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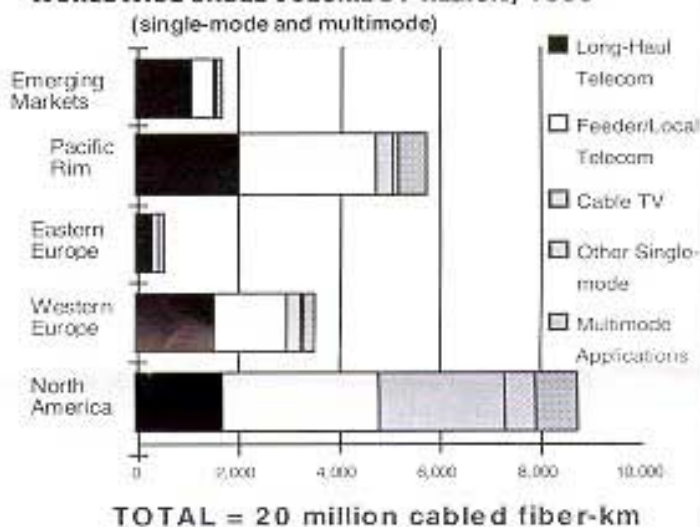
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Market Watch Figure from **Fiberoptics**

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WORLDWIDE CABLE VOLUME BY REGION, 1995



MARKET RESEARCH FROM THE WORLD'S TOP ANALYSTS ON FIBEROPTICS AND TELECOM TRENDS CAN BE YOURS

When you pay good money to receive market intelligence, you want to make sure the information is accurate, timely, and worth the price. So let me tell you how we put *FMI* together ... and what others say about it.

Unlike many other newsletters, most of which reprint warmed over press releases (or condense and summarize articles you have already read in your trade magazines), most of *FMI* is based on original research you cannot obtain elsewhere.

To gather this unique market data — and analyze and report it in a fashion meaningful to you — we have a staff that includes the world's top analysts, a corporate librarian, administrative and marketing personnel, a full-time correspondent based in Washington, DC, plus a database manager.

FMI's market data is often derived from primary research — visits to major fiberoptics conferences, in-person interviews, telephone surveys, market research questionnaires, Internet connections — augmented with economic modeling, substitution analysis, and library research.

What's more our firm, KMI Corporation owns and maintains the industry's most comprehensive database: FiberFax™, a compilation of thousands of fiberoptic systems installed in more than 50 countries ... and FiberRef™, a computerized listing of over 12,000 published articles on fiberoptics, with the emphasis on markets.

As a result, we can proudly say we publish the **most valuable, timely, and accurate** market reports and surveys in the fiberoptics industry today. *FMI* contains capsular excerpts from each report, not published by any other magazine or newsletter.

Professor Donald Merino of the Stevens Institute of Technology who compared market forecasts from several firms, reported: "*Past Kessler forecasts have been close to actual results.*"

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- * The tremendous China market — 3.25 million km of new fiberoptic cable to be installed by 2000
- * Why construction of fiberoptic MANs (metropolitan area networks) is booming — and how you can get in on this major growth market
- * New developments in ISDN, ADSL, FDDI, SONET, SDH, EDFAs, dense WDM and other technologies

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Publisher

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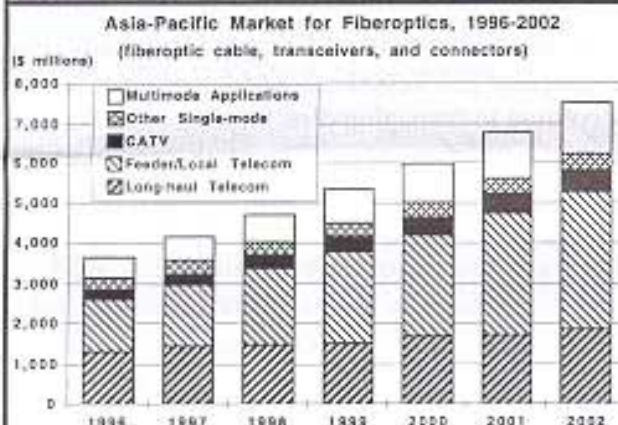
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Market Watch



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News Brief

Alcatel to supply North Sea cable system

Alcatel Submarine Networks and Cable & Wireless Marine have received a \$50-million contract to supply and install a high-capacity undersea system between Scarborough, England and Norden/Grossheide, Germany. The contract for the 560-km, eight-fiber network, to be completed in September 1998, has been awarded by BT, Cable & Wireless of the U.K., Deutsche Telekom and o.tel.o of Germany. The system will use SDH and WDM technology, giving it a basic capacity of 40 Gbps. It will be upgradable to 80 Gbps.

