay Area.

The East Bay is naturally endowed with a beautiful setting next to the Bay and nestled in the hills, with a mild climate. Historically local governments have invested in educational institutions and transportation infrastructure connecting cities around the Bay. This basic infrastructure has provided a base for strong business performance and for high personal income and quality of life.

However, the East Bay along with the Bay Area in general is now suffering from its success. The cost of housing is among the highest in the nation. Traffic congestion is a serious issue. The cost of doing business is higher than comparative national regions, largely because of relatively high real estate costs and high wages. These issues collectively present significant challenges to the area's ability to sustain its prosperity.

In order to determine which factors are considered most important to telecom employers, focus group participants were asked to rate the importance of, and satisfaction with, eight location factors (Exhibit V-1). Employers were instructed to rate "very important" issues with a "5" and "very unimportant" issues with a "1". They were also asked to rate their satisfaction with each factor, with a "5" denoting they were "very satisfied" and a 1, "very dissatisfied".

EXHIBIT V-1

Location Factors Measured

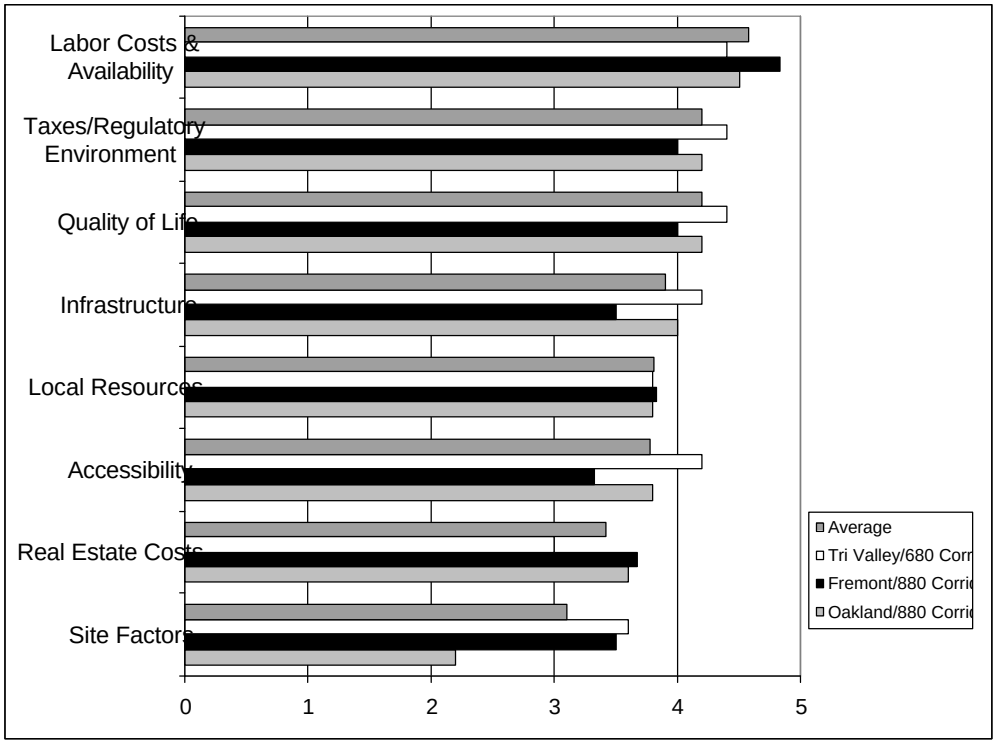
Location Factors	Sub-Factors
Labor Availability and Costs	Includes labor costs, labor relations, availability of low-cost labor, availability of highly skilled workforce, availability of job training, availability of recruitment/placement services
Hard Infrastructure	Includes highways, mass transit, airports, water ports, railways and telecommunication systems
Taxes and Regulatory Environment	Includes favorable local government attitude; property, corporate and personal tax rates; tax concessions; regional growth planning; and permit process
Quality of Life	Includes low crime rate, ease of commute, cost of living, housing affordability, recreational and cultural amenities, school system, air and water quality, availability of quality medical services, climate, and community atmosphere
Local Resources	Includes access to venture capital; access to commercial loans; proximity to universities and research laboratories; co-location with other telecom firms; availability of collaborative agencies; availability of suitable office and plant space; hotels, restaurants, and retail stores; business services such as temp agencies, recruiting firms, travel agencies, office equipment rental, and so forth
Accessibility	Includes accessibility to customers, suppliers and headquarters
Real Estate Costs	Includes lease rates, construction costs, and up front rent/occupancy concessions
Site Factors	Includes appearance of office building, and availability of suitable space (office,manufacturing plant, warehouse)

A
Employer Location Requirements

Exhibit V-2 shows that employers in the Oakland, Fremont and Tri Valley corridors were consistent in their ranking of the importance of location factors. Labor Availability and Costs was judged to be the most important issue, closely followed by Taxes and Regulatory Environment, and Quality of Life. Real Estate Costs and Site Factors were judged to be least important.

EXHIBIT V-2

Importance of Site Selection Factors to East Bay Employers



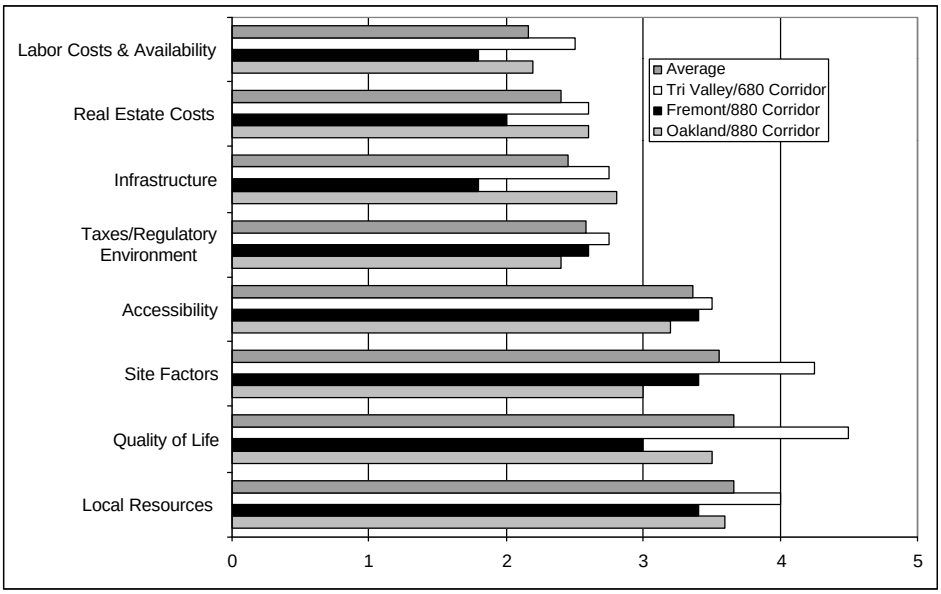
Factors	Oakland/ 800 Corridor	Fremont/ 880 Corridor	Tri Valley/ 680 Corridor	Average
Labor Availability & Costs	4.5	4.8	4.4	4.6
Taxes/Regulatory Environment	4.2	4.0	4.4	4.2
Quality of Life	4.2	4.0	4.4	4.2
Hard Infrastructure	4.0	3.5	4.2	3.9
Local Resources	3.8	3.8	3.8	3.8
Accessibility	3.8	3.3	4.2	3.8
Real Estate Costs	3.6	3.7	3.0	3.4
Site Factors	2.2	3.5	3.6	3.1

Ranking based on 1 to 5 scale (1=very low, 5=very high)

Exhibit V-3 shows that employers in the Oakland, Fremont and Tri Valley corridors were also fairly consistent in their satisfaction with location factors. Employers were most dissatisfied with Labor Availability and Costs, followed by Real Estate Costs, Hard Infrastructure, and Taxes and Regulatory Environment. They were most satisfied with Quality of Life and Local Resources.

EXHIBIT V-3

Satisfaction With Location Factors By East Bay Employers



	Oakland/ 880 Corridor	Fremont/ 880 Corridor	Tri Valley/ 680 Corridor	Average
Labor Availability & Costs	2.2	1.8	2.5	2.2
Real Estate Costs	2.6	2.0	2.6	2.4
Hard Infrastructure	2.8	1.8	2.8	2.5
Taxes/Regulatory Env't	2.4	2.6	2.8	2.6
Accessibility	3.2	3.4	3.5	3.4
Site Factors	3.0	3.4	4.3	3.6
Local Resources	3.6	3.4	4.0	3.7
Quality of Life	3.5	3.0	4.5	3.7

Ranking based on 1 to 5 scale (1=very low, 5=very high)

From discussions with employers it is clear that the absolute ranking of importance of or satisfaction with a factor alone is not indicative of employers' evaluations of the acceptability of location factors. Rather, it is the combination of being both important and unsatisfying to employers that elevates a factor to the top of the list of employers' concerns. This "gap" analysis appears in Exhibit V-4.

EXHIBIT V-4

Employer Site Selection Gap Analysis

Factor	Importance*	Satisfaction*	Gap
Labor Availability & Costs	4.6	2.2	-2.4
Taxes/Regulatory Environment	3.8	2.5	-1.3
Hard Infrastructure	3.9	2.7	-1.2
Real Estate Costs	3.4	2.5	-0.9
Quality of Life	4.2	3.5	-0.7
Accessibility	3.8	3.4	-0.4
Local Resources	3.8	3.7	-0.1
Site Factors	3.1	3.5	+0.4

Ranking based on 1 to 5 scale (1=very low, 5=very high)

Exhibit V-5 is another tool for developing economic development strategies and priorities based on employer feedback. Three factors that are important but with which employers are highly dissatisfied are "first priority" areas for immediate action. They are Labor Availability and Costs; Hard Infrastructure; and Taxes and Regulatory Environment. Three factors which are considered important, but with which employers are satisfied are areas that should continue to "be protected". These areas should continue to receive local government support to maintain high satisfaction levels. They are Quality of Life; Local Resources; and Accessibility.

Factors that are not considered as important by employers, regardless of satisfaction ratings, have lesser priority. They are Real Estate Costs and Site Factors. Each of these eight factors will be discussed below.

EXHIBIT V-5

Economic Development Priorities

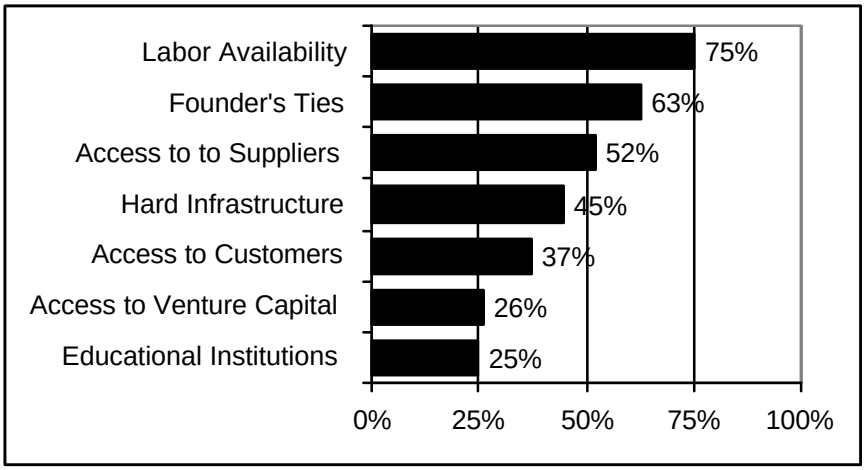
Importance	Satisfaction	
	Low	High
High	FIRST PRIORITY Labor Availability & Costs Taxes/Regulatory Envt Hard Infrastructure	PROTECT Quality of Life Local Resources Accessibility
Low	LOW PRIORITY Real Estate Costs	IGNORE Site Factors

A recent study conducted by A.T. Kearney, the Internet Cluster Study, polled 125 Internet executives across the U.S. on their preferences about the most important location factors. The seven most critical factors in determining company location are listed in Exhibit IV-6. They are very similar to the priorities voiced by East Bay telecom executives. Availability of highly skilled labor was the number one priority followed by Hard Infrastructure, Accessibility (to suppliers and to customers), and Local Resources (venture capital and educational institutions).

