APPENDIX C

CABLE TELEVISION OPERATOR MARKET SHARES AND CONCENTRATION AS MEASURED BY THE HERFINDAHL-HIRSCHMANN INDEX (HHI)

Cable Television Operator	Subscribers	Market Share (Percent)	HHI Value
Tele-Communications, Inc. (1,2)	12,974,000	20.43 %	417.52
Time Warner Cable	11,750,000	18.51	342.45
Continental Cablevision, Inc	4,219,000	6.64	44.15
Comcast Corporation	3,430,000	5.40	29.18
Cox Communications, Inc.	3,300,000	5.20	27.01
Cablevision Systems Corporation	2,772,000	4.37	19.06
Adelphia Communications	1,706,000	2.69	7.22
Jones Intercable, Inc.	1,486,000	2.34	5.48
Marcus Cable Partners	1,252,000	1.97	3.89
Viacom Cable (3)	1,216,000	1.92	3.67
Falcon Cable TV	1,174,000	1.85	3.42
Century Communications	1,111,000	1.75	3.06
Lenfest Communications	1,071,000	1.69	2.85
Charter Communications	907,000	1.43	2.04
E.W. Scripps	807,000	1.27	1.62
Prime Cable	662,000	1.04	1.09
TKR Cable (4)	651,000	1.03	1.05
InterMedia Partners	635,000	1.00	1.00
Total (5)	51,123,000	80.52 %	915.76

Source: Subscriber data from Paul Kagan Associates, Inc., *Cable TV Investor,* June 20, 1996, as of March 31, 1996. Total industry subscribers. 63,494,570. as of May 1996, from A.C. Nielsen

July 3, 1996

Notes:

(1) Tele-Communications, Inc., subscriber data includes customers served by TCI and its consolidated subsidiaries. This data does not reflect subscribers of cable companies in which TCI has an interest accounted for by the equity (TCI investment of 20 to 50 percent) or cost (TCI investment of less than 20 percent) methods, including Lenfest, TKR Cable and InterMedia Partners. If all of TCI's interests are included, TCI would have 14,527,000 subscribers, or 22.88 percent of the market, and the HHI would be 1,018.01.

(2) TCI has agreed to acquire Viacom Cable (1,216,000 subscribers) and TKR Cable (651,000 subscribers). If these transactions are completed, TCI would have 14,841,000 subscribers, or 23.37 percent of the market, and the HHI would be 1,039.84. If all of TCI's interests are included (see note 1), TCI would have 16,068,500 subscribers, or 25.31 percent of the market, and the HHI would be 1,131.07.

(3) Viacom has agreed to be acquired by TCI (see note 2).

(4) TKR Cable has agreed to be acquired by TCI (see note 2).

(5) Although it is desirable to include all firms in the market in the HHI calculation, small fringe firms do not affect the HHI significantly and therefore are not critical. The top 18 were used here because beyond the 18 largest each smaller company captures less than one percent of the market and the square of a number less than one will have little impact on the value of the index. The top 18 cable companies serve approximately 51 million subscribers, or about 81 percent of all subscribers

APPENDIX D

Telecommunications and Advanced Services Provided by the Cable Television Industry

April 1996

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I. INTRODUCTION

The cable television industry is the preeminent provider of video services in the United States. The cable industry's high capacity broadband infrastructure is in place in over 63 million U.S. homes and passes 97% of all homes[1] delivering the broadest range of programming choices available anywhere in the world.

The cable industry is now transforming this nearly universal network to provide U.S. homes with new competitive communications and information services. Cable has already begun to offer a wide range of new voice services such as personal communications service, business telephone access services, and local residential service. **Over the next five years, the cable industry and its affiliates and partners are expected to spend at least $14 billion in new technology investments that will enable cable systems to deliver these and other services in competition with existing service providers. By the year 2004, revenues from telephony delivered over cable plant are expected to reach over $7 billion annually.**[2]

Cable's investment in infrastructure will establish a broadband platform that generates revenues from telephony as well as high speed data access. Just as the build out of cable's plant was supported by the steady incremental growth of new video services and revenues, the next evolution of cable's infrastructure will be incrementally supported by new voice and data revenues.

The material which follows discusses the status of the cable industry's efforts to deliver telecommunications and data services. With passage of the Telecommunications Act of 1996, it falls to the FCC to implement the legislation's provisions to facilitate competitive entry into the local exchange markets. To this end, the cable industry urges the Commission to implement the Act with the following priority objectives:

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[1] A.C. Nielsen Data Reporting Services, February 1996.

[2] Paul Kagan Associates Inc., *10-Year Cable TV Projections*, The Cable TV Financial Databook, July 1995, p. 8.

- Make a timely decision on the "competitive checklist" regulatory actions to carry out the key objective of the Act: **to promote facilities-based competition in telecommunications**. Specific focus should be placed on the following items that promote that objective.

    a. Ensure that pricing and numbering policies meet the needs of new competitors and do not impose barriers to entry.

    b. Ensure that resale, unbundling and joint marketing policies do not undermine incentives to invest in telecommunications facilities.

- Minimize regulation of "new entrants," including unnecessary and burdensome requirements on the underlying plant of new entrants; and adoption of broad forbearance policy for new entrants.
- Ensure that universal service policies, while maintaining universal telephone service, do not impose unfair burdens on new competitors.
- Develop procedures and processes to ensure that FCC approval of the initial interconnection agreement in each state -- which then allows the Regional Bell Operating Company (RBOC) to enter long distance -- is with a serious, long-term, predominantly facilities-based competitor.
- Develop procedures to resolve quickly questions of whether state and local rules or laws effectively prohibit entry into telecommunications. Implement adequate procedures to monitor anticompetitive behavior by the Local Exchange Companies (LECs) and impose sanctions against the LECs when anticompetitive behavior is discovered.

The following document provides an overview of cable's rapidly evolving technological infrastructure, and the voice and data transmission business ventures that this architecture makes possible. The industry's growing commitment to telephony and data transmission makes these policy goals ever more important to cable's ability to compete in these businesses.