Report from PTC

Despite SE Asia, the outlook for fiberoptics is for greater demand and increasing capacity

The theme of the Pacific Telecommunications Conference (PTC) in Honolulu this month was *Coping with Convergence*. And although there was discussion of the convergence of telecom services, companies, and technologies, the focus of most of the sessions was simply "the future of telecommunications." Fiberoptics was a relatively small part of the sessions, but the implications of what was said at the conference involving enormous increases in communications have a strong bearing on the future of the fiberoptics industry.

A special satellite hook-up linked the conference to cities throughout the Asia-Pacific region. As part of that international panel, Arthur Clarke, the renowned essayist and science-fiction writer (whose predictions, such as communications satellites, have been less fiction than reality) said that "the number of low-orbit satellites proposed will create a mine field for astronauts." Asked about the issue of privacy on the Internet, Sir Arthur replied: "Keep your filthy hands off my filthy mind."

Pekka Tarjanne, Secretary-General of the International Telecommunications Union spoke of today's Internet as "a children's toy compared with what it will be in five years. Today," he said, "it (the Internet) is a network of networks; it will become a network of services."

Thomas Keenan, Professor and Dean, Faculty of Continuing Education, University of Calgary, said



that in the near future, "voice traffic will be comparable to an oil slick on an ocean of telecommunications traffic."

Christian Reinaudo, President of Alcatel Submarine Networks Division, discussed advanced technology for undersea links: the move from megabits per channel to eight channels per fiber operating at 2.5 Gbps, systems with all optical gain, new branching systems, wavelength add/drop and fiber and channel add/drop capability. Submarine systems costs, he said, have remained relatively flat as capacity has increased by orders of magnitude and prices for bandwidth have dropped significantly, especially in the past year. Present applications of new technologies he discussed included WADM on the SEA-ME-WE 3 (36,000 km) system and the use of 48-fiber (Alcatel's URC2) cable for the Ulysses project.

David G. Ross, Managing Director, Product Marketing, Tyco Submarine Systems Ltd., discussed the evolution of undersea fiberoptic communications and satellite systems. Mr. Ross concluded both technologies are needed, although this does not represent technology convergence.

A similar view was put forward by TRW, which has proposed a "satellite constellation" consisting of geosynchronous and non-geosynchronous satellites. The capacity of such a system, according to TRW, could be 853,500 circuits. The proposed satellite system could handle long-distance as well as short-haul, government, and private telecommunications.

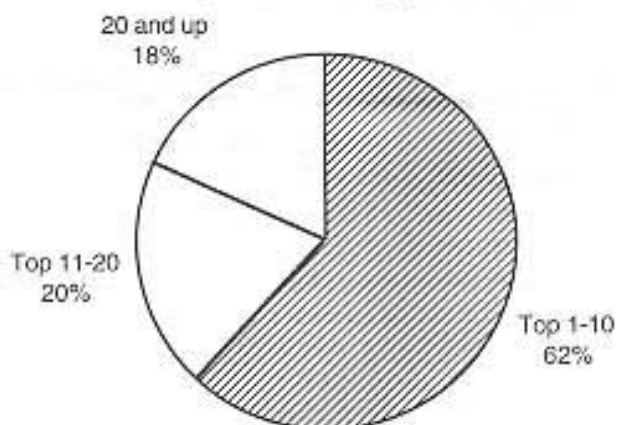
One sign for future fiberoptics systems is the increase in telephone density in China, which will rise from less than 1% a few years ago to as much as 10% by 2000. Although the density of telephones in China is low compared with other developed countries, there will be more than 140 million telephones added to China's network—

more telephones than any other country except the United States.