EXHIBIT V-6

Economic Development Priorities, Internet Cluster Study

Source: A.T. Kearney, Internet Cluster Study, 1999.



B
Most Critical Location Factors

Labor Availability, Costs and Quality

Of the eight broad categories, labor availability, costs and quality were both the most important to the focus group employers, and the factor with which they were the least satisfied. All 16 employers rated the factor either “important” or “very important” and none of the employers rated their satisfaction as either “high” or “very high”. This result was the same in all three focus groups (San Ramon, Fremont and Oakland).

Employers stated the scarcity of highly skilled workers was the factor that drove employers to bid up salaries and perks such as stock options and sabbaticals. The situation is exacerbated during strong economic times when unemployment is low. In some cases, employers are losing more skilled workers than they can hire. The average job tenure is less than 12

months for many in-demand positions. In many firms, retention has become more important than new hiring.

The availability of continuing education and job training programs was important to employers who work in a fast-paced, quickly changing industry. Up-to-date skills are critical to achieving and maintaining a competitive advantage.

Although a skilled workforce was the single most important factor, labor costs were not as important to employers.

Labor availability was an emotionally charged issue for many employers who repeatedly reinforced the point that this was the single most important challenge they were facing.

Hard Infrastructure

Hard Infrastructure was an important category to focus group panelists, and almost all were very dissatisfied with the transportation component. Employers felt commuting to work was a significant problem which could drive valuable highly skilled workers out of the Bay Area. Three-quarters (12 of 16) of the employers rated mass transit and highways as either "important" or "very important", but only 25 percent (4 of 16) were either "satisfied" or very satisfied" with this factor.

Employers felt the highways are crowded, there are some terrible potholes on some major and side arterials, and most damaging of all, they perceive there is no plan to remedy the situation in the near or distant future. The Sunol grade between the Tri-Valley and Fremont was mentioned as the worst local bottleneck.

In both the San Ramon and Fremont focus groups, employers were asked for commute patterns of their workforce. Exhibits V-7 and V-8 reveal that few workers live and work in Fremont (23%) and even fewer live and work in the Tri-Valley area (8%).

Workers commute to Fremont from San Jose and Santa Cruz (16%), Livermore (10%) and the Peninsula (Palo Alto, Mountain View) (10%). But, by far, the largest group (41%) commutes from the Tri-Valley cities of Dublin, San Ramon, and Pleasanton. Employers stated that many workers would ride BART transportation if connections between the BART station and workplace were improved. Due to traffic jams, workers' daily 18-mile commute from San Ramon to Fremont currently takes over an hour.
In San Ramon, employers felt that both BART and transportation from the BART station to their workplace was adequate. In fact, the key factor in

determining where to lease office space for several employers was how far the office was from the BART station.

Oakland employers were satisfied with highways, mass transit and the daily commute.

EXHIBIT V-7

San Ramon Commute Patterns, % of Workers

Direction>	Local	NW	S	E	SW	Very SW
SAN RAMON	Tri-Valley	Walnut Creek	San Jose	Livermore,Tracy	Hayward	Peninsula
Employer 1	0%	30%	25%	15%	30%	0%
Employer 2	0%	30%	25%	15%	30%	0%
Employer 3	10%	25%	25%	20%	20%	0%
Employer 4	20%	25%	15%	20%	30%	0%
Average	8%	28%	23%	18%	28%	0%

EXHIBIT V-8

Fremont Commute Patterns, % of Workers

Direction>	N	Very NW	S	NE	Local	W
FREMONT	Tri-Valley	Walnut Creek	SJ, S Cruz	Livermore	Fremont	Peninsula
Employer 1	60%	0%	15%	15%	0%	10%
Employer 2	60%	0%	35%	0%	5%	0%
Employer 3	0%	0%	0%	0%	80%	20%
Employer 4	40%	0%	20%	20%	10%	10%
Employer 5	45%	0%	10%	15%	20%	10%
Average	41%	0%	16%	10%	23%	10%

Taxes and Regulatory Environment

Nearly two-thirds (63%) of the employers rated taxes and regulatory environment as “important” or “very important”. Specifically, they mentioned favorable local government attitude as being the critical element in this grouping. Employers were not seeking tax concessions or reductions in property, corporate or personal tax rates. They were seeking intelligent, responsive government representatives with whom they could resolve permitting and other problems.

Very few employers were either “satisfied” or “very satisfied” with taxes and regulatory environment (13%). This quantitative result did not agree with what participants said in the focus groups. They were very satisfied with local government interactions. And, even when prompted, they did not feel that taxes were unfairly high.

Both labor shortages and congested roadways were perceived as much larger challenges than the tax and regulatory environment. The level of

emotion expressed and the amount of time spent in discussions concerning workers and commutes was much greater than the brief discussions concerning taxes and regulatory issues.

C
Location Factors With High Satisfaction Ratings

Quality of Life

The broad category "quality of life" was either "important" or "very important" to 75 percent of the employers. Sixty-three percent of the employers were either "satisfied" or "very satisfied" with factors in this category, the highest percentage of all eight factors. The Bay Area, it was agreed, has many of the amenities that attract businesses and workers to a city: decent air and water quality, availability of high quality medical services, many recreational and cultural activities, and superb climate.

San Ramon employers were significantly more satisfied (average=4.5) with quality of life issues than either Fremont (average=3.0) or Oakland (average=3.5) employers. One has only to visit the area to understand why. It is a beautiful, accessible suburban community with excellent schools, community facilities, and community atmosphere.

The high cost of housing in the Bay Area is considered undesirable and was identified as the primary reason that people move to more affordable areas. This in turn increases commute time and congestion on the roads.

Oakland employers stated that crime, particularly in the downtown area, was more of a "perception" than "reality". Crime reporting statistics cover a macro area of the downtown and include several older transitional areas such as the San Antonio and West Oakland neighborhoods. To fully understand the effect of crime activities in the downtown area, a more detailed and focused analysis would be required.

In addition, Oakland employers stressed the quality of K-12 education as a major concern.

Local Resources

Local resources were either "important" or "very important" to 75 percent of the employers. Fifty percent of employers rated their satisfaction as "high" or "very high". This category received the highest average satisfaction rating of 3.67.

Local resources includes financing by venture capitalists or commercial loans from banks; access to major universities and research laboratories; co-location with other telecom firms; availability of suitable office space and plant facilities; convenient hotels, restaurants and retail stores; abundance of business services such as recruiting firms, law firms, travel agencies; and local presence of collaborative agencies such as EDAB, and Joint Venture Silicon Valley.

In Fremont, where many high tech telecom startups are located, access to venture capital and to universities and research labs was cited as important to their success. Co-location with other telecom firms was also an incentive for doing business in Fremont.

In San Ramon, employers were more satisfied (average=4.0) with local resources than employers in Fremont (average=3.4) or Oakland (average=3.6).

Dissatisfaction among Fremont employers stems from the rapid industrial growth which has created a shortage of suitable, affordable office space ("Our building was half full a year ago, now there's no room for us to expand. We'll have to move very soon.") and hotels ("You can't get a room for love or money"). Several firms are moving to the Tri-Valley area where office space is more plentiful and cheaper.

Accessibility

Sixty-nine percent of employers felt accessibility to customers, corporate headquarters and suppliers was either "important" or "very important". Forty-four percent of employers were "satisfied" or "very satisfied", a generally positive score.

This issue did not elicit much discussion. It was suggested that accessibility was an issue in determining the original location, but after that, unless major customers, suppliers, or headquarters moved, it was a moot issue.

D

Less Significant Location Factors

Real Estate Costs

Very few (13%) of employers were "satisfied" or "very satisfied". With Real Estate Costs. Employers were more dissatisfied with only one other factor, Labor Availability and Costs. However, only 50 percent of employers felt real estate costs were either "important" or "very important", the second lowest rating of eight factors. Not surprisingly, San Ramon employers rated this factor lower in importance (average=3.0) than either Fremont or Oakland (average=3.6 and 3.7, respectively) because lease rates are lower in the Tri-Valley area.

Employers mentioned in passing that lease rates were high in the area, but accepted this reality as a cost of doing business in the Bay Area. Even when repeatedly prompted, focus group participants felt other issues were much more important. They did not expect any rent concessions or subsidies from local government agencies.

Office facilities are the preferred property type to meet corporate expansion needs (Exhibit V-9). In a nationwide study of corporate real estate executives conducted by Ernst & Young, 58 percent of employers preferred a suburban midrise or campus location for their expansion or relocation, 17 percent required light industrial space and only 12 percent preferred a traditional downtown location. About 10 percent required bulk distribution space and the remaining 3 percent sought R&D space.

Demand from major corporations is expected to continue to stimulate construction of suburban office space, such as the type offered in the Tri-Valley. Areas that provide light industrial park space, such as Fremont, should also see high demand.

Oakland's central business district maintains a less than 10 percent vacancy rate in Grade A office space, and less than 15% vacancy in Grade B. Many of the city's older buildings require substantial tenant improvements including seismic repair. As demand for both office space and housing in the entire Bay Area rises, Oakland continues to experience new interest in these older buildings.

Currently, the Oakland Tribune Building, the former headquarters for the newspaper, is being adapted for reuse for live/work and retail. The Rotunda Building is undergoing renovation and will be available for lease within the next one to two years. These large-scale projects provide additional high-end office and retail space as well as set a precedent for the adaptive reuse project of an older office building to housing in the downtown.

EXHIBIT V-9

Large Corporation Property Preferences

Property Type	% Respondents
Suburban midrise	33%
Campus	25%
Light industrial park	17%
Central business district	12%
Bulk warehouse	10%
R&D	3%

Source: Ernst & Young, US Corporate Relocation Survey, 1995.

Site Factors

Fifty-six percent of employers were either "satisfied" or "very satisfied" with site factors, the second highest ranking among eight factors. They also felt it was the least important variable with only 44 percent rating it "important" or "highly important".

Oakland employers felt the appearance of their facilities was not very important (average=2.2). Whereas Fremont and San Ramon felt it was moderately important (average= 3.5 and 3.6, respectively). Oakland employers, however were less satisfied (average=3.0) than Fremont (average=3.4) and significantly less satisfied than San Ramon (average=4.3) employers with site factors.

E
Comparison of Importance Rankings

The focus group rankings of site location factors were compared with rankings from results of a 1995 Ernst & Young survey of executives in large domestic firms.

East Bay focus group participants represented, for the most part, small, entrepreneurial, high technology firms. Respondents to the Ernst & Young study represented large, staid, non-technology firms.

As shown in Exhibit V-10, the major difference in their ranking was that East Bay Telecom employers felt that Labor Availability and Costs were far and away the most crucial issue and large non-technology employers felt by a wide margin that Real Estate costs were most crucial.

EXHIBIT V-10

Employer Ranking of Site Selection Factors

Factor	Ernst & Young	East Bay Telecom
Real Estate Costs	4.1	2.9
Taxes/Regulatory Env't	2.9	3.0
Accessibility	3.4	3.8
Quality of Life	3.4	4.0
Labor Availability & Costs	3.6	4.7
Hard Infrastructure	3.5	4.0
Site Factors	Not Included	2.9
Local Resources	Not Included	3.8

One firm interviewed in the focus groups was a major communication service provider that employs approximately 25 percent of East Bay telecom workers. This firm's responses were more similar to large companies than with small telecom companies. They felt Real Estate Costs and Tax and Regulatory Environment were more important than Labor Availability and Costs.

The implication of this finding is that priorities depend on company size and maturity. One set of policies and incentives may be required to attract and retain large "anchor" telecom firms and a different set for small, entrepreneurial firms.

VI

East Bay Telecommunications Occupations and Labor Market

A East Bay Telecommunications Labor Market

The East Bay has about 440 telecom firms (36% of Bay Area telecom firms), employing approximately 30,000 workers (40%), paying them $1.2 billion (28%) and generating revenues of $6 billion (25%). Exhibit VI-1 contrasts these figures with Bay Area and U.S. figures.