II. OVERVIEW OF CABLE SYSTEM CORE TECHNOLOGY

The cable industry's transformation into a competitive voice and data service provider results directly from the evolution of cable's technological architecture from a traditional video-only plant configuration to fiber-based hubs. Cable's deployment of fiber, construction of hybrid fiber-coax networks, activation of two-way capability and introduction of regional hub architecture, enable the industry to deliver a range of telecommunications and information services to consumers.

A. Overview of Cable's Basic Plant

The cable industry's core technology has evolved from a traditional "tree and branch" architecture which is composed of five major parts: 1) the headend, 2) the trunk line, 3) the feeder or distribution line, 4) the drop line, and 5) the terminal equipment or customer interface units.[3] These basic components allow cable operators to deliver a diverse mix of local, national, and international programming to customers with relatively little inconvenience due to terrain or geography.

The center of any cable system is the headend, where many of the system's diverse programming operations and functions are processed, such as the reception of satellite delivered programming and broadcast signals and the insertion of all the pre-recorded programming, commercials and live local programs.[4] **The headend is capable of receiving and processing programming in various formats (AM, FM, digital).**

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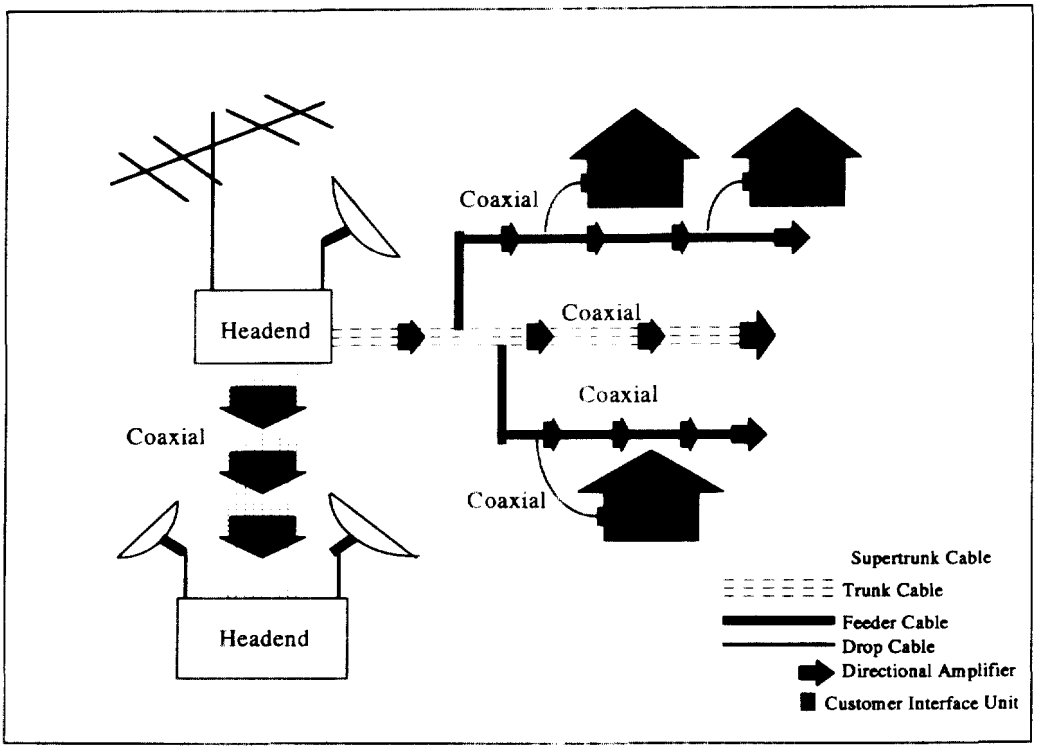
[3]Walter S. Ciciora, *Cable Television in the United States- An Overview*, CableLabs, May 25, 1995, p. 7.
[4] Id. at 9.

Tree and Branch Coaxial Cable System



The trunk line is usually a much larger "untapped" cable that carries signals from the headend into the "last mile" or neighborhood. Most systems that have not been rebuilt or upgraded still have coaxial cable in the trunk portion of the cable plant.[5]

The feeder cable is composed of rigid coaxial cable and interconnects the trunk line through a "bridger amplifier." "Feeder" cable of a smaller diameter connects the customer's home to the distribution cable through an interconnection device called a "tap." When a customer purchases cable service, the cable operator runs a smaller "drop" cable from the feeder cable directly into the customer's home. **The drop cable terminates at the customer interface unit (CIU), which is the where the integrated data signals (video, audio, telephony) are separated for customer use.**

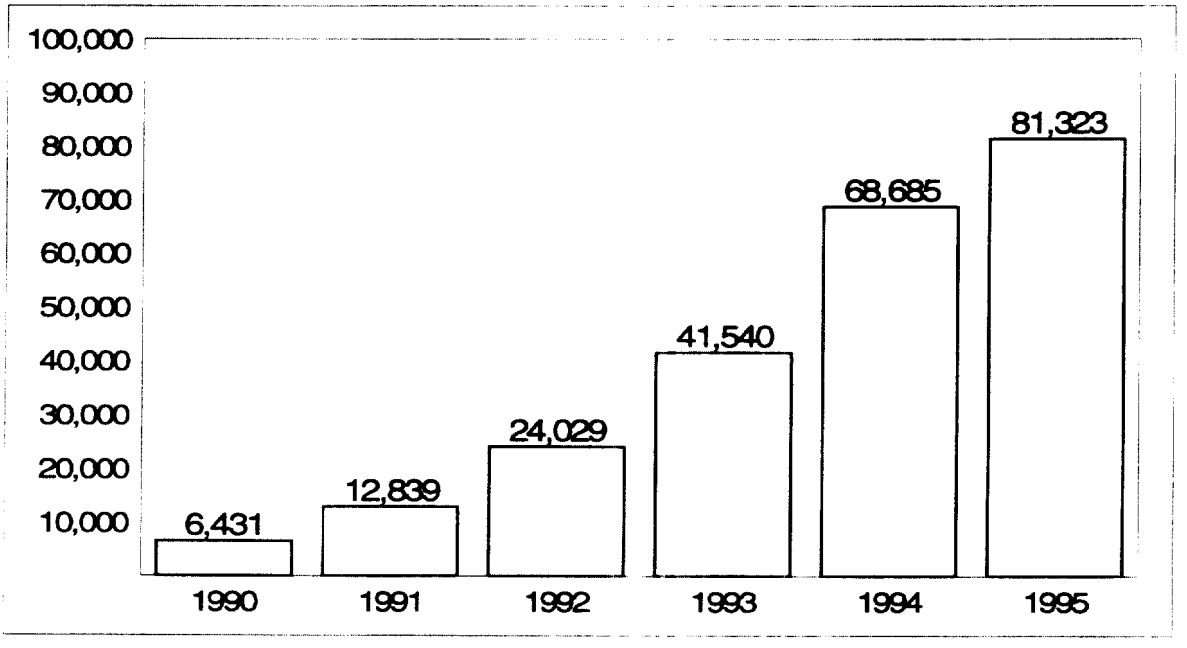
[5] Walter S. Ciciora, *Cable Television in the United States- An Overview*, CableLabs, May 25, 1995, p. 9.