Despite the economic turmoil in southeast Asia, three new fiberoptic cabling plants have been reported. The largest new fiberoptic cabling operation in southeast Asia was cutover in Malaysia by Fibercore on January 7, 1998. According to company chairman, Mohd Aslami, the factory has a capacity of 1.6 million cabled fiber-km. Kabelwerk Eupen, headquartered in Belgium, also has opened a new fiberoptic cabling facility in Cebu in the Philippines. The production capacity of the plant is 150,000 cabled fiber-km per year, according to managing director, Friedrich Krahn. It is reported, but not confirmed, that Fujikura will open a fiberoptic cable plant near Hong Kong.

The repercussions of the economic crisis in SE Asia are difficult to assess. Most observers feel that China will remain unaffected, but one comment was that "If China does suffer a recession, watch out! It will be selling telecom products in the U.S." The increasing competition in fiberoptic cable in China has had an effect on the number of cabling firms there; two years ago, there were more than 100 manufacturers of fiberoptic cable; today there are about 80, and it is forecast that there will be far fewer in the next year. See Figure below.

Market Share of Top 20 Domestic Chinese Cabling Firms, 1997
(% in annual output)



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Based on comments from some PTC attendees, the economic situation in Malaysia is expected to last three to five years. One major hydroelectric project that would have used a large volume of OPGW was cancelled. And there have been cut-backs in orders and decreasing prices for fiberoptic cable amounting to as much as 20% since July. The situation in Indonesia will take longer to resolve and get worse before getting better.

According to reports from the conference, NTT, which once consumed more than 90% of the fiberoptic cable in Japan, represents about 60% of the market today. The remaining 40% of the fiberoptic cable market is divided among KDD, which has formed alliances with companies such as Japan Electric Power, the independent telephone companies, CATV companies, and electrical power companies.

Conference highlights the power of the China fiberoptics market

Although Japan is by far the largest market for fiberoptics in the Asia-Pacific region, China is the fastest-growing market, and it has remained relatively unscathed by the faltering economies in much of the rest of Asia. KMI's *Second Annual Conference on Markets for Fiberoptics in the Asia-Pacific Region* included three presentations on China – all indicating strong growth with an increasing share of domestic fiber.

- Mr. You Qiwei, First Deputy General Manager, Yangtze Optical Fibre and Cable Co. (YOFC), said China has nearly completed its nationwide long-haul backbone project; major constructions will be focused on provincial trunks and local networks.

- Mr. Yu Xiangguo, General Manager, Siemens Optical Fiber Cables Ltd., Chengdu, outlined the plans of the MPT/China Telecom, Unicom (the only licensed competitive telecom carrier), railway, highway, power utilities, and CATV companies. He concluded that demand growth from all players will boost the rise of the nation's fiberoptic cable market.

- Mr. Shi Xiaodong, Sales/Marketing Manager, Alcatel Shanghai Optical Fibre Cable Co., predicted that annual average growth rate for optical fiber demand in China will be 31% over the next five years.

In his overview of the region, Charles Xu, a senior analyst at KMI, said that the average annual growth rate of the region's fiberoptics market over the next five years will be 13%. Thus, the market for fiberoptic cable, transceivers, and connectors is forecast to grow from \$4.2 billion in 1997 to \$7.5 billion in 2002.

KMI tracks the demand of fiberoptic cable, transceivers, and connectors in 15 Asia-Pacific markets. These are divided into developed and developing telecom markets. The developed markets include Japan, Australia, New Zealand, Hong Kong SAR, Korea, Taiwan, and Singapore.

The developing telecom markets include China, India, Thailand, Malaysia, Indonesia, Philippines, Vietnam, Pakistan and other emerging markets in northern and southern Asia. Mr. Xu said that, in 1997, developed markets combined for 64% of the region's \$4.2-billion fiberoptics market. But in 2002, their share of the market will decline to 55% as developing markets grow faster.