EXHIBIT VI-1

U.S. and Local Telecommunications Markets, 1997

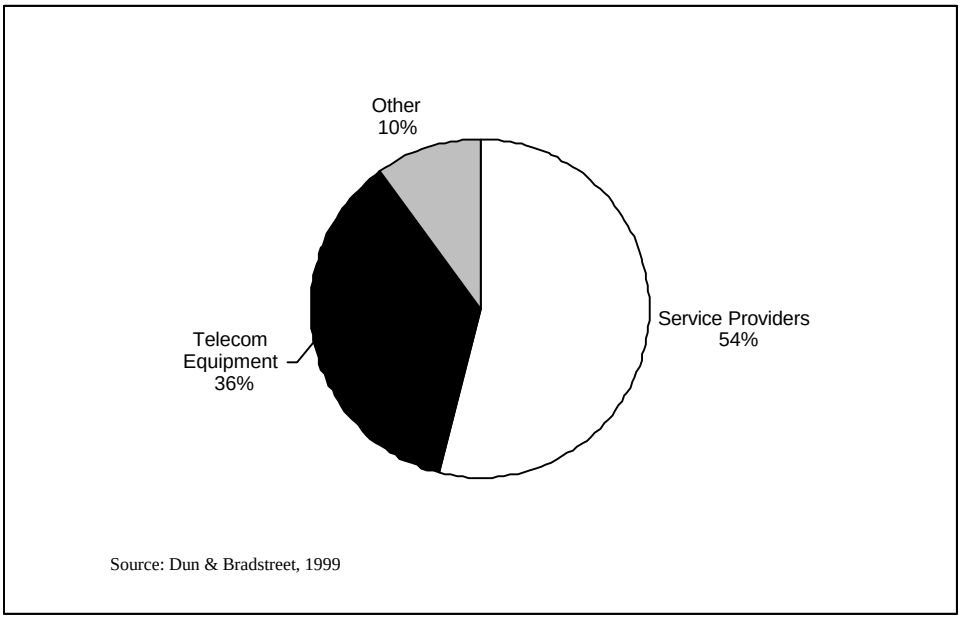
	U.S.	Bay Area	East Bay
# Telecom Companies	34,000	**1,200**	**440**
# Telecom Employees	1,200,000	75,000	30,000
Payroll	$43.4 Billion	$4.3 Billion	$1.2 Billion
Revenues	$335 Billion	$24 Billion	$6 Billion

Sources:
Standard & Poor's Industry Survey, Communications Equipment, December, 1998
Standard & Poor's Industry Survey, Telecommunications: Wireline, September, 1998
Standard & Poor's Industry Survey, Telecommunications: Wireless, December, 1998
Employment Development Department, 1999
Dun & Bradstreet, 1999

Approximately 54 percent of telecom workers are employed by telecom service providers and about 36 percent by telecom equipment firms. The remaining 10 percent are employed by "Other" firms which includes telecom consulting firms, Internet consulting firms, and telecom system design, installation and maintenance firms. (Exhibit VI-2).

EXHIBIT VI-2

East Bay Telecom Employees by Employer Type, 1999

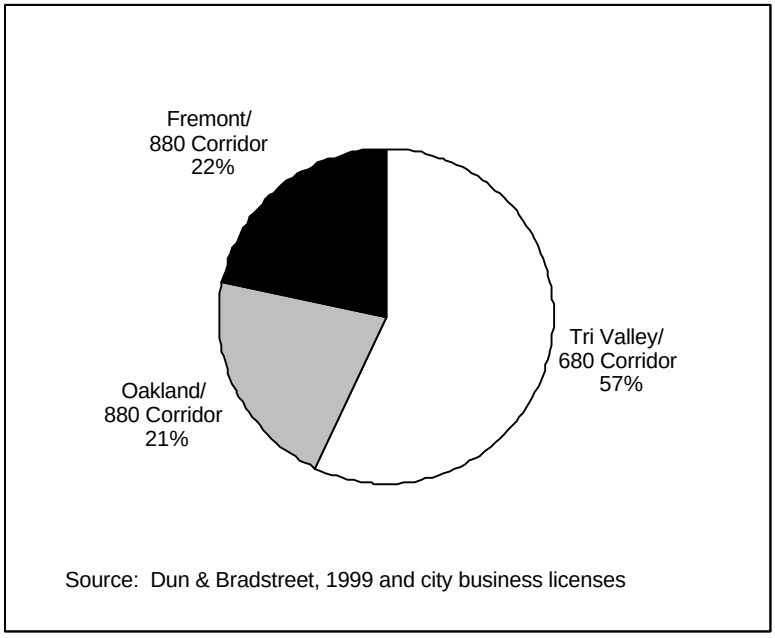


Source: Dun & Bradstreet, 1999

In the East Bay, 57 percent of telecom employees work in the San Ramon area, 22 percent work in the Fremont area and 21 percent work in the Oakland area (Exhibit VI-3).

EXHIBIT VI-3

Location of Telecom Employees, 1999



Sixty percent of approximately 30,000 East Bay telecom employees work for ten (less than 5%) of the firms which are, for the most part, located in the San Ramon area. These ten firms are the giant telecom service providers and equipment firms discussed in Chapter III: SBC/Pacific Bell, Sprint, GTE Corp, Siemens, Nextel, NET, Nortel, Ericsson, Airtouch Communications (acquired by Vodaphone), and Ascend Communications (acquired by Lucent Technologies).

Data Sources

Employment forecasts are based on California State Employment Development Department (EDD) occupational data for Alameda and Contra Costa Counties, 1999. In spite of known weaknesses that tend to underestimate, the EDD data is the only employer-driven, consistent source of local occupation information available.

Current employment figures are compared with data from the Dun & Bradstreet (D&B) database. EDD estimates of East Bay telecom employment are 18,000, whereas D&B estimates are about 30,000. The discrepancy can be attributed to the omission of several high growth occupations that are not counted by EDD. When estimates for these

occupations are included, the EDD estimates closely agree with the D&B estimates.

There is also a discrepancy between EDD figures and employer-reported statistics for expected growth rates (Exhibit VI-4). Employer estimates are given preference over EDD estimates because they do the hiring and represent telecom industry-specific needs as defined in this study.

EXHIBIT VI-4

Examples of Occupational Growth Discrepancies

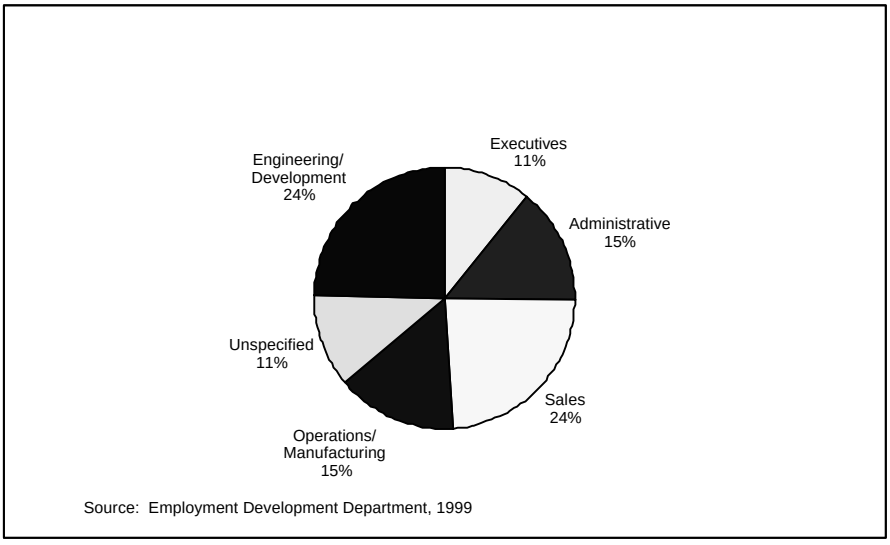
Occupation	EDD Estimate	Employer Reports
Electrical Engineer	4.8%	18.5%
Engin, Math, Natural Sci Mgrs	7.6%	23.1%
Systems Analysts	10.4%	63.1%

Occupational Categories in the Telecom Industry

About a quarter of East Bay telecom workers are in Sales/Service or Marketing; a quarter are in Administration/Management; a quarter are in Engineering/Development; 15 percent are in Operations/Manufacturing; and the remaining 11 percent are in unspecified occupations (Exhibit VI-5).

EXHIBIT VI-5

Occupational Categories in East Bay Telecom Firms, 1999



Source: Employment Development Department, 1999

East Bay telecom industry employment is approximately 30,000, about 3.4 percent of the 944,400 total East Bay employment. However, the telecom industry employs almost 8,000 Engineering/Development employees or slightly over 10 percent of all East Bay Engineering/Development employees as reported by EDD.

This is significant for three reasons. Engineering/Development employees positions in the telecom industry are growing at an average rate of 13.8 percent vs. 5.8 percent for all other telecom positions. These positions require more highly skilled workers who earn higher salaries. And in a broader sense, other East Bay and Bay Area industries rely upon the Engineering/Development staff of telecom companies to enable their firms to be more productive.

Telecom Engineering/Development job openings in the East Bay will grow by almost 17 percent annually. Between 1999 and 2002 about 2,000 new jobs will be created for 11 of the fastest growing occupations. If 500 net replacement jobs are added to 2,000 newly created jobs, 2,500 new Engineering/Development workers will need to be trained and hired over the next 3 years.

These occupations take on added significance when they are measured against several criteria: number of new positions, expected growth rate, and difficulty in recruiting. The last three occupations in Exhibit VI-6 contribute a small number of new jobs to the telecom industry, so they will not be discussed in additional detail.

EDD did not report statistics for six critical occupations. Therefore, the Compass Group estimated demand for Software Engineers, Telecom Engineers, Internet Web Site Designers, LAN Managers, Telecom Technicians and Network Control Technicians.

Focus groups were conducted from 1996 to 1998 with 7 to 15 employers for each California Cooperative Occupational Information System (CCOIS) occupation. Additional focus groups were conducted in July, 1999 by the Compass Group to confirm the research findings and discover new insights.

EXHIBIT VI-6

Characteristics of Selected Telecom Engineering/Development Occupations

Occupational Title	New Positions '99-'02	Size of Occup	Annual Growth	Projected Growth	Difficulty in Recruiting
Software Engineers	363	large	35%	High	Somewhat
LAN Managers	300	large	35%	High	Somewhat to very difficult
Electrical Engineers	284	large	19%	High	Somewhat
Telecom Engineers	232	large	132%	Very High	Somewhat
Telecom Technicians	182	large	35%	High	Somewhat
Internet Web Site Designers	175	large	250%	Very High	Somewhat to very difficult
Computer Support Specialists	150	medium	4%	Low	Somewhat to very difficult
Network Control Technicians	138	large	33%	High	Somewhat to very difficult
Electrical, Electronic Assemblers	92	medium	6%	Average	Somewhat
Electrical Engin Technicians	89	medium	7%	Average	A little difficulty
Engin, Math, Natl Sci Mgrs	44	medium	24%	High	Somewhat
TOTAL	2,050				

Sources:
Occupational Outlook Reports for Contra Costa and Alameda Counties, 1996 – 1998
Employment Development Department, 1999
Focus Groups conducted with telecommunication firm executives, 1999

Six of the eight critical occupations listed in Exhibit VI-6 are so new that they have not yet been assigned job codes by EDD. However, Alameda and Contra Costa Counties have published Occupational Outlook Reports with information on these occupations. Local vocational schools have been offering courses in these fields for several years. Employers in focus groups confirmed that they currently employ and are actively recruiting candidates to fill the following positions:

- Local Area Network Manager
- Internet Web Site Developer/Designer
- Software Engineer
- Network Control Technician
- Telecom Technician
- Telecom Engineer