B. The Cable Industry and Fiber Optics

Most cable operators in the United States are deploying fiber optic transmission lines to replace much of the coaxial cable present in trunk. These fiber optic lines are constructed from thin strands of glass that transmit light signals. Light signals travel much farther in fiber than electrical signals travel in either coaxial cable or twisted pair cable copper wire before requiring amplification.[6] **In 1995, the cable industry increased deployment of fiber optic lines by 18.4% over the previous year's total.[7] In fact, the cable industry deployed over 195 miles of fiber every hour for a total of 81,323 route miles and 1,707,783 fiber miles.[8] By comparison the LECs deployed only 3.4% more fiber in the same period.**

CABLE TV INSTALLED FIBER

(000) Route Miles



Source: Paul Kagan Associates Inc., *Top 50 MSO Fiber Construction*, Cable TV Technology, Mar. 28, 1994, p. 5.

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[6] *The Cable Connection: The Role of Cable Television in the National Information Infrastructure*, CableLabs, Sep. 18, 1995, p. 4.

[7] U.S. Dept. of Commerce, Office of Telecommunications, International Trade Administration, Fiber Optics Industry, 1996.

[8] The Federal Communications Commission, Industry Analysis Division defines route miles of fiber as the total mileage of fiber routes as would be seen on a network map. Fiber miles are defined as the number of fiber strand miles used in all routes including both lit and unlit fiber--the sum of the number of miles of each owned cable weighted by the number of fiber strands.

Total fiber optic footage varies by system, but generally cable companies use fiber to connect headends or extend trunk lines into neighborhoods, which amounts to about 25% of a cable system's plant.[9] Fiber optic cable also reduces the amount of "noise" in a system by requiring less electronic equipment (i.e. amplifier cascades) and making the system "passive."[10] These "passive" architectures support newer technologies by providing "cleaner" transmission paths which are necessary for two-way interactivity

By upgrading existing infrastructures with fiber technology, the cable industry is able to maximize its existing infrastructure without totally replacing the trunk, feeder and drop lines that already exist, thereby reducing the cost of introducing advanced telecommunications services and networks.[11] **The existing feeder and drop lines represent the cable industry's "last mile" of plant into the consumer's home. These lines are high bandwidth coaxial cable, which are capable of delivering broadband applications at data rates much faster than the very limited capability of twisted copper pair used by the telephone companies in their "last mile" connections. In fact, cable plant is capable of transferring data at rates as high as 30 million bits per second[12] in each 6 MHz television channel allocated to data transmission. This is a hundred times faster than ISDN lines, the telephone companies' fastest residential phone line.**[13]

Furthermore, **the incremental cost to upgrade coaxial cable plant to HFC[14] for high speed data access and telephony is considerably less than the comparative costs for**

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[9] Walter S. Ciciora, *Cable Television in the United States- An Overview*, CableLabs, May 25,1995, p. 9.
[10] Richard R. Green, *High Speed Information Access-A Cable Television Perspective*, National Research Council, June 15, 1995.
[11] Richard R. Green, *Cable Television Technology Deployment* CableLabs, National Research Council, June 15, 1995, p. 3.
[12] Katie Hafner and N'Gai Croal, *Getting Up to Speed*, Newsweek, Mar. 4, 1996, p. 46.
[13] Id.
[14] HFC is the acronym for hybrid fiber-coax architecture. This network topology uses a combination of fiber optic cable and coaxial cable transmission lines to deliver signals to customers.

telephone companies to upgrade their twisted-copper pair networks to provide similar broadband video and data applications. (*See table below*) The following economic data summarizes the capital expenditures necessary for cable operators to upgrade their coaxial networks to HFC and activate their return paths. This data is hypothetical and not representative of any system in particular; however, the economic model is useful in illustrating the fundamental costs of establishing the basic platform for advanced telecommunications services.

Fiber to the Node Upgrade and Two-Way Activation[15]

[Hypothetical Suburban System]

Homes Passed	50,000	Basic Subs	30,000
Basic Penetration	60.0%	Total Nodes	100
Node Size-Home Passed	500	Node Size-Basic Subs	300
Homes per Route mile	100	Total Route Miles	500
Trunk as % of Total Miles	25.0%	Underground Construction as %	20.0%
Trunk Miles - Aerial	100.0	Trunk Miles - Underground	25.00
Feeder Miles - Aerial	300.0	Feeder Miles - Underground	75.00

	Unit Costs	Units Requirements	Upgrade Costs
Laser Transmitters	$12,000 per unit	2.5 nodes per laser	$480,000
Optical Receivers	$2,000 per unit	2.0 per node	400,000
Return Lasers	$3,000 per unit	1.0 per node	300,000
Fiber Trunk Cable	$0.75 per foot		495,000
Underground Trunk Construction	$7.50 per foot		990,000
Aerial Trunk Construction	$0.75 per foot		396,000
Line Extenders	$500 per unit	4.0 per mile	750,000
Line Extender Install.	$200 per unit		300,000
Power Supply	$20 per sub		600,000
Other Feeder Electronics	$10 per sub		300,000
Other Feeder Electronics Install.	$4 per sub		120,000
Drop Cable and Install.	$80 per drop	20% of Subs	480,000
		Total Expenditures	**$5,611,000**