Applications vary by market groups

In 1996, 9.5 million fiber-km of single-mode cable was installed in the Asia-Pacific region; of these, long-haul telecom represented 35% but this percentage will decrease to 15% in 2002. The share of the feeder/local telecom—47% in 1996—will reach 70% in 2002, representing a stronger growth application segment. The share of the cable TV sector will remain at 7% to 8%. The share of other single-mode applications will decrease from 9% in 1996 to 6% in 2002.

In his presentation, Mr. Xu said that the mix of fiberoptic cables installed in single-mode applications and the trend forecast for the next few years vary significantly between developed and developing telecom markets. In developed markets, local

telecom represented nearly half of the cable installed in 1996. This percentage will approach 70% in 2002. The long-haul market will be 8% in 2002, down from 24% in 1996.

In 1997, said Mr. Xu, the long-distance cable deployment by developing countries was 57% of all cable installed that year whereas local telecom and CATV combined for 38%. Over the next few years, most developing markets will continue building long-haul trunks but overall network constructions will switch to local telecom. In 2002, the feeder/local telecom market alone will account for nearly 60% of the cable installed.

China telecom market overviewed

In his presentation at the conference, Mr. You Qiwei, an executive at Yangtze Optical Fiber and Cable Co., said that "1997 was a harvest year of China's fiberoptic trunk deployment." That year alone, China Telecom (the MPT's operating arm) installed 17 trunk networks which consumed nearly 1.4 million km of cabled fiber.

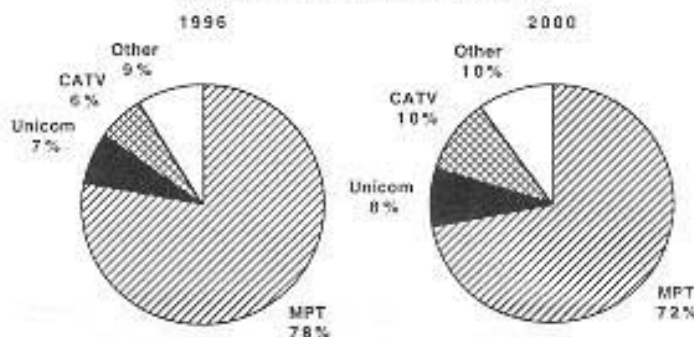
The Chinese government, he said, understands the importance of an advanced telecommunications system to a rapidly growing economy. This is why, for the past 10 years, China's telecom revenue has been rising at a higher rate than the annual GDP growth. The consequence is the rapid penetration of telephone access lines ahead of most other developing countries in Asia.

Fiber optics has been given higher priority than other transmission media such as microwave and satellite. Since 1992, more than 10 million fiber-km of single-mode cable has been installed and nearly 40% was installed in 1997.

"China Telecom's share of the fiberoptic cable market fell from 84% in 1995 to 78% in 1996," said Mr. You, "but its dominant position will not be threatened." Mr. You said China Telecom will increase its demand of fiberoptic cable in provincial trunk, feeder, and local networks over the next few years. Other customers of fiber optics, according to Mr. You, will include Unicom, China's second telecommunications carrier, the Ministry of

Radio, Film, and Television that plans to install its own nationwide network, and others that will build up fiberoptic networks using rights-of-ways. This "other" category includes the military, utility, and petroleum, railroad, and highway companies.

Customer Shares of Fiber Optics Market in China
(% of annual fiber optics market)