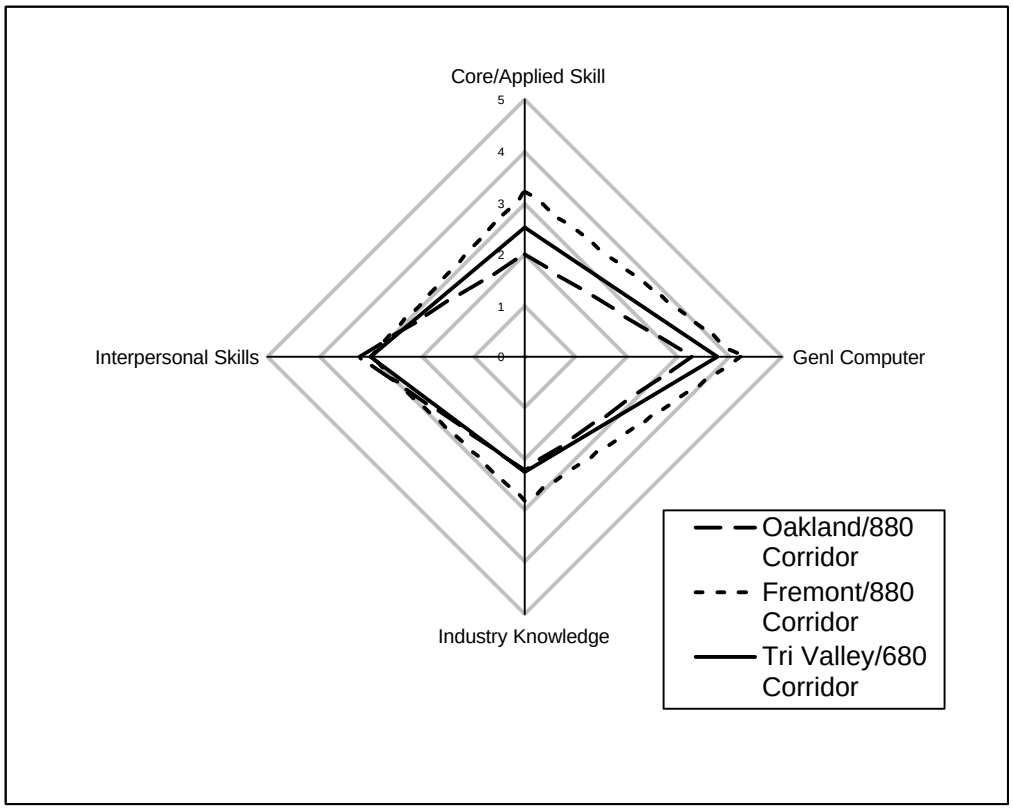
B
Critical Skill Sets

Skills Availability in Local Labor Markets

In recent focus groups, employers were asked to rate available skills for all jobs in the workforce where a score of 1=no supply and a score of 5=easy to find. Results in Exhibit VI-7 show that although job applicants have ample basic computer skills and interpersonal skills, industry knowledge and core/applied skills are difficult to find.

EXHIBIT VI-7

Difficulty in Finding Occupational Skills in East Bay Telecom Industry, 1999



Source: Employer focus groups, 1999

Engineering/Development Skills in Demand

The changing nature of information technology has had an impact on the tasks and skill requirements of entry-level positions. Prior to the 1990's, typical job titles were Data Entry Operator, Data Control Clerk, Computer Operator and Programmer Trainee. These positions required little beyond a high school diploma.

Today's entry-level positions are in Systems Administration, Network Analysis and Support and Help Desks. These positions require considerable technical knowledge beyond high school. Typically, this knowledge is acquired by completing a 1 to 2 year program culminating in a certificate or associate's degree from vocational schools, community colleges, or university extensions.

However, a December 1997 study of East Bay employers suggests that degrees are less important than the actual skill set. Skill clusters may prove to be a more useful approach in examining shortages than traditional functional classifications. The skills listed in Exhibit VI-8 are in high demand.

EXHIBIT VI-8

Percentage of Employers Seeking Selected Skill Sets

Skill Set	% Employers
Internet	73%
Web Development	62%
HTML	60%
LAN/WAN Platform	57%
Windows NT	56%
Java	53%
Windows98	47%
Local Area Networks	47%
E-Mail	47%
Intranets	42%
Wide Area Networks	40%
Enterprise Networks	35%
Database Applications	20%
Computer Based Training	18%
Presentation Graphics	14%

Source: Ready for Work in Information Technology, 1997

In spite of relaxed hiring practices (driven by tight labor markets) most employers state they require a four-year college degree for three Engineering/Development occupations (Software Engineer, LAN Manager, Internet Web Site Designer), a two- or four-year degree for four occupations (Network Control Technician, Electrical and Electronic Engineer, Telecom Technician, Computer Support Specialist) and some post-high school courses for 1 occupation (Telecom Engineer) (Exhibit VI-9).

EXHIBIT VI-9

Minimum Education and Training Required in Selected Occupations

	Educational Level				
Occupational Title	**HS**	**Some Coll**	**AA**	**BS**	**Grad**
Software Engineers	0%	0%	0%	90%	10%
LAN Manager	0%	25%	6%	63%	6%
Internet Site Designer	0%	0%	10%	90%	0%
Network Control Tech	0%	0%	50%	50%	0%
Electrical/Elec Engin	0%	13%	13%	47%	7%
Telecom Tech	22%	11%	33%	33%	0%
Comput Supp Spec	20%	20%	0%	60%	0%
Telecom Engin	27%	40%	13%	13%	7%

Source: Occupational Outlook Reports, 1996 – 1998

Employers require work experience for four occupations (Software Engineer, LAN Manager, Internet Web Site Designer, Network Control Technician), but will hire inexperienced workers in other occupations (Electrical Engineer, Telecom Technician, Computer Support Specialist, Telecom Engineer) (Exhibit VI-10).

EXHIBIT VI-10

Work Experience Requirements in Selected Occupations

	Work Experience Required			
Occupational Title	**Never**	**Sometimes**	**Usually**	**Always**
Software Engineers	0%	0%	100%	0%
LAN Manager	0%	10%	0%	90%
Internet Site Designer	0%	0%	10%	90%
Network Control Tech	0%	0%	9%	91%
Electrical/Elec Engin	0%	13%	20%	67%
Telecom Tech	0%	22%	22%	58%
Comput Supp Spec	7%	13%	27%	53%
Telecom Engin	0%	7%	33%	60%

Source: Occupational Outlook Reports, 1996 – 1998

However, employers are willing to allow training or certified skill as a substitute for work experience to some extent in all occupations (Exhibit VI-11).

EXHIBIT VI-11

Training as a Substitute for Experience in Selected Occupations

	Training as Substitute for Experience			
Occupational Title	**Never**	**Sometimes**	**Usually**	**Always**
Software Engineers	0%	100%	0%	0%
LAN Manager	67%	33%	0%	0%
Internet Site Designer	50%	30%	20%	0%
Network Control Tech	36%	36%	28%	0%
Electrical/Elec Engin	53%	13%	27%	7%
Telecom Tech	33%	33%	11%	22%
Comput Supp Spec	40%	47%	7%	7%
Telecom Engin	13%	67%	20%	0%

Source: Occupational Outlook Reports, 1996 – 1998

C
Labor Supply/Demand Analyses

For High Level Occupational Groupings

Employers were asked to rate the four occupational groups in terms of demand on a five-point rating scale. Those occupational groups in which employers experienced high demand were rated "5", and those occupational groups in which employers experienced low demand were rated "1".

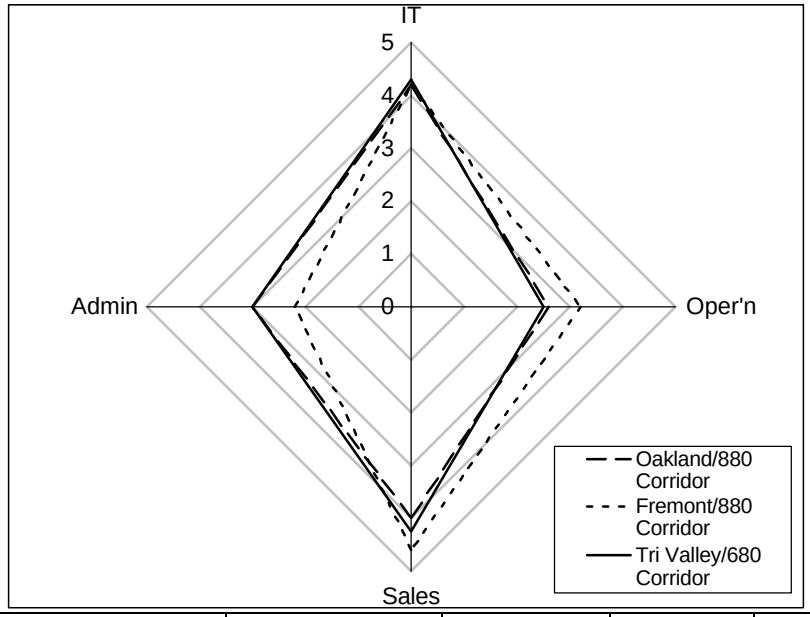
Employers were then asked to rate the same four occupational groups by the ease with which they were able to find qualified candidates. A rating of "5" indicated applicants were easy to find and a rating of "1" indicated they were in short supply.

Exhibit VI-12 shows that employers from three different locations in the East Bay were fairly consistent in their responses. Sales/Support (average demand=4.2) and Engineering/Development workers (average demand=4.3) are in the greatest demand by telecom employers. There was moderate demand for Administrative (average demand=2.7) as well as most Operations/Manufacturing positions (average demand=2.8).

Employers in Fremont report that Sales, Marketing, and Customer Service employees, particularly Technical Sales positions, are in great demand. There is also a greater demand for Operations/Manufacturing workers in Fremont than in Oakland or San Ramon. This may be due to the fact that a greater proportion of equipment manufacturers are located in Fremont which require more operations/manufacturing and direct sales personnel than service providers.

EXHIBIT VI-12

Labor Market Demand



Location	Engin/Develop	Oper/Mfg	Sales	Admin
Oakland/880 Corridor	4.2	2.6	4.0	3.0
Fremont/880 Corridor	4.2	3.2	4.6	2.2
Tri Valley/680 Corridor	4.3	2.5	4.3	3.0
Avg	4.2	2.8	4.3	2.7

Source: Employer focus groups, 1999

Employers were then asked to rate the four occupational groups in terms of supply on a 5-point rating scale. Those occupational groups in which employers experienced no difficulty in recruiting qualified candidates were rated "5", and those occupational groups in which employers experienced a great deal of difficulty, or for which there was no supply were rated "1".

Exhibit VI-13 shows that employers experienced shortages in Engineering/Development, Operations/Manufacturing and Sales. They felt there was adequate supply of Administrative personnel.

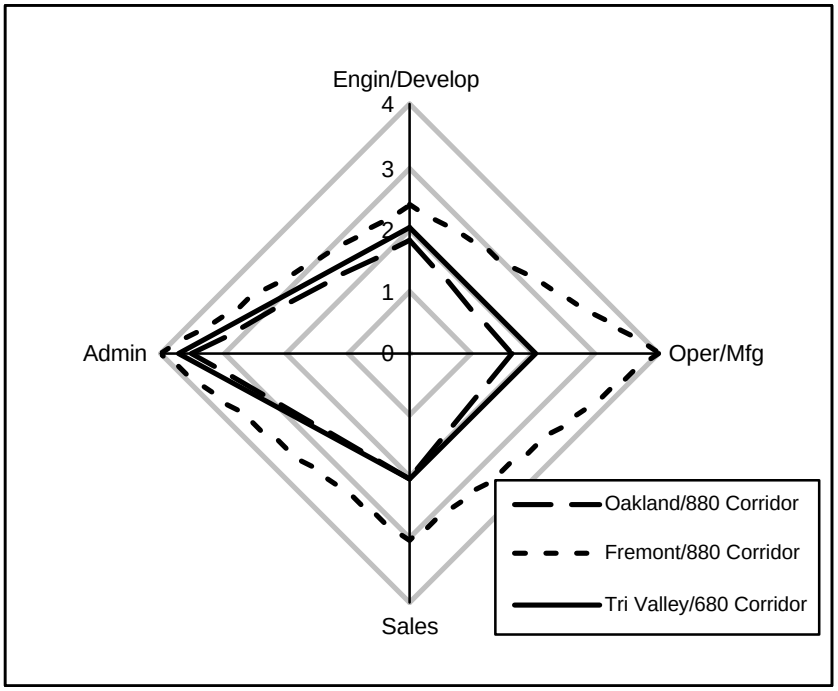
Although there is a greater demand for Operations/Manufacturing workers in Fremont, there also seems to be a greater supply to fill those positions. This may be the result of being located adjacent to Silicon Valley where there is a large pool of Operations/Manufacturing talent. The same argument might be made for Fremont employers' across-the-board response that supply was greater in their area than was being experienced in Oakland or San Ramon.