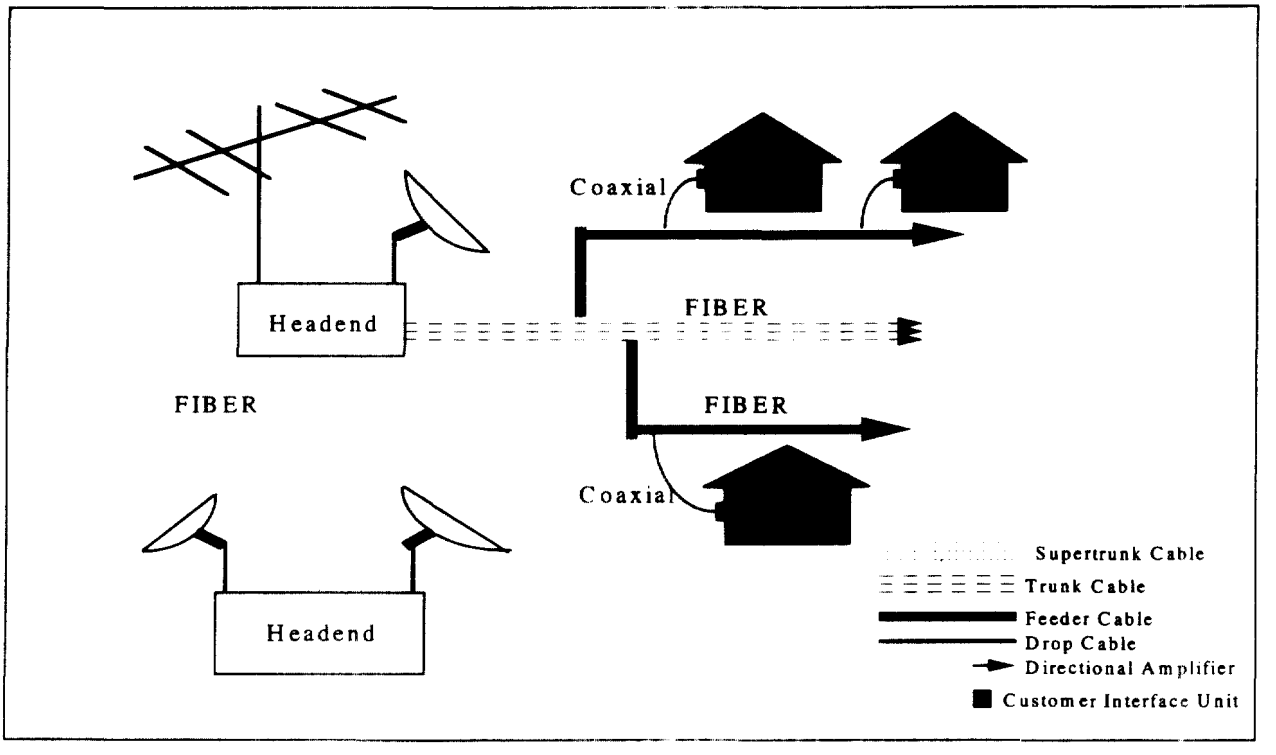
Cost per Route mile	**$11,222.00**
Cost per Home passed	**$112.20**
Total Cost per Subscriber	**$187.03**
Fiber and Laser Cost per Subscriber	**$55.83**
Other Material Costs per Subscriber	**$71.00**
Labor Costs per Subscriber	**$60.20**

[15] Richard Bilotti, *The Cable Television Industry-Deploying Wireline and Wireless Telephony*, Dec. 12, 1994, p. 50.

C. Tree-and-Branch to Hybrid Fiber Coax (HFC)

Traditional "tree and branch" architecture interconnects cable transmission lines, which vary in size as they penetrate communities, from the headend to the end-user, through a series of "taps" or interconnection devices and amplifiers. Initially, cable transmission lines were made of coaxial cable[16] only and required a cascade of amplifiers to deliver a high quality video signal. **However, today's cable systems are upgrading their plants with a mix of fiber optic and coaxial cable, which reduces noise, improves signal quality, increases channel capacity and increases reliability.**

Current Hybrid-Fiber Coax Design



[16]Walter S. Ciciora, *Cable Television in the United States*, CableLabs, May 25, 1995, p. 5. ("Coaxial cable contains it's own separate frequency spectrum tightly sealed inside the cable which behaves like over-the-air spectrum except that frequencies can be 're-used' in the cable spectrum without interference to the outside applications or to the cable service.")

Hybrid Fiber-Coaxial (HFC) architecture has evolved from a "fiber backbone" architecture, first introduced by the cable industry in 1988. HFC takes fiber from the headend all the way to the feeder lines, thereby increasing bandwidth and signal quality while placing fiber optics closer to the home than ever before.

Moreover, the HFC design transforms a single cable system into a series of "smaller cable systems" with individual serving areas of as few as 200 to 500 homes. These "smaller systems" are connected to the headend by fiber links, which increase bandwidth and facilitate two-way transmission. Fiber optic cable is not subject to ingress and each "neighborhood node" is separate from the others, so if one should fail, it will not impair the other neighborhood systems.[17] **Therefore, HFC design improves cable service by increasing bandwidth, signal reliability and quality while reducing the ingress, which limits return path viability.**

D. Advanced Cable Networks and Architectures

Cable industry architectures are evolving to allow for the integration of telephony, video-on-demand and two-way data services. These network architectures incorporate similar designs such as fiber backbone, fiber redundancy and regional hub interconnection to increase network reliability and interoperability, which are essential for two-way services such as voice transmission.

[17] Id. at 49.