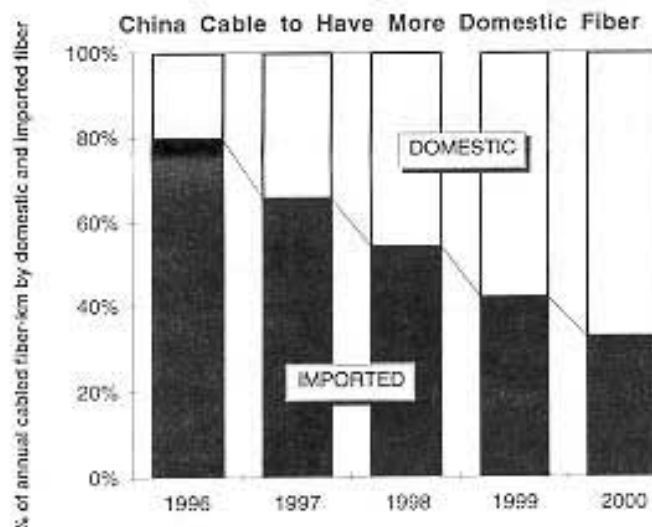


In the near-term, there is no sign that the country's basic telecom services market will be opened to foreign carriers, said Mr. Xu of KML. The MPT's major concern is that it has invested hundreds of millions of dollars to build up China's basic telecom infrastructure with state-of-the-art technology including fiber optics. Further, the government's preferential policies allow the MPT to retain 90% of the telecom profit but payback only 10% of the loans it needed for telecom projects. Few carriers from other countries have been treated this way, and as such, they are deprived from entering the China market to cash in on the growth opportunities. The telecommunications equipment market, however, was opened to foreign companies a few years ago.

With the MPT dominating the nationwide landline network, the alternative telecom carrier, Unicom, appears to be losing market opportunities, according to Mr. Xu. The carrier, now in its fourth year of operation, has not established a nationwide fiberoptic backbone. And even though Unicom has had a backbone network in place, it still faces considerable difficulties at the point of local access. This is because all city ducts, conduits, and telephone poles are assets of the MPT. Unicom would have to form alliances with railroad, highway, and utility companies to expand its landline network.

Cables made in China are forecast to use more domestic fiber

In 1997, about 270,000 sheath-km, or more than four million fiber-km of single-mode cable, was installed in China. Of this amount, direct cable imports accounted for less than 3% of the annual cable deployment, however, more than 60% of the fiber sheathed by domestic cable manufacturers was imported, mostly from the Corning group. This percentage will decrease significantly over the next few years, according to Mr. You.



Mr. You said that direct fiber imports to China have declined from 80% of annual demand in 1996 to 66% in 1997 and will drop to 33% in 2000. This switch of market shares does not indicate that China has less demand for fiber; on the contrary, more fiber companies from the U.S., Japan, and Europe are moving their fiber manufacturing operations to China. Thus, their annual fiber output is included as "domestic volume" of the China fiber market by KMI.

In China, foreign companies typically form joint-ventures with domestic wire and cable companies, PTT's local branches, or other financial or investment institutions. Examples of foreign fiber entities that have facilities in China include Lucent Technologies, Fujitsu, Furukawa, and Draka Group. Lucent Technologies started making fiber in China in 1996, and its presence there has increased the value of domestic fiber market. In 1997, Lucent accounted for about 70% share of the domestic single-mode fiber volume.

Localization of fiber manufacturing offers the benefits of proximity to customers and cost and tax advantages but also brings up the concern of patent protection. But with more fiber companies moving into China and with fiberoptic cable demand poised at a higher level over the next few years, those without local fiber manufacturing capabilities are looking at China for joint-venture opportunities. The most recent entrant to start fiber manufacturing in China is Sumitomo which formed a joint venture with a telecom cable firm in the southwestern city of Chengdu. This trend of "localization" is a main reason behind the rapid decline of direct fiber imports from overseas markets, according to Mr. Xu of KMI.

Industry News

AT&T to boost fiber capacity with Lucent WaveStar Dense WDM system

AT&T Chairman, C. Michael Armstrong, announced AT&T will be the first carrier to test and deploy Lucent Technologies' new WaveStar OLS 400G, the industry's first 80-wavelength Dense Wave Division Multiplexing (DWDM) system.

Unveiled by Lucent this month, the WaveStar OLS 400G can increase the transport capacity of an existing fiberoptic network by a factor of 10. Mr. Armstrong said that the system will help save AT&T more than \$1 billion over five years on facilities and decrease its SONET equipment costs by more than one-third.

AT&T has 64,000 km of fiberoptic cable installed in the U.S. The company has coast-to-coast connectivity with 32 large fiber rings. In 1998, the company will add another 20 rings, completing a three-year project.

Lucent said that WaveStar can provide up to 400 gigabit-per-second capacity over a single fiber. The new optical networking system can be configured to handle up to eight such fibers. This gives communications providers a maximum capacity of 3.2 terabits, or 3.2 trillion bits per second of voice, video and data traffic.