Sales/Support (average supply rating=2.3) and Engineering/Development workers (average supply rating=2.1) are in the shortest supply.

Employers report shortages among particular occupations: Programmers (C++, software, windows), Installation and Field Technicians, Technical Sales workers, and Network personnel (engineers, designers, administrators).

EXHIBIT VI-13

Labor Market Supply



Location	Engin/Develop	Oper/Mfg	Sales	Admin
Oakland/ 880 Corridor	1.8	1.7	2.0	3.5
Fremont/ 880 Corridor	2.4	4.0	3.0	4.0
Tri Valley/ 680 Corridor	2.0	2.0	2.0	3.7
Avg	2.1	2.6	2.3	3.7

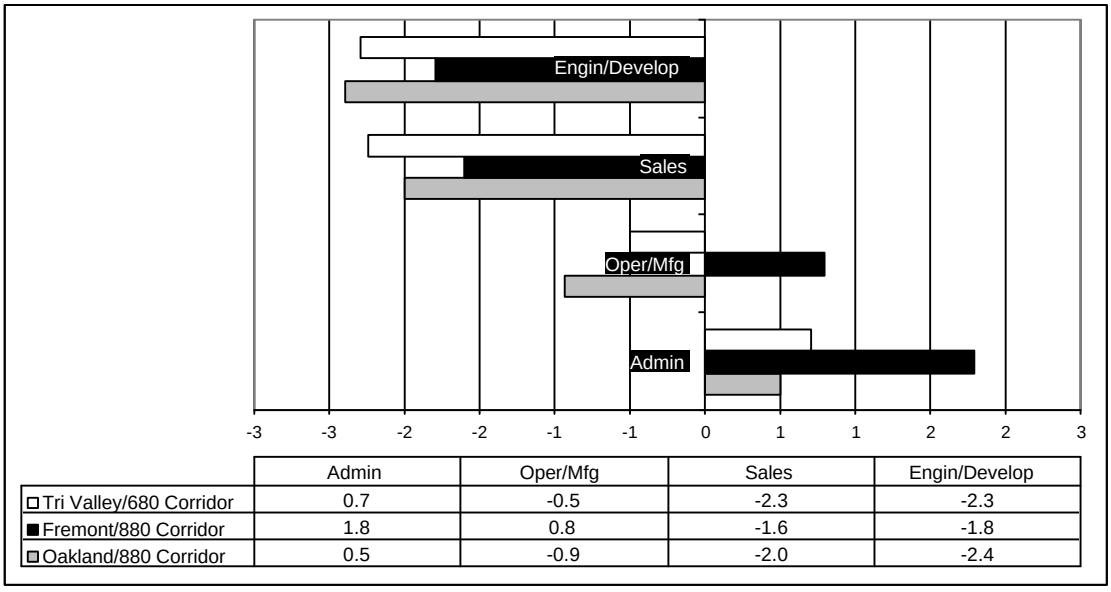
Source: Employer focus groups, 1999

When employer reports of demand and supply are juxtaposed, a workforce gap is obvious. When supply ratings are subtracted from demand ratings, the occupations with adequate workforce show a surplus, or positive value. When there is inadequate workforce for occupations in high demand, negative values result. The more negative the number, the greater the shortage.

Exhibit VI-14 confirms that there are severe shortages in Sales and Engineering/Development positions, Operations/Manufacturing is experiencing a slight shortage and there are no shortages in the Administrative area.

EXHIBIT VI-14

Workforce Gaps



	Admin	Oper/Mfg	Sales	Engin/Develop
Tri Valley/680 Corridor	0.7	-0.5	-2.3	-2.3
Fremont/880 Corridor	1.8	0.8	-1.6	-1.8
Oakland/880 Corridor	0.5	-0.9	-2.0	-2.4

Source: Employer focus groups, 1999

Field Technicians

Employers identified one occupation within Operations/Manufacturing which will experience a potential crisis of increasingly severe shortages. Installers and Field Technicians who lay fiberoptic and copper cables for the telecom industry are in short supply.

There are a large number of installers who had about 20 years' experience with Pac Bell before being laid off during industry downsizing in the early 1990's. These same workers were hired back in the mid- to late-1990's to satisfy the explosive demand for implementing new telecom infrastructure (fiber and wireless). When these workers retire within the next five years, it will create a huge Field Technician workforce deficit. Some astute companies have recently recognized the future implications of the situation and are scrambling for a strategy to prevent a crisis.

Employers suggest that one solution to future shortfalls is streamlining BICSI certification from the current 2 years to 6 months offered at Skyline Community College (San Mateo) and through unions.

Engineering/Manufacturing Occupations

The most severe chronic shortages occur in the Engineering/Development occupations within the East Bay telecommunications industry. The situation is expected to worsen due to high projected growth for the foreseeable future.

Evidence of labor supply problems are the high wages paid due to employers trying to outbid each other for scarce talent, and results of surveys which ask employers about recruiting difficulties (Exhibit VI-15).

EXHIBIT VI-15

Employer-Reported Recruiting Difficulty in Selected Occupations

	Difficulty in Finding Applicants			
Occupational Title	**None**	**Little**	**Somewhat**	**Very**
Software Engineers			100% 100%	
LAN Manager	14% 50%	 25%	57% 25%	29%
Internet Site Designer	10%	30%	30% 67%	30% 33%
Network Control Tech	18% 50%	18%	36% 50%	28%
Electrical/Elec Engin			100% 100%	
Telecom Tech			100% 100%	
Comput Supp Spec			100%	 100%
Telecom Engin			100% 100%	

Note: Upper number refers to experienced workers, lower number for inexperienced workers.
Source: Occupational Outlook Reports, 1996 – 1998

The workforce shortage is a critical impediment to corporate growth and to the economic vitality of the region. Currently the workforce gap is driven by a limited supply of qualified candidates, high housing costs which affects attraction and retention of workers, and high wages which hinder small and mid-sized companies' ability to hire.

The costs to employers of these shortages are lost productivity, high recruiting costs, and constrained growth. Employers respond to labor shortages by recruiting people from outside the East Bay, hire people with

long commutes, or leave positions unfilled until a suitable candidate is located. A recently conducted survey on the Silicon Valley workforce came to conclusions that may broadly apply to the East Bay:

- 11% of the workforce is recruited from outside Silicon Valley
- # jobs increased by 36,600 while local employment increased by only 25,700 from 1997-1998
- Average commute time has increased 14.2% over past year to 26.5 minutes
- Average commute length has increased 2.2% over past year to 14.1 miles
- About 6% of current positions are unfilled
- Average time to fill open positions is 3.7 months, with some "hot" jobs taking as long as 6 months
- Unemployment rate of 3.4% is lower than 4.5% national average
- Annual turnover rate of 20-30% is higher than national average of 13-18%

Employers felt that critical occupations would either remain stable or get worse in the next 3 years (Exhibit VI-16).

EXHIBIT VI-16

Three-Year Growth Expectations in Selected Occupations

Occupational Title	3-Year Growth Expectations		
	Decline	Stable	Grow
Software Engineers	0%	25%	75%
LAN Manager	0%	60%	40%
Internet Site Designer	0%	35%	65%
Network Control Tech	0%	25%	75%
Electrical/Elec Engin	0%	67%	33%
Telecom Tech	0%	44%	56%
Comp Supp Spec	7%	60%	33%
Telecom Engin	0%	73%	27%
Average	1%	49%	51%

Source: Occupational Outlook Reports, 1996 – 1998

During the previous 12 months, employers reported that at least half of the vacancies resulted from growth, about 15 to 20 percent resulted from turnover, and 15 to 20 percent resulted from promotion (Exhibit VI-17). As labor markets tighten, competition for limited resources increases and turnover rates rise. Since the cost of a new hire is front-loaded and turnover represents a "brain drain", employers are shifting emphasis from new hiring to retention.

EXHIBIT VI-17

Sources of Vacancies in Selected Occupations

	Vacancies Filled in Last 12 Months			
Occupational Title	**Temp/On Call**	**Turnover**	**Promotion**	**Growth**
Software Engineers	0%	30%	10%	60%
LAN Manager	0%	33%	33%	33%
Internet Site Designer	0%	0%	0%	100%
Network Control Tech	0%	10%	30%	60%
Electrical/Elec Engin	0%	17%	17%	67%
Telecom Tech	13%	13%	33%	40%
Comput Supp Spec	NA	NA	NA	NA
Telecom Engin	15%	37%	2%	46%
Average	4%	18%	16%	51%

Source: Occupational Outlook Reports, 1996 – 1998

East Bay telecom employers have filled jobs in the past with local residents, workers who are recruited from outside the Bay Area, commuters, and non-citizens who hold H1-B visas.

In order to fill the gap between supply and demand, employers will have to tap into new labor pools and create innovative programs.

Workforce Solutions/Recommendations

It is difficult to attract workers with the appropriate skills and experience to the Bay Area because of the high cost of living. Recruiting workers from outside the Bay Area would contribute to the congestion. Training local workers to fill empty positions would be a better option. Several long-term solutions are listed below.

Most Engineering/Development workers are males. Women need to be informed of career opportunities as early as grade school to kindle interest in high technology professions.

Many local workers have 50 percent or more of the skill set required for high demand jobs. Employers can, on an individual basis, provide training in the deficient areas. This is not a popular choice, however, because many employers are reluctant to provide extensive training to workers who typically change jobs every 1-2 years.

Industry executives and educators agree that most high school students do not have a clear understanding of the content or salaries of high technology jobs. Programs that inform K-12 students of potentially high paying jobs may attract a larger pool of talent to the telecom industry in future years.

Employers require work experience in several of the occupations listed in Exhibit V-9. One way to attract experienced workers is for employers and/or government agencies to subsidize work/study programs. Such programs might have the added benefit of retaining trained workers in the Bay Area.

D
Salaries and Wages

All Occupational Groups

Almost all telecom occupations exceed the East Bay median annual income of $34,561 (Exhibit VI-18). Executives and managers average twice the East Bay median, and telecom Engineering/Development workers earn about a third more than the average worker does.

EXHIBIT VI-18

Salary Ranges for East Bay Telecom Occupations

Occupation	25th %ile	Median Hrly	75th %ile	Median Annual
Executives	$22.64	$33.17	$47.34	$68,312
Administrative	$12.10	$15.43	$20.14	$33,504
Sales/Service	$12.03	$17.02	$23.93	$38,239
Oper'n/Manuf'g	$13.30	$17.98	$23.97	$38,123
Infor Tech	$15.97	$23.00	$40.00	$46,248
All Telecom	$14.31	$19.43	$27.67	$40,736
All East Bay	$12.60	$16.01	$20.49	$34,641

Source: Employment Development Department, 1999

Engineering/Development

Within the Engineering/Development field, all but two high-demand occupations (Telecom Technicians and Telecom Engineers) earn median annual salaries in excess of the East Bay median (Exhibit VI-19). However, this statistic belies the fact that workers with even a few years' experience can command salaries that are twice the East Bay average and 50 percent greater than the average for telecom occupations.

EXHIBIT VI-19

Salary Ranges for Engineering/Development Occupations

Occupation	25th %ile	Median Hrly	75th %ile	Median Annual
Software Engineers	$ 15.25	$ 24.30	$ 38.25	$ 47,140
LAN Managers	$ 14.75	$ 25.65	$ 43.15	$ 49,500

Internet Site Designers	$	11.51	$	21.20	$	103.00	$	41,100
Network Control Tech	$	11.00	$	23.10	$	38.42	$	44,800
Electrical Engineers	$	25.63	$	32.72	$	39.81	$	63,210
Telecom Tech	$	8.25	$	15.82	$	38.36	$	30,700
Computer Support Spec	$	14.39	$	20.48	$	37.06	$	39,730
Telecom Engineers	$	10.00	$	17.62	$	40.76	$	34,200
All Info Tech	$	15.97	$	23.00	$	40.00	$	46,248

Source: Employment Development Department, 1999

Occupations such as Internet Web Designer, Network Control Technician, and LAN Managers are among the most difficult for employers to hire (see Exhibit V-14) and can "write their own ticket" in terms of compensation. Some Engineering/Development workers can earn $100,000 to $200,000 per year or more.