Regional Hub Fiber Ring Technology

Increasingly, multiple system operators are deploying "regional hubs" for interconnection of headends using high capacity fiber optic rings. This concept allows companies and/or systems in the same geographical area to share the benefits and costs of a fiber optic ring. **Specifically, "regional hubs" allow companies to share the same headend equipment, such as digital video libraries and compression equipment, ad insertion equipment and computer data servers, sparing companies the expense of individual facility upgrades.** Some company headends are eliminated as a result of the "sharing concept," which further increases the economic benefits of the regional hub design

The "regional hub" concept not only shares economic costs and benefits but also speeds the deployment of advanced services such as telephony and interactive two-way services by allowing cable companies to interconnect with other telecommunications networks.[18] In terms of telephony delivery, the economic benefits of sharing costs is more significant initially, as customer penetration levels may be as low as 1% to 5%, and eventually increase to 12% to 25% in five to seven years.[19]

Teleport Communications Group (TCG) operates regional hub fiber rings in 27 MTAs throughout the U.S., while several cable operators are building regional hub systems in Baltimore, Boston, Denver, Detroit, Ft. Lauderdale, Hartford, Indianapolis, Long Island, Northern and Southern New Jersey, Philadelphia, Pittsburgh, San Francisco and Sarasota.[20] These operators seek to maximize their economies of scale by clustering and interconnecting their cable systems with other systems and networks. Moreover, the sharing of a

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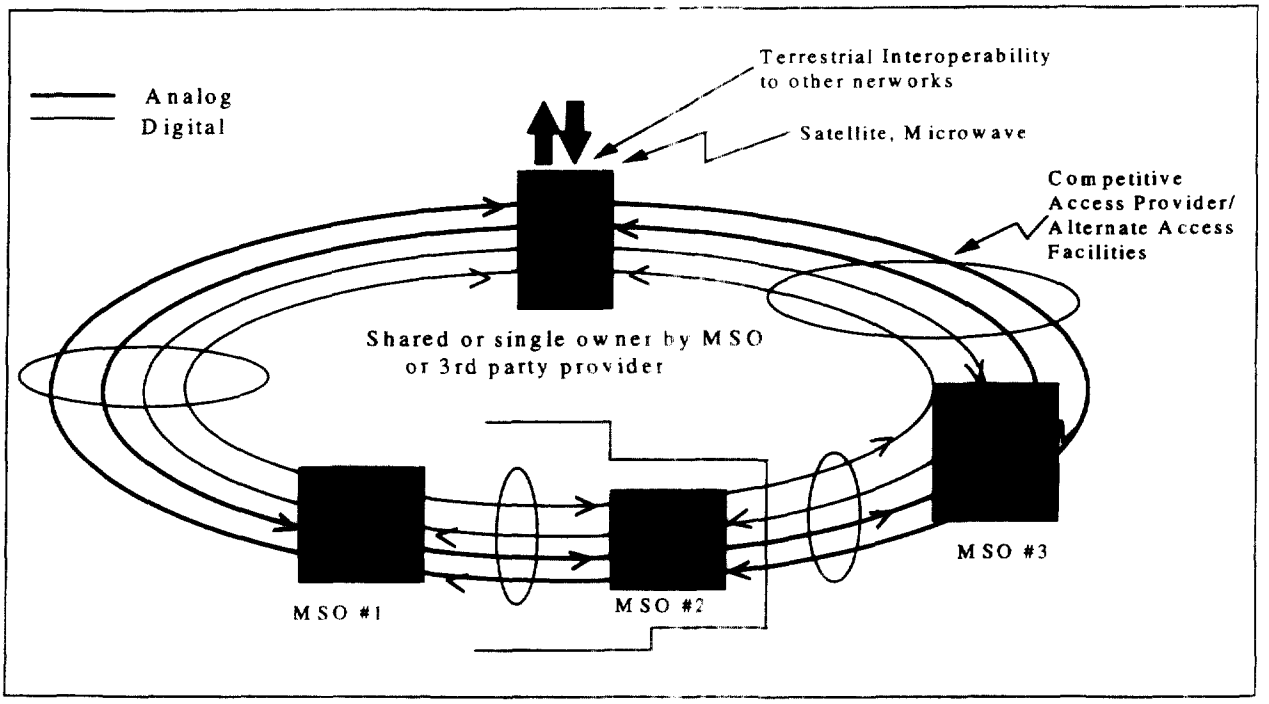
[18] *The Cable Connection: The Role of Cable Television in the National Information Infrastructure*, CableLabs, Sep. 18, 1995, p. 6.

[19] Gary Kim, *Switching Architectures and Principles*, Probe Research, p. 38I.

[20] *The Cable Connection: The Role of Cable Television in the National Information Infrastructure*, CableLabs, Sep. 18, 1995, p. 6.

main switching facility will potentially reduce the costs of this expensive equipment, which can cost as much as $7 million per switch and service up to 50,000 access lines.[21]

Fiber Ring Network Architecture



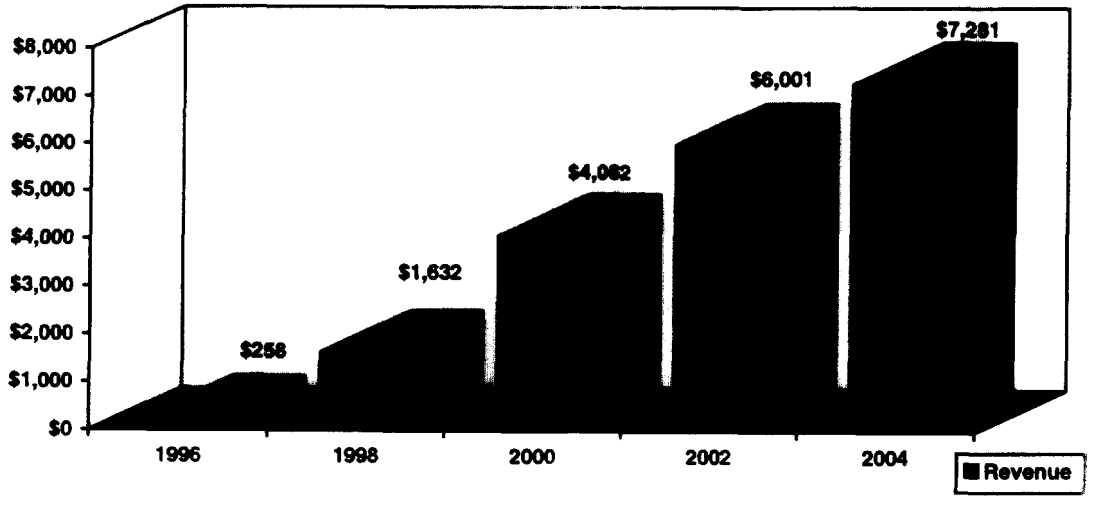
A typical fiber ring consists of a fiber optic cable several miles in length containing 20 to 200 fibers deployed in a circular ring design. The two ends of the fiber cable are connected at a central hub location or company headend. These rings allow for the interconnection of telephone networks and the Internet.