Level 3 plans 36,000-km fiber network

Level 3, a subsidiary of Peter Kiewit Sons', Inc., will start building this year the first phase of a 36,000-km fiberoptic system that will be the first end-to-end network designed and built specifically for Internet Protocol (IP)-based services.

"We will start construction soon and expect to be in approximately six cities by year end," company spokesman, Josh Howell, told FMI. "Over the next few years Level 3 will install 20,000 route miles (36,000 km) of fiber cable in the United States. We will later expand internationally and install submarine cables."

Earlier this month, Kiewit Diversified Group (KDG), a subsidiary of Peter Kiewit Sons', Inc. (PKS), changed its name to Level 3 Communications, Inc. Level 3 is based in Denver, CO. PKS said: "The new identity reflects a change in the Company's business focus from investments in a range of industries to a concentration on business information and communications services. This shift began in the summer of 1997 with the hiring of a team of former MFS Communications Co., Inc. executives, including James Q. Crowe, president and chief executive officer of Level 3, R. Douglas Bradbury, executive vice president and chief financial officer, and Kevin J. O'Hara, executive vice president, operations."

OCI Communications completes two fiberoptic ring networks in Twin Cities

OCI Communications Inc., an employee-owned Minneapolis-based telephone company, is providing local dial-tone service over a newly completed 106-km SONET-based fiberoptic network in the Twin Cities area. OCI's network includes a 288-fiber ring in the downtown area and a 144-fiber ring in the suburban area.

MetroNet launches service over Toronto fiberoptic network

MetroNet Communications announced the cutover of its 17-km fiberoptic network in Toronto and the opening in the city of its Network Operations Center, part of a system that monitors MetroNet's networks nationwide. MetroNet provides local

telephone service in Vancouver, Calgary, Edmonton, Winnipeg, Montreal, and Ottawa-Hull.

Under an agreement with the City of Toronto, MetroNet refurbished a decommissioned water pipe system for the installation of a fiberoptic network in downtown Toronto. The city's underground water pipes are located throughout key business, financial and government areas in the downtown core. Under the agreement, MetroNet installed fiberoptic cables in the water pipe system to form the backbone. MetroNet has plans for further expansion this year.

ELI announces fiberoptic expansion

Electric Lightwave, Inc. (ELI), a full-service competitive communications provider, has received approval from the California Public Utility Commission to provide competitive local phone service to businesses in the City of Roseville.

ELI has installed more than 320 km of fiberoptic cable in the Sacramento area and plans to install more than 65 km in neighboring Roseville.

RCN Corp. acquires Boston and Washington's largest Internet providers

RCN Corp. has signed definitive agreements to acquire Boston and Washington's largest Internet service providers, UltraNet Communications, Inc. and Erol's Internet, Inc., for a combined \$110.5 million in cash and RCN common stock.

The acquisitions would make RCN one of the largest regional ISPs in the Northeast, with more than 325,000 Internet subscribers from Boston to Washington. RCN offers local and long-distance telephone service and cable television over its own fiberoptic network.

Unity First to buy Boston Optical Fiber

Unity First Acquisition Corp. has signed a letter of intent to merge with Boston Optical Fiber Inc., a privately-owned optical fiber producer for computer networks and medical devices.

The company said that under the proposed merger terms, it will acquire Boston Optical, located in

Westborough, MA, in exchange for 3,125,000 shares of Unity First common stock. On completion of the merger, Boston Optical will have a 62.5% equity interest in Unity First, it said.

Latin America

Nortel donates transmission equipment for Sao Paul university fiber system

Nortel has donated a 2.5-Gbps transmission system to the University of Campinas (Unicamp) for Multicom 21, its high-speed broadband digital data network project in the state of Sao Paulo.

Multicom 21 will use Telesp's (Telecomunicações de São Paulo) fiberoptic network to connect the Sao Paulo Hospital of the Federal University of Sao Paulo, the University of Sao Paulo, and the Sao Paulo Heart Institute. The system is expected to be operational by the third quarter of 1998.

The telmedicine and education broadband data network will permit the transmission of voice, data and digital video images simultaneously. It will allow increased access and information exchange among members of the academic, medical, and scientific communities by facilitating services like tele-diagnosis, medical consulting and long-distance educational lectures for students in various communities in Brazil.