E
Job Training

Large employers are forced to invest heavily in training. They offer a wide variety of in house programs such as courses in basic workplace skills (seven habits, supervisor training), sales (customer service and vendor training), computer skills (website development, Oracle database, graphic design, programming); technical telecom topics (telephony, switching, BICSI, Sonet), and functional topics (finance).

The larger employers also contract with local educational institutions to provide telecom training (Laney College, Tucker), CWA apprenticeships (Chabot College), BICSI certification (no specific college cited), and software applications such as Microsoft Office (CompUSA, Acorn, Catapult).

Employers recruit at many vocational schools, colleges and universities, but few are actively involved in curriculum development.
Small- and medium-sized employers are at a disadvantage regarding their ability to invest in in-house training, partner with local educational institutions, and recruit on campus.

F
Views on Government Funded Training

Only two of 15 employers in the focus groups had experience with government-funded training programs. In one case, the Private Industry

Council retrained employees when a major call center closed several years ago. In the second case, the Employment Development Department (EDD) provided a $110,000 grant to retrain Field Technicians. The employers felt their experience with the government agencies was positive and were able to retain seasoned employees. However, one employer felt the EDD record-keeping requirements were excessive.

Employers generally felt they would be interested in working with local cities to train residents for telecom jobs if certain conditions are met:

- Right to screen students
- Low cost
- Provide input to curriculum
- On-the-job training
- Geographically convenient

The telecom industry is not likely to provide jobs for individuals with few job skills who need to earn livable wages. Although there is a labor shortage and growth rates over the next few years are expected to exceed 10 percent, these positions are open only to highly skilled workers. And even if employers are willing to train workers, they must come equipped with basic workplace skills, computer skills, interpersonal skills, and a functional knowledge of the job for which they are applying.

G
Multiplier Effect

The telecom industry supports business activity and employment in a wide variety of supplier industries including computers, electronics and semiconductor manufacturers. Telecom firms also support firms which sell business services such as recruiting firms, temporary help agencies, travel agencies, legal services, accounting services, market research services, employee benefit services, public relations and advertising firms, on-site health services, insurance services, financial services interior design services, security and alarm services, janitorial services, waste management, landscaping services, office equipment rental and leasing, office furniture retail and leasing, hotels and motels, food services, restaurants and catering services, education and training services, and social services.

Economic multipliers provide a measure of all the economic activity that is supported by a particular industry. For the Bay Area, economic multipliers indicate that for every job in telecom equipment manufacturing, there are an additional 4.2 jobs throughout the region. And for each telecom service provider worker, there are an additional 5.5 jobs.

While these multipliers are lower than some other industries, e.g. food services, the payroll dollars per job are higher.

This implies that in addition to the 30,000 East Bay telecom jobs, there are roughly 145,000 additional jobs supported in the Bay Area region, for a total of 175,000 jobs.

VII

Strategies and Programs to Assist the East Bay Telecommunications Industry

Focus groups with telecom employers reveal that they are pleased with many aspects of doing business in the East Bay. However, they consistently identified three important factors with which they are concerned. They are (1) current and projected worker shortages, (2) traffic congestion, and (3) promoting supportive business/government relationships.

There are a variety of actions that EDAB and other economic development agencies can pursue to address these issues.

A
Organize an "East Bay Telecom Development Network"

EDAB should organize a group of industry and government leaders, who would identify challenges and solutions, consolidate support among stakeholders, raise funding for projects that will directly reduce critical obstacles, and initiate an ongoing dialog with telecom executives to strengthen the East Bay as a great home for telecom firms.

This is an opportunity to create a breakthrough in the delivery of public sector services, using the telecom industry as a focus for pilot testing innovative approaches. A successful and proven model could be applied to other industries in the future. Using web-based solutions, EDAB and its partners could demonstrate public sector leadership in becoming more responsive to customer needs -- just as corporations have learned to offer more timely, higher quality, customized products and services.

Specific actions could include:

- *Inventory current East Bay economic and workforce development programs affecting the telecom industry*
- *Determine a budget, milestones, time frame, and expected results for the "East Bay Telecom Network".*
- *Source a Director and staff to coordinate activities. Some positions could be filled by low-cost work/study students (Internet Web Developer, Census Taker, Meeting Planner, and Researcher/Project Manager).*

- *Raise funds to implement programs.*
- *Maintain current list of telecom firms (easier said than done in a fast-moving, merging and consolidating industry)*
- *Solicit input from telecom members on a regular basis*
- *Support cluster-specific information gathering, compilation, and dissemination such as:*
  - ❖ *K-12 and Community College telecom career education*
  - ❖ *Job bank (resumes on line)*
  - ❖ *Annual survey of industry shortages*
  - ❖ *Skill and certification standards*
  - ❖ *Complete listing of curriculums and courses offered at local schools, number of graduates, length of program, skills learned, and capacity for growth*
  - ❖ *Work/Study Programs*
  - ❖ *Creative partnerships between industry and schools*
- *Set up website or add information of interest to members on East Bay Works website, and receive feedback through email or chatroom from industry members*
- *Provide networking opportunities for industry members to meet informally with each other and with other stakeholder groups*
- *Plan symposia on trends in technology and workforce issues*

B
Develop EDAB Strategy for East Bay Telecom Industry

It is necessary to identify the size and type of company (and the number and type of workers) the East Bay wishes to attract and retain because different types of companies have different priorities. Locally sponsored programs need to directly address employers' specific concerns.

Large service providers' primary concerns are for low-cost real estate, low-cost customer service employees, and low tax rates. The Bay Area is one of the most expensive areas in the country to buy or lease commercial space. Its workers are among the most highly paid. And its taxes are high relative to other regions of the country. Therefore, it would be difficult to attract or retain the big companies that are looking for cheap labor, cheap real estate, and low taxes.

The danger to the East Bay is that these companies may concentrate their growth in lower-cost cities and may relocate non-location specific activities outside the area. For example, some telemarketing and customer service functions serving Pac Bell Bay Area customers are already being conducted in distant locations. This trend could have a profound impact on the 12,000+ East Bay telecom workers who are employed by such

firms as Pac Bell/SBC and AT&T. It could affect an additional 54,000 workers who are indirectly affected (multiplier effect), or, in other words, affect a total of 8 percent of the East Bay workforce.

Tax concessions and subsidies might be effective with large anchor tenant companies. The benefit these firms bestow on the East Bay is that they employ a lot of people. They also contribute to the mix by employing more lower skilled, lower paid entry-level positions than telecom equipment manufacturers. However, they are growing at a much slower rate than telecom equipment manufacturers (5% vs. 25%).

Therefore, a critical activity is to:

- *Determine size and type of companies East Bay telecom cluster wants to attract*

Almost all U.S. cities with significant telecom clusters have from one to four "anchor", or very large (Fortune 500) telecom firms. In the same way that shopping malls have anchor stores to draw mall tenants and customers, clusters gain a measure of prestige when a large telecom firm is located within the cluster.

The East Bay currently has two "anchors". They are Pac Bell/SBC and Ascend/Lucent. Just as San Francisco's Multimedia cluster conducted targeted recruiting to attract US Web and Sega Enterprises, the East Bay telecom cluster should decide if they will engage in targeted recruiting, and if so, which firms will they target. It is more likely that the East Bay's strengths will appeal to equipment manufacturers or Internet core technology firms than to service providers.

Therefore, a specific action is to:

- *Develop strategy to determine number and type of large "anchor" firms, and marketing plan to target these firms.*

It should be noted that over 80 percent of a cluster's growth usually comes from "home-grown" firms, not from "transplanted" firms. Therefore, the strategy should also address measures to retain firms of all sizes.

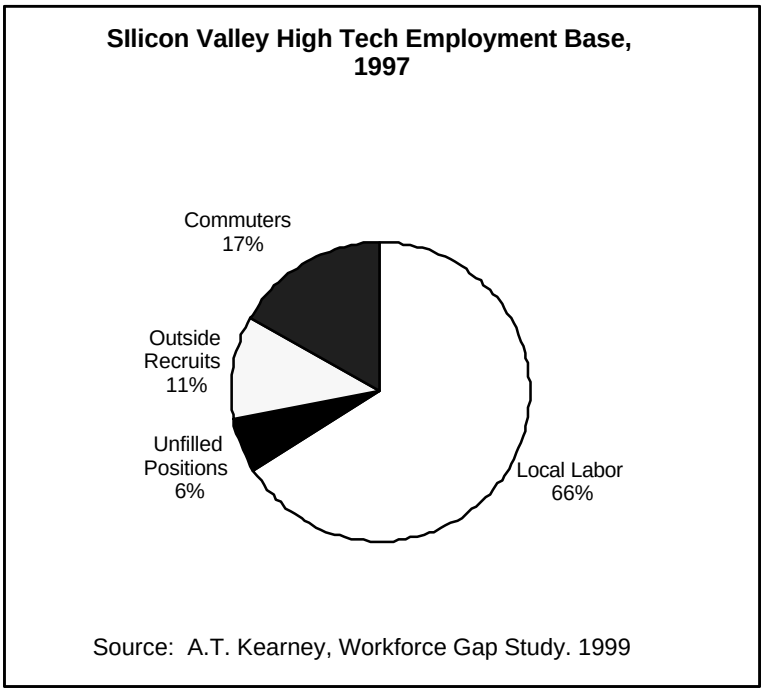
C
Strengthen the East Bay Telecom Workforce

East Bay telecom employers feel the most significant priority is to address the shortage of skilled workers. In nearby Silicon Valley, local residents (Exhibit VII-1) fill only 66 percent of high tech jobs. The remaining jobs are filled by commuters (17 percent) and outside recruits such as foreign

citizens with H-1B visas or workers who have relocated from out of the area (11 percent). Six percent of jobs are unfilled.

Assuming that the same proportions apply to the East Bay, in order to attract and retain telecom employers, there must be a sufficient pool of skilled workers. In other words, unfilled positions must be reduced. Recommendations will be made for each group of workers: commuters, outside recruits, and the 'invisible' group of local workers with insufficient skills, but who can be trained to fill the workforce gap. If local workers could be trained, it would ease the strain on the already tight housing market and on congestion.

EXHIBIT VII-1



Increase Local Labor Force

There are several large pools of local labor, which are being underutilized. With adequate training, they could narrow the workforce gap.

High School Students

High school students are not well informed about telecom careers or the relatively high salaries they pay. Some actions include:

- *Educate high school career counselors about course requirements for telecom careers.*

- *Educate high school students about job prospects in the telecom field through school-sponsored career days*
- *For those students who already possess fundamental skills such as math and science courses, teach telecom classes on-campus or at nearby vocational schools and community colleges so graduating high school seniors have sufficient skills to be immediately employable upon graduation.*
- *Develop co-op or work/study programs to provide students with work experience.*
- *For students without fundamental skills, teach basic computer skills, 'job etiquette', communication and teamwork (the skills employers are seeking).*
- *Secure commitment from major firms to sponsor games such as Cisco's Networking Academy Program that instructs students how to build and manage a computer-server network.*
- *Coordinate industry donations to schools of up-to-date computer equipment.*

Vocational Training Centers and Community Colleges

There are at least 35 vocational training centers and community colleges in Alameda and Contra Costa counties that offer courses in high-demand telecom occupations. This is not enough to fill demand. These organizations face the challenge of trying to stay on the leading edge of offering courses in occupations experiencing shortages. This requires staying in close touch with employers and constantly updating expensive resources such as computers, test equipment, and labs to keep up with changing technology.