[21] Richard Bilotti, *The Cable Television Industry - Deploying Wireline & Wireless Telephony*, Dec. 12, 1994, p. 14.

III. CABLE TELEPHONY AND ADVANCED SERVICES

The cable industry is now expanding its competitive offerings to include business, residential telephone and data services. Cable's evolving fiber-based platform will enable the industry to transport personal communications services, competitive access for businesses to connect to long distance companies, and competitive local residential voice service. **Industry analysts project that by the year 2004 cable-based telephony services will generate over $7 billion a year, up from $258 million in 1996.**

Cable Industry Telephony Revenue 1996-2004
(in millions)



Source: Paul Kagan Associates Inc., *10-Year Industry Projections*. Cable TV Financial Databook, July 1995, p.7.

A. Local Voice Service

Cable companies are beginning to offer voice service in competition with the existing local exchange monopolies. Several cable companies, as outlined below, are actively competing for residential customers, and at least 11 companies are pursuing certification at the state level in order to provide local residential voice service in competition with existing providers. **In fact, several cable companies and telephony affiliates have been certified as Competitive Local Exchange Carriers (CLEC) in 40 markets nationwide and many more applications for local voice service are pending.** (See *Appendix A: Cable TV Involvement in Local Telephony*)

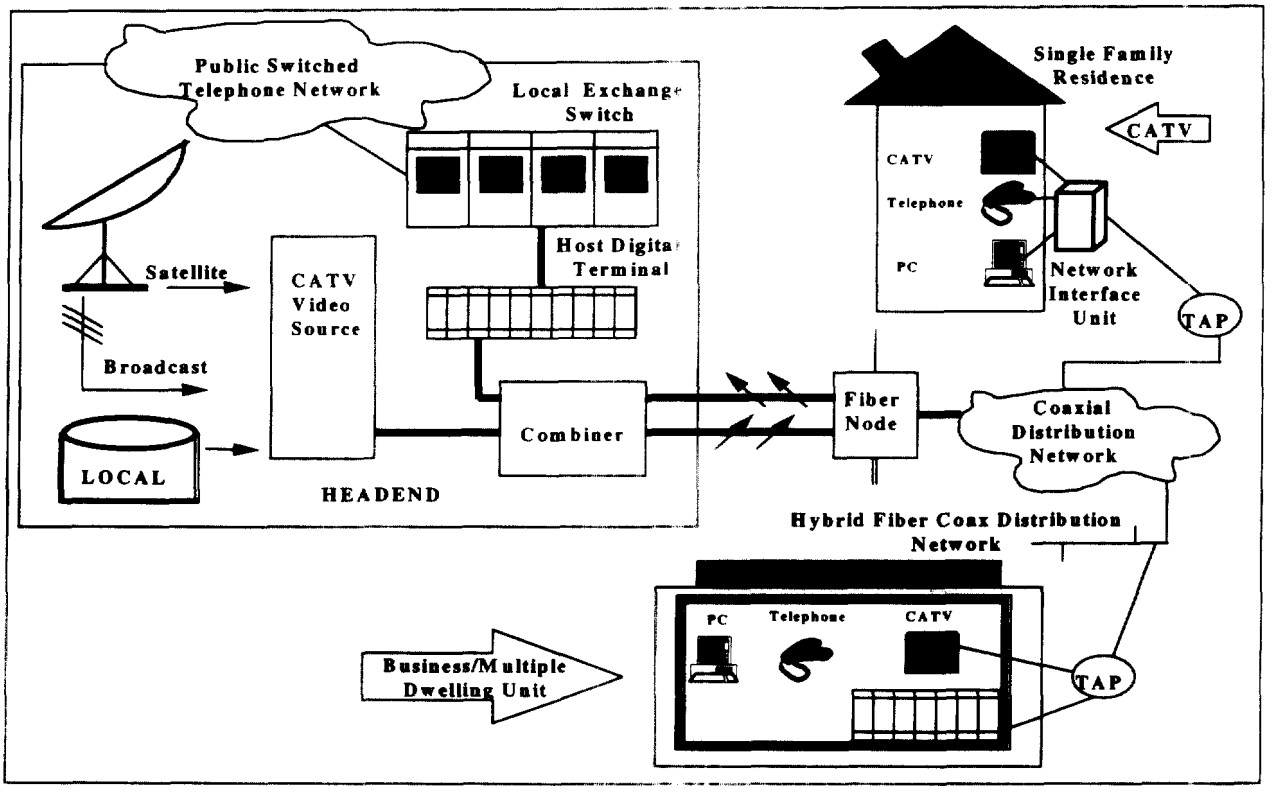
Emerging Cable Local Voice Offerings and Architecture

Since signing the first interconnection agreement between a cable operator and a telephone company, Time Warner has become the cable industry's leader in the delivery of switched voice service to the residential customer. Currently, Time Warner's Greater Rochester Cablevision property is providing local, long distance, custom calling features, fax and 911 "lifeline" services to over 1,500 residential and business telephone customers in multiple dwelling units, single family homes and office complexes in Rochester, N.Y., a 450,000 household market. The company is also testing delivery of switched voice service to single-family residential homes over its broadband, two-way interactive HFC architecture using the Tellabs CABLESPAN telephony-over-cable system. This is a seamless upgrade to the existing HFC infrastructure that allows telephone service to travel over the same fiber optic and coaxial lines used to deliver traditional cable television service [22]

[22] *Time Warner and Tellabs Deliver Cable Telephony*, Tellabs News Release, Feb. 28, 1995.