The Multicom 21 project was launched in 1993 by the Electrical Engineering College of Unicamp to stimulate research and development of computer and telecommunications technology and services. Multicom will be connected in the future to the Internet II providing high-bandwidth interconnections between Brazilian research centers and researchers around the world.

Europe

Telefonica announces CATV partnerships in Madrid, Galicia

Iberdrola, Itochu, and Abengoa have taken a 15% stake in Telefónica Cable Madrid, a Telefónica

lead cable television consortium that also includes Telemadrid, Canal Isabel II, and Caja Madrid.

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Clarification concerning fiber and preform prices

Fiber prices dropped in the second half of 1997, mainly because the world's fiber-producing capacity had increased and surpassed the world's fiber demand. This was a notable development after more than two years of fiber shortage and stable prices.

For some fiber manufacturers, the demand in 1997 may have been lower or "softer" than they had estimated earlier in the year. But the main factor affecting the fiber market was that several substantial plant expansions came on line during 1997. With ongoing competition between cablers for large contracts with the telecom carriers and other network operators, the downwards pressure on fiber prices was pushed through to the fiber manufacturers.

The extent of price decreases in late 1997 varied among countries and regions. In some countries, there has been little fiber sold outside the large groups that make both fiber and cable. And in such cases, the "spot" market prices for fiber can be more volatile than the prices in high-volume, long-term contracts. Some countries also showed greater price volatility due to competitive factors, such as new fiber manufacturers starting up or increasing threats in the home market from imported fiber.

The November 30, 1997 issue of *Fiber Optics Marketing Intelligence* said that lower preform prices also contributed to lower fiber prices, and that Shin-Etsu Chemical Company was lowering prices for its preforms to gain market share. This statement was incorrect. Shin-Etsu says it has had to reduce prices so that its preform customers can remain competitive in the fiber market. Thus, Shin-Etsu says it has had to react to the pressures of fiber importers and other competitive threats, but it is not a direct contributor to lower prices.

Telefónica Cable Madrid plans to pass two million homes over the next 10 years. In addition to basic cable television, the company plans to offer video-on-demand, interactive services, and voice and data services.

In Galicia, Telefónica Cable has teamed up with Grupo Voz, a publishing company, to develop a broadband network that will offer services to more than 450,000 homes over the next 10 years. The joint venture will offer cable television, interactive broadband services, telephony, and high-speed Internet access.

Lyonnaise Cable deploys Motorola cable modems in Paris

Lyonnaise Cable will use Motorola's CyberSURFR cable modem to launch commercial Internet access in Paris to homes, businesses and schools during the first quarter 1998.

Lyonnaise Cable already offers its CyberCable Internet access service in Le Mans, Annecy and Strasbourg using the Motorola CyberSURFR.

Swisscom, CNS of Germany link national fiberoptic networks

Swisscom has linked its national fiberoptic network with that of southwestern Germany's Communication Network Services (CNS), Swisscom's joint venture there with two regional utility companies in the Baden-Wurttemberg state. The link also gives Swisscom an interconnection with Deutsche Telekom via CNS.

The CNS network includes 3,000 kilometers of fiberoptic cable. The company operates Baden-Wurttemberg's university network, connecting all universities and advanced technical colleges. Alliances between CNS and Freiburg, Karlsruhe, Pforzheim and Stuttgart have been arranged. The company expects to be the largest telecommunications operator in Baden-Wurttemberg after Deutsche Telekom.

Asia

Ericsson signs major SDH contract

Ericsson Business Unit Transport and Cable Networks has signed a \$3.5-million contract for the provision of SDH equipment to the Communications Authority of Thailand (CAT).

This is the second SDH contract announcement made by Ericsson in the past six months, the first, announced in June, was a smaller SDH contract with the other major PTT and joint regulatory body in Thailand, Telephone Organization of Thailand. The contract was awarded out of a strategic partnership with Jasmine International, a major telecommunications provider in Thailand, where Ericsson supplies the SDH technology and Jasmine supplies the fiber and outside plant.

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