Employers are very interested in jointly developing streamlined telecom-related curricula using industry standards with schools. Employers' requirements are that the programs be low-cost, geographically convenient, provide on-the-job training, and allow the employer to screen students.

Specific actions include:

- *Set up committee of employers and training specialists to develop streamlined skill and certification standards.*
- *Set up a special program to address the future shortage of telecom Field Technicians (see page 75).*
- *Develop marketing programs with schools and employers to target students who are already enrolled in community colleges but who are uncertain about a major.*
- *Present forums and panel discussions with recent graduates employed by local firms, and sponsor open houses at local telecom firms.*

- *Establish mentor programs that pair a graduating telecom student with an experienced worker.*
- *Assist employers by compiling, publishing, and updating a list of the vocational centers and community colleges and the courses they offer.*
- *Periodically sponsor events that bring together employers, educators, recent graduates and students.*
- *Act as central coordinator for internship and co-op programs between schools and businesses.*
- *Conduct and disseminate research on best employer/training center collaboration practices available both within and outside the East Bay. For example, several employers mentioned that DeVry Institute develops relevant curricula based on input from local employers. By scheduling day and evening classes, they help students obtain and maintain part time jobs to gain work experience. Upon graduation, DeVry maintains contact with its alumni to continue to improve the curriculum and increase business contacts. Other schools might benefit from this model.*
- *Solicit funds from telecom firms to provide scholarships and financial assistance for students enrolled in high-demand majors. Students would repay funds if they accepted employment after graduation from firms not funding the program.*
- *For employed workers seeking a change of career, offer more telecom certification programs through adult education centers throughout the East Bay.*
- *Identify and invite more vocational training centers to the East Bay.*

Four-Year Colleges and Graduate Schools

Bay Area universities graduate about 1,000 electrical engineers with BS degrees each year, about 5 percent of the U.S. total. And, these same schools graduate about 120 Ph.D. EE graduates each year, approximately 7 percent of the 1700 U.S. total. It is not known whether there are shortages in East Bay telecom companies for candidates with these qualifications. Some actions could include:

- *Determine East Bay telecom industry requirements for BS, MS, and Ph.D. electrical engineers and other majors over the next 5 years.*
- *If demand exceeds supply, understand willingness of or hesitation by graduates from universities outside the Bay Area to accept positions within the Bay Area.*
- *If appropriate, develop program to address specific concerns of graduates and increase migration to the Bay Area.*

Within the Bay Area, actions might include:

- *Provide liaison for telecom firms to sponsor projects at TELCOT at Cal State at Hayward.*
- *Subsidize work/study and internship programs at Bay Area colleges and universities.*
- *Sponsor job fairs and other events to introduce employers and students to each other.*
- *Publicize website for employers to post job openings and for applicants to post resumes.*

Redeployed Telecom Workers

Even in the best of economic times, individual high tech and telecom firms downsize, relocate, and otherwise redeploy their workforce. In August 1999 Silicon Graphics in Mountain View announced that 1500 workers would be laid off and in May 1999 Nortel announced it would reduce its Sunnyvale workforce by 500. In addition, whole other industries in the East Bay may be contracting. Although workers in unrelated industries may require more training than redeployed high tech workers, the investment would be a win-win situation.

- *Provide resources for recruiting experienced workers who already have many of the required skills in East Bay telecom firms.*
- *Develop website for employers to post job openings and for applicants to post resumes.*
- *Assign liaison HR officers on as-needed basis.*
- *Publish a listing of recruiting firms that specialize in telecom placements.*
- *Streamline and assist with process for employers to receive Federal funds for retraining workers.*

Recruit Workers From Outside the East Bay

Rather than poach other employers' workers, which leads to high turnover and increased labor costs, East Bay telecom firms can work to increase the total number of telecom workers in the area by attracting workers from outside.

After intense lobbying, Congress doubled the annual allotment of H-1B visas in 1998, but visas still ran out by mid-summer. Another legislative proposal includes allowing an unlimited number of foreign graduates of American universities to work in the U.S. for up to 5 years. And another proposal would exempt foreigners with at least a master's degree in a specialty related to their employment from needing H-1B visas.

Action Item:

- *Lend support to lobbying efforts to increase visas for qualified foreign workers or to waive visa requirements in some cases.*

The workforces of other high tech centers such as Austin, Seattle, Denver and North Carolina might be targeted for recruiting.

Action Items:

- *Convene a group of telecom employers to suggest ways to attract experienced workers from the other areas.*
- *Hold job fairs to promote the benefits of the East Bay telecom industry.*

Maintain High Level of Skills in Current Workforce

There are very few low-skill jobs in the telecom industry. One example is Webvan, an e-commerce company that sells groceries over the Internet. Webvan has a 330,000 square-foot warehouse in Oakland. And although the company employs low-skill delivery truck drivers, the warehouse itself is so highly automated that warehouse workers are required to have significant computer skills.

Significant technology improvements in all functional areas of telecom companies require workers to constantly update their skills. There are several ways in which EDAB can assist:

- *Spearhead effort to produce on-line "refresher" courses for common skill sets.*
- *Publish list of courses offered at local schools.*
- *Monitor capacity of local schools to meet the needs of the East Bay telecom industry and assist in increasing capacity when necessary.*
- *Provide liaison for employers and schools to build partnerships.*

D
Reduce Traffic Congestion

The second most important challenge to telecom employers is the traffic congestion during rush hour. Actions to reduce traffic snarls include:

- *Cooperate with established Bay Area organizations that understand traffic patterns and are working to reduce congestion.*
- *Respond to telecom employers' specific requests such as subsidized shuttles from Fremont BART station to employer sites.*
- *Survey the extent, success of, and future plans for remote commuting facilities set up by Silicon Valley companies. If appropriate, develop plan to promote more remote facilities in San Ramon area to reduce area-wide traffic congestion.*

E
Promote Favorable Government Attitude

The third most important factor to telecom employers is being located in an area in which local government has a favorable attitude toward business. Actions to promote employers' perception that government agencies are responsive include:

- *Establish East Bay telecom incubator (already in progress) in San Ramon.*
- *Offer fast track permit and inspection process.*
- *Follow-up with new telecom businesses when they start-up or relocate to the East Bay, regardless of size.*
  - ❖ *Refer firms to East Bay Telecom Industry web page for industry resources.*
  - ❖ *Invite to industry events.*
  - ❖ *Pair with a "sponsor".*
  - ❖ *Assign a liaison officer to troubleshoot problems.*
- *Assist in locating suitable larger quarters when firm outgrows current location.*
- *Develop plan for East Bay firms to gain a larger share of Bay Area venture capital. Currently East Bay firms receive 10% of Bay Area venture capital. Arrange for office space at Bishop Ranch in San Ramon for "Sand Hill Road East".*
- *Lure high-profile national research consortium to the East Bay.*
- *Influence regulatory bodies such as the state legislature to adopt favorable policies toward telecom businesses.*
- *Assist key government organizations to become sophisticated buyers and beta testers of telecom products and services.*

Bibliography

Association of Bay Area Governments *Input-Output Model and Economic Multiplier for the San Francisco Bay Area*, 1987.

Bay Area Economic Forum *The Bay Area: Leading the Transition to a Knowledge-Based Economy*, August 1996.

Bay Area Multimedia Partnership *A Conversation with the Multimedia Industry*, July 1998.

Burke Associates *The Potential for Multimedia and Telecommunications Industries at Closing Military Bases in the Bay Area*, June 6, 1996.

California Cooperative Occupational Information System *Occupational Outlook Reports*:

County	Occupations	Published
Alameda	Computer Programmers	1998
	Internet Web Site Designer/Developers	1998
	Local Area Network Managers	1997
	Network Control Technicians	1998
	Systems Analysts	1997
Contra Costa	Computer Engineers	1995
	Computer Programmers	1998
	Electrical and Electronic Engineers	1996
	Engineering, Math and Natural Sci Managers	1996
	Local Area Network Managers	1998
	Systems Analysts	1998
	Telecommunications Engineers	1997
	Telecommunications Technicians	
Santa Clara	Computer Support Specialists	1998
	Electrical and Electronic Engineers	1996
	Engineering, Math and Natural Sci Managers	1998
	Internet Web Site Designer/Developers	1996
	Software Engineers	1996
	Systems Analysts	1998

Compass Group *Telecommunications Industry Bay Area Labor Market Analysis*, 1996.

Corporation for Enterprise Development *1998 Development Report Card for the States*, Twelfth Edition, 1998.

CorpTech *CorpTech Directory Of Technology Companies*, Woburn, MA : Corporate Technology Information Services, Inc., 1999.

Craft Consulting Group *Contra Costa Telecommunications Incubator Market Feasibility Study*, September, 1998.

Employment Development Department *Labor Supply in Information Technology Occupations*, March 25, 1998.

Ernst & Young *The Ernst & Young Almanac and Guide to U.S. Business Cities: 65 Leading Places to Do Business*, John Wiley & Sons, 1994.

Gale Group *U.S. Market Trends and Forecasts*, 1999.

Gale Research Inc. *U.S. Industry Profiles: The Leading 100*, Thomson Publishing Co, 1995.

Kearney, A.T. *Internet Cluster Analysis*, 1999, http://www.jointventure.org.

Kearney, A.T. *Workforce Initiative Study*, May 18, 1999, http://www.jointventure.org.

Office of Management and Budget *North American Industrial Classification System*, 1997, http://ww.ntis.gov/naics.

Office of Management and Budget S*tandard Industrial Classification Manual*, 1987.

Perry, Linda *Telecommunications Industry Cluster in the Bay Area*, August 1996.

Philos Computer Solutions, Inc. *Ready for Work in Information Technology*, December, 1997.

Plunkett, Jack *Plunkett's InfoTech Industry Almanac: the Only Complete Guide to the Technology and the Companies that are Changing the Way the World Thinks, Works and Communicates*, Galveston, TX: Plunkett Research, 1996.

Porter, Michael *On Competition*, Boston: Harvard Business Review Press, 1996.

Rich's *Rich's Everyday Sales Prospecting Directory,Contra Costa County*, Mountain View, CA : Rich's Business Directories, Inc., 1996.

Rich's *Rich's Everyday Sales Prospecting Directory, Alameda County*, Mountain View, CA : Rich's Business Directories, Inc., 1997.

Standard & Poor's *Communications Equipment Industry Survey*, December 31, 1998.

Standard & Poor's *Computers: Consumer Services & the Internet Industry Survey*, October 15 , 1998.

Standard & Poor's *Telecommunications: Wireless Industry Survey*, December 10, 1998.

Standard & Poor's *Telecommunications: Wireline Industry Survey*, September 17, 1998.

U.S. Department of Commerce, Bureau of the Census, *County Business Patterns*, 1996.

U.S. Department of Commerce, Bureau of the Census, *Annual Survey of Communication Service*, BC/97, 1997.

U.S. Department of Commerce, Bureau of the Census, *Annual Survey of Manufactures*, BC/97, 1997.

U.S. Department of Commerce, Bureau of the Census, *The Official Statistics*, December 30, 1998.

Webster *Webster's Online Business Guide*, http://www.webstersonline.com/

A

Information Highway Glossary

DAVID BANK, San Jose Mercury News Staff Writer

Discussions of the Information Highway often are dense with arcane jargon and complex concepts. Here is an alphabetized glossary of key terms in the convergence of communications and computer technologies.

This article is part of The Road Ahead: A Basic Guide to the Information Super-Highway, which appeared in the San Jose Mercury News December 4 - 6.

Sources: John V. Pavlik and Everette Dennis, "Demystifying Media Technology"(1993); Frederick Williams, "The New Telecommunications," (1991); Bloomberg Business News; General Accounting Office; Office of Technology Assessment; Scientific-Atlanta.

ANALOG -- The traditional format for telephone and cable television transmission, in which sound and video are converted into continuous electrical impulses that can be carried by radio waves. Increasingly, the analog format is being replaced by a digital one.

ASYNCHRONOUS TRANSFER MODE (ATM) -- An emerging standard for switching and routing all types of digital information, including video, voice and data. With ATM, digital information is broken up into standard-sized packets, each with the "address" of its final destination.