Using HFC Architecture to Provide Local Voice Service:

Time Warner's Rochester System



Several other cable companies are in the process of offering local residential voice service. Cablevision Lightpath, a subsidiary of Cablevision Systems, is certified as a CLEC in NYNEX territory and is offering switched voice service in Long Island, N.Y. Likewise, Jones Lightwave, a subsidiary of Jones Telecommunications, is a CLEC in Florida, and is in certification proceedings for Alexandria, Virginia for commercial deployment of residential voice service in multiple dwelling units. Similarly, Cox Fibernet, a subsidiary of Cox Cable, is certified in Norfolk, Virginia; New Orleans, Louisiana and Oklahoma City, Oklahoma.[23] Continental Cablevision subsidiaries are certified to provide exchange services throughout Florida and in 10 California counties. In connection with its California operations, Continental

[23] See *Appendix A: Cable Company Involvement in Local Telephony* for complete listing of cable telephony involvement.

Telecommunications of California has acquired an AT&T Network System's 5 ESSTM-2000 switch; Continental already has deployed a Class 5 switch in Jacksonville for switching and transmitting telephone traffic in Florida.

Moreover, **Teleport Communications Group, TCG, which is 100% owned by cable operators, is certified as a Competitive Alternative Local Exchange Provider in 30 markets and provides special access or private line service in 51 markets.**[24] TCG is the leading competitor to the monopoly local exchange companies (LECs) for network access revenues - and accounts for less than 1% of LEC network access revenues.[25]

Historically, TCG and other cable telephony affiliates have derived their revenues by providing access services to business users in metropolitan areas only. **This approach will change as Teleport Communications Group, Eastern Telelogic and other cable telephony affiliates integrate their switched business and residential services in their overlapping markets.** Soon, strategic alliances will provide the nation with its first ubiquitous, competitive, facilities-based, local exchange alternative for switched business and residential service in most U.S. markets.

The following economic data summarizes the next phase of capital expenditures cable operators will incur to provide wireline telephone service using existing HFC infrastructure. Again, the economic model is hypothetical and not representative of any system in particular but is useful in illustrating the expenditures cable operators will incur as they incrementally upgrade their systems to provide wireline telephone services.

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[24] *TCG's Current Markets as of February 1996*, Teleport Communications Group, Mar. 13, 1996. ("Cable operators, Tele-Communications Inc. (29.9%), Cox Cable (31.1%), Comcast Corporation (20%) and Continental Cablevision (20%) own TCG, which operates in 51 markets and 22 states.")

[25] Federal Communications Commission, *Common Carrier Competition*, May 31. 1995, p. 6.

The model assumes that cable operators will provide wireline service in clustered communities and connect systems through a regional hub fiber ring to reduce costs. As a result, industry analysts estimate a wireline telephony upgrade incorporating a fiber ring may cost $875-900 per subscriber for fully switched residential service passing 500,000 homes.

Economics of Wireline Telephony Deployment [26]

[Hypothetical Suburban Fiber Ring]

Regional Fiber Ring Demographics

Total Homes Passed	500,000	Basic Subscribers	300,000
Basic Penetration	60.0%	# of Headends	20.0
Homes Passed by Headend	25,000	Subs per Headend	15,000

CATV System Architecture		**Base Station Demographics**	
Total # of Nodes per headend	50	Telephony Penetration - Homes passed	15.5%
Node size - homes passed	500	Telephony Penetration - Basic subs	25.9%
Node size - Basic Subs	300	Telephony Subs per Node	78
Total Base stations per headend	5.0	Telephony Subs per headend	3,883
		Telephony Subs per Fiber ring	77,658

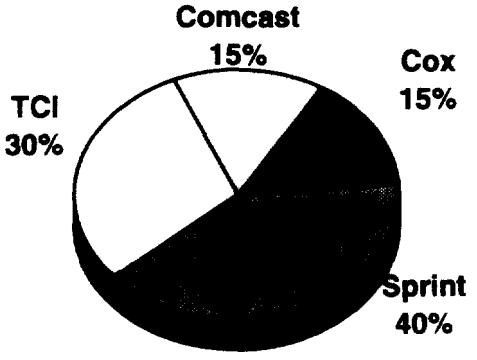
	Total Costs	**Cost per Telephony sub**
Customer Capital Expenditures	$27,180,286	$350.00
Coaxial/Fiber Expenditures	$13,834,478	$178.15
Headend Equipment Expenditures	$11,731,200	$151.06
Switching Equipment Expenditures	$15,947,366	$205.35
Total Telephony Expenditures	**$68,693,329**	**$884.56**
Total Fixed Capital Expenditures	**$23,957,497**	**$308.50**
Total Variable Capital Expenditures	**$44,735,833**	**$576.06**

[26] Richard Bilotti, *The Cable Television Industry-Deploying Wireline and Wireless Telephony*, Dec. 12, 1994, p. 17. (Excerpts only, contact Morgan Stanley for detailed report).

B. Personal Communications Services (PCS)

Personal Communications Services,[27] or PCS, is the name given to a new generation of digital cellular-like telecommunications services which promise customers new choices in wireless mobile telecommunications by providing superior digital quality voice and data service at lower prices than traditional analog services. The cable industry continues to pioneer the development of PCS technology and deployment.[28] **More than 25 cable companies applied for and received experimental PCS licenses from the FCC in the early stages of PCS Rulemaking.**[29] Since then, the FCC has held two auctions of spectrum licenses for delivery of PCS services.[30]

Sprint Spectrum L.P. Ownership



Sprint Spectrum L.P. won 29 of 51 available Broadband PCS licenses in U.S. major trading areas, the most licenses of any participant in the Broadband PCS auction.[31]

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[27] The Federal Communications Commission defines PCS as "radio communications that encompass mobile and ancillary fixed communication that provide services to individuals and businesses and can be integrated with a variety of competing networks." See *Second Report and Order*. ET Docket No. 92-9, 7 FCC Rcd 6886 (1992) at App. A, Sec. 99.5.

[28] See *Appendix B: Cable Industry Personal Communications Service Markets* for a complete listing of cable PCS markets.

[29] Federal Communications Commission, *In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services*, GEN Docket No. 90-314, June 13, 1994, p 9.