BABY BELLS -- The seven local telephone holding companies that were created in 1984 with the breakup of the old American Telephone and Telegraph monopoly, or "Ma Bell." Also known as Regional Bell Operating Companies or RBOCs, the seven companies are BellSouth, US West, Pacific Telesis, Ameritech, SBC Communications (formerly Southwestern Bell), NYNEX and Bell Atlantic.

BANDWIDTH -- A measure of the volume of information that can be transmitted over a communications link. Technically, bandwidth refers to the width of the frequency spectrum available on a certain technology. Colloquially, it is measure in the number of bits per second a network can deliver.

BIT -- A contraction for "binary digits," that is, either a 1 or a 0 in the binary languages used by computers. By itself, a single bit conveys little information; in groups of eight (a "byte"), bits can be used to represent all types of information.

BROADBAND -- A communications system with enough bandwidth to carry multiple channels of video, along with voice and data traffic.

CELLULAR -- A wireless transmission technology that uses a grid of antennae to send and receive signals from mobile users. The antennae hand off signals as the user travels between "cells." In that way, the same frequency, or channel, can be used by many callers at once.

CENTRAL OFFICE -- The telephone company facilities where calls are switched from main trunk lines to customers' individual lines. Each central office --usually squat, windowless, concrete bunkers -- serves about 10,000 customers. The service area is known as the "local loop."

CIRCUIT -- The type of switching traditionally used by telephone companies, in which a physical connection is established between a caller and a called party through a series of switches.

COAXIAL -- The pencil-thick cable that is commonly used to deliver cable television and also is being deployed in new two-way broadband networks. Coaxial has far more information-carrying capacity than copper telephone wires, but less than fiberoptic cable. Coaxial cable consists of a metal conductor surrounded by another tubular conductor.

CLIENT-SERVER -- The basic architecture for modern computer networks, in which personal computers (clients) communicate with shared central resources, or servers, such as files, processors and printers. The metaphor has been extended to any network in which users use front-end devices to access back- end resources. For example, in interactive television, the set-top terminal is the client; the large, centrally-located computer that deliver video-on-demand are servers.

COMMON CARRIAGE -- A regulatory principle to assure that services considered essential to the public are provided on an open and non-discriminatory basis to those willing and able to pay for them. Telephone companies have been considered common carriers, while cable television operators and the Internet have not.

COMPACT DISK-READ ONLY MEMORY (CD-ROM) -- A method for storing digital data on disks that can be read by lasers. A single CD-ROM has room for about 600 times as much data as a standard computer floppy disk.

COMPETITIVE ACCESS PROVIDERS (CAPs) -- Companies that compete with monopoly local telephone companies by installing their own transmission networks to connect large business customers directly to long distance carriers. CAPs operate mostly in downtown business districts and large industrial parks, but are expanding their reach as technology costs decline.

COMPRESSION -- A software or hardware technique that shrinks the computer data before it is transmitted over communication networks. Decompression re-inflates the data at the receiving end. Compression is particularly important for digital video, which in its uncompressed form consists of a huge number of bits, making it slow and difficult to transmit.

CONNECTIVITY -- A measure of a user's access to communication networks, that is to say, the degree to which he or she is "wired."

CONSENT DECREE -- The settlement between the Justice Department and AT&T that led to the break-up of the Ma Bell monopoly in 1984. The consent decree barred the seven Baby Bells from the long-distance, equipment manufacturing and information services markets. The information services ban since has been relaxed; the other two remain in place.

CONVERGENCE -- The phenomena of approaching the same point from different directions. Commonly used to refer to the collision of the telecommunications and computer industries in the race to deliver interactive digital services to the home.

CYBERSPACE -- A term coined by science fiction author William Gibson to refer to "a new universe, a parallel universe created and sustained by computers and communication lines." However, a computer network complex enough to transport human consciousness as though it were computer data, as envisioned by Gibson, does not yet exist.

CROSS-SUBSIDY -- An accounting method under which excess revenues from one part of the business are used to lower prices in another. A major issue is how to prevent monopoly telephone and cable companies from forcing current customers to pay for the upgraded networks.

DATABASE -- Information or files stored in a computer for retrieval and use. The new interactive networks will utilize large databases to process transactions, authenticate credit requests, track inventory, locate mobile users and collect marketing information -- raising thorny privacy considerations.

DIGITAL -- Format that stores sound, video or other information as a series of1's and 0's so the information can be understood by computers. The conversion from analog to digital makes possible the transmission of all kinds of information over general-purpose networks.

DIRECT BROADCAST SATELLITE (DBS) -- Satellite systems with sufficient power to allow pizza-sized earth stations to be used to receive compressed video signals. DBS competes with cable television.

DISINTERMEDIATION -- The process of removing middle layers of management or distribution in a company, industry or government agency, a trend hastened by the spread of computer networking.

DISTRIBUTED INTELLIGENCE -- The characteristic of a network in which much of the computer processing is performed at the periphery; for example, in users' PCs, rather than by a mainframe computer. Computer networks utilize distributed intelligence. The telephone network, in contrast, uses large central switches and dumb terminals (telephones).

ELECTRONIC MAIL (e-mail) -- The most popular use of computer networks. Messages are transmitted over a communications network and stored in "mailboxes" on a computer server until they are retrieved by the recipient. E-mail also can be used to send graphics and sound clips.

ENCRYPTION -- The encoding of data so it can be decoded only by those with an appropriate "key." Encryption is considered essential to electronic commerce to protect the security of financial transactions, preserve the secrecy of proprietary information and provide for the authentication of documents and signatures.

FIBEROPTICS -- A thin, flexible strand of glass the thickness of dental floss that carries huge amounts of information as light waves generated by lasers. A single strand can carry 12,000 telephone conversations at once. The development of fiberoptics helped make the information highway possible.

HEAD-END -- The electronic control center of a cable television system where signals are received from satellites for processing and distribution to customer's homes. In the future, local head-ends will be linked by fiberoptic cable, creating a regional cable system.

HIGH DEFINITION TELEVISION (HDTV) -- A method for transmitting and receiving television signals with near-movie theater resolution and clarity. Competing technologies are under development in the United States, Japan, Europe. U.S. standards, using digital technology, are expected to be adopted next year.

HYBRID FIBER-COAX -- An architecture for new broadband networks that has been adopted by many cable and telephone companies to deliver video, telephone and data services. Generally, fiberoptic cable carries signals to neighborhood nodes of about 500 homes each. The final connection to the homes is made with lower-cost coaxial cable.

INTEGRATED SERVICES DIGITAL NETWORK (ISDN) -- The digital evolution of the existing telephone network. As telephone companies replace analog equipment with digital switches, they increase the capacity of their copper wires, making possible faster data transmissions and limited video. In California, Pacific Bell offers home ISDN service for $22.95 per month.

INTERACTIVITY -- The two-way capabilities of a communications network. The levels of interactivity range from merely allowing viewers to order specific programming, such as movies or sports events, to two-way video calls, multi-player games across the network, and long-distance education.

INTERFACE -- The point at which a connection is made between different hardware and software elements of a network so they can work together. Each interface represents a potential bottleneck where conflicting technical standards or monopoly business practices can inhibit the free flow of information.

INTERNET -- The descendant of a Pentagon research project to design a computer network that could withstand nuclear war. The Internet is a network of smaller computer networks that are able to communicate with each other because they use a common protocol. Internet traffic can be sound, video or data and can move over any kind of physical transmission network, making it a model of the information superhighway. The Internet's explosive growth may mean it already is the information superhighway.

KILLER APP -- The elusive hit product that will make the information superhighway indispensable to consumers and drive demand. For the PC, the spreadsheet was the killer app. For computer networks, it is e-mail.

LOCAL ACCESS -- The service that local telephone companies such as Pacific Bell provide to long-distance carriers to complete their telephone calls. The long distance carriers complain that local access charges, which can amount to half the price of a long-distance call, are too high.

LOCAL AREA NETWORK (LAN) -- A group of computers and other devices in a department or building able to interact with each other over a communication network. Local area networks can be connected together to form a wide area network (or WAN) that links, for example, a headquarters with field offices. In architecture and technology, the new communications networks resemble LANs and WANs.

MICROPROCESSOR -- A computer chip that contains an entire central processing unit. Microprocessors are migrating from personal computers into a wide range of consumer products, including telephones and televisions. The continuous increase in the speed of such chips (along with their declining price) is an important factor in the development of the information highway.

MODEM -- Short for modulator-demodulator. The device that lets a computer communicate over telephone lines by turning digital computer data into analog signals for transmission, and back again.

MOTION PICTURE EXPERTS GROUP (MPEG) -- The body that has developed standards for video compression and decompression that will be coded into electronic chips. There are two standards, MPEG 1 and MPEG 2.

MULTIMEDIA -- The integration of at least two of the five types of electronic information (text, voice, video, graphics and data) for presentation on a personal computer or other device. Multimedia computers are here; networks capable of delivering multimedia are coming.

NARROWBAND -- A low-bandwidth network capable of carrying only voice or low-speed computer communications.

ON-LINE -- The state of being actively connected to a network, able to exchange data, commands and communications with other people or computers on the network.

OPEN ACCESS -- A conception of the information infrastructure in which the specifications for all critical interfaces are in the public domain, allowing a maximum of interoperability, competition and consumer choice. Such a network would allow all information providers to reach all consumers, and vice versa, with a minimum of interference and outside control.

PACKETS -- A bundle of data for transmission over a network. In a packet-switched network, such as the Internet, each packet carries the address of its destination, eliminating the need for a dedicated circuit such as that provided by a telephone company.

PERSONAL COMMUNICATION SERVICES (PCS) -- A new class of wireless devices that will be smaller and lower-powered than cellular and will be used to connect computers as well as telephones. The Federal Communication Commission is auctioning off licenses for several PCS networks in each region.

PLAIN OLD TELEPHONE SERVICE (POTS) -- traditional telephone service.

SET-TOP BOX -- A cross between today's cable TV converter box and a personal computer. The set-top box will link a standard television set to the new digital networks. The set-top box will decompress digital video, process orders for video-on-demand and home shopping, and include a port for a high-speed computer connection.

STORAGE -- Banks of disk drives that store data on the network. The declining cost of disk storage is another important factor in the development of a national information infrastructure.

TELECOMMUTING -- The use of computers and telecommunications to work at home. More broadly, the substitution of telecommunications for transportation.

TWISTED PAIR -- The common method for delivering POTS. The low information-carrying capacity of a twisted pair of copper wires has caused many telephone companies to begin replacing it with a combination of fiberoptic and coaxial cable. Technologies to enhance its capability, e.g. ADSL, are being developed.

UBIQUITOUS COMPUTING -- The dispersal of networked computing resources into everyday objects, such as walls, appliances, refrigerator doors and desktops.

UNBUNDLING -- A regulatory term for the requirement that dominant network operators, such as telephone and cellular companies, sell individual services separately to competitors, rather than only in often over-priced bundles.

UNIVERSAL SERVICE -- A 60-year-old regulatory principle that a minimum level of telephone service should be available to every resident at a reasonable price. Traditionally, telephone companies bore the burden of universal service in return for their monopoly status. Universal service is being re-evaluated as markets become competitive and technology changes.

VIDEO DIALTONE -- A policy to regulate the entry of telephone companies into the cable television market that retains their common carrier obligations. Telephone companies will be required to transmit video programming for third parties, as well as themselves, over their new networks.

VIDEO-ON-DEMAND -- A service that allows customers to order movies, television shows and sports events from video libraries to view at any time, and provides videocassette recorder functions such as pause, fast-forward and reverse. A less sophisticated service, near video-on-demand, would broadcast popular movies and events at staggered start times, typically every 15 minutes, and would not offer VCR-type controls.

VIRTUAL REALITY -- Artificial locations where people can experience sight, sound and motion in locations created by computers, typically by using devices such as electronic goggles, gloves and body suits. Networked virtual reality is considered a possibility if increases in network bandwidth continue.

WORLD WIDE WEB -- The fastest growing part of the global Internet. The Web links "servers" around the world with a common protocol, allowing users to easily surf among a huge variety of multimedia offerings and commercial services.

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