[30] Id. at 10.,("Section 309 (j) for the first time authorized the Commission to select licensees by competitive bidding and establishes objectives for the bidding process, including rapid deployment of new technologies, promotion of economic opportunity, competition and public access, wide dissemination of licenses, and efficient use of the spectrum...").

[31] *Sprint-Cable Venture Wins More Markets Than Any Other Bidders in PCS Auction*; TCI, Mar. 13, 1995.

Sprint Corporation and cable operators Comcast Corporation, Cox Communications and Tele-Communications, Inc. were the biggest winners, under the name Wireless Co., in the Broadband MTA auction. The venture, now renamed Sprint Spectrum L.P., acquired Broadband PCS licenses in 29 of the 51 available markets at a cost of over $2.4 billion or $14.03 per pop. These newly acquired licenses cover 72% of the total U.S. population or 171.8 million pops when coupled with Cox Cable Communications and American Personal Communications (APC) Pioneer's Preference licenses.[32]

PCS technology enables mobile communications by use of "micro-cells" and radio transmitters to form a wireless telecommunications network. The call is "handed off" from one cell to another as the caller travels from point A to point B. These micro-cells will be interconnected using the cable industry's two-way HFC networks and cable micro-cell interface (CMI) technology developed by the cable industry.[33] Moreover, cable's HFC architecture will provide a wireline backbone for Personal Communications Services.

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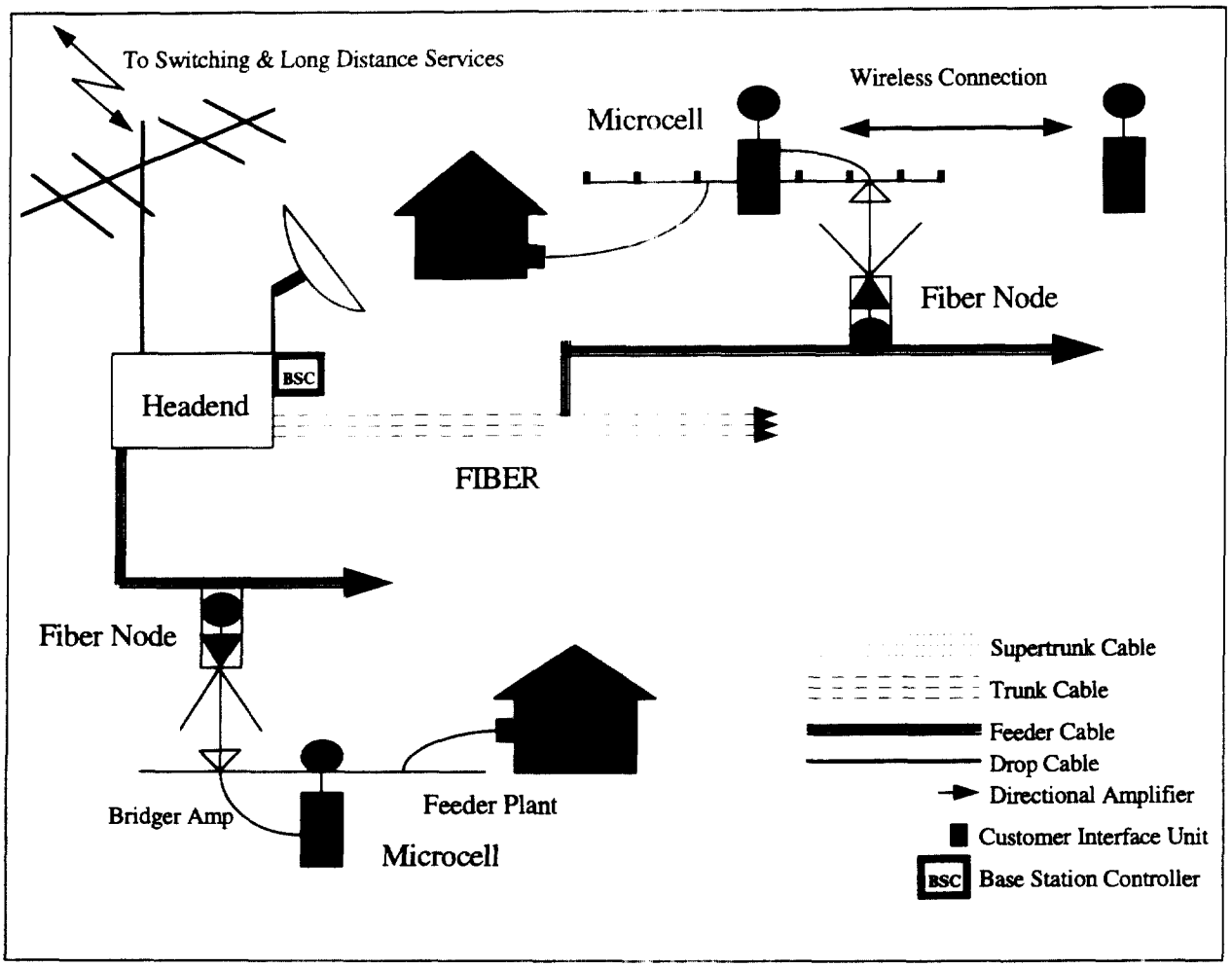
[32] Cox Cable won a Pioneer's Preference License for its proposal to use pre-existing HFC architecture for PCS instead of limited radio spectrum. Cox has successfully tested its approach in San Diego, California with several PCS vendors.

[33] George Hart, *Cost Effective Cable Television Transport for PCN*, 1992 NCTA Technical Papers, May 1992, p. 151. (CableLabs and Rogers Cable developed a method of remoting antennas relative to wireless base-station equipment.)

Hybrid Fiber Coax Architecture for PCS



Cox Communications is successfully deploying PCS over cable networks using the CMI technology in its two-way 550 MHz plant with fiber to 1,000 home nodes in San Diego, California.[34] **In Cox's deployment, PCS signals travel over the same HFC transmission lines as video signals, thus maximizing existing infrastructure and obtaining other cost savings such as centralized modulation, which allows most of the signal processing to occur at the headend instead of in each mini-cell.**[35]

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[34] Bruce Crair, *Cable-Based PCS: Cox's Vision of the Future*. CableLabs PCS Conference, Oct. 26, 1994.
[35] Id. at 4.