Capital Budgeting Alternatives for Residential Broadband Networks

by Bruce L. Egan
and Douglas Conn

Columbia Institute for Tele-Information
Graduate School of Business
Columbia University
809 Uris Hall
New York, NY 10027
(212)854-4222

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Bruce L. Egan

and

Douglas A. Conn *

* Bruce L. Egan is Special Consultant and Affiliated Research Fellow and Douglas A. Conn is Associate Director, Center for Telecommunications and Information Studies, Graduate School of Business, Columbia University. Research Assistance was provided by Richard E. Nohe, Pierrette Pillone and Yong C. Liu. The views expressed herein are solely those of the authors.

1.0 Introduct on

The prospect of widespread deployment of new communications technology to support an efficient high-speed public information highway has attracted the attention of many researchers and policymakers. Numerous studies examining the engineering costs of deploying residential broadband networks have been made and many have been controversial. The rhetoric surrounding the social costs and benefits of the new communications technology is rampant as telephone and cable television companies jockey to become the future provider of residential broadband services.[1] There is precious little credible research quantifying the added value to society of broadband technology, and even less evidence on what people or their government representatives are actually willing to pay for it. In fact, if actual business activity is any indication, neither telephone companies (telcos), cable companies, nor any other companies can foresee a sufficient net revenue opportunity in the current private marketplace to justify aggressive fiber-to-the-home construction projects.[2] There are simply no significant demand drivers.

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[1] One good recent example of this is in Communications Daily, September 25, 1989, p. 6. A cable representative states that their industry can provide residential broadband networks for an investment of about $4 billion while the telephone industry would require over $250 billion. In the case of cable, the figure is only for fiber backbones, while for telcos it includes fiber to the home. Such apples and oranges comparisons are typical in the trade press.

[2] For more detailed information regarding the costs and benefits of broadband networks see Bruce L. Egan, "Toward a Sound Public Policy for Universal Broadband Networks," Research Working Paper #282, Center for Telecommunications and Information Studies, Graduate School of Business, Columbia University, 1988; Bruce L. Egan and Lester D. Taylor, "Capital Budgeting for Technology Adoption in Telecommunications: The Case of Fiber," Research Working Paper #336, April, 1989a; and Bruce L. Egan "Fiber to the Home: Public Policy/Technology Conflict," Research Working Paper #349, 1989b.

The issue then, if the deployment of residential broadband networks is to remain a public policy priority, is how to finance such an enormous investment. Herein lies the focus of this article. The general conclusions reached are: (1) The most feasible near-term and cost-effective scenario for widespread deployment of novel two-way residential broadband networks is a hybrid fiber/coaxial cable network, not a telephone switched network; (2) but unfortunately, the capital structure and market situation of cable-television companies are inherently ill-suited for an aggressive technology adoption program supporting two-way residential broadband service.

2.0 Residential Broadband Service

There is no general agreement on just what constitutes a "residential broadband network." The purest vision is an integrated, all-fiber, all-digital, two-way high-speed network over one "super-pipe" which provides for everything from plain old telephone service to on-demand interactive video. This definition is quite futuristic and expensive, but continues to receive much attention in trade press and research articles.[3]

Of more current interest is the technological transition to networks featuring a combination of new fiber-optic and digital

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[3] For example, see Heinrich Armbruster and Gerhard Arndt, "Broadband Communications and Its Realization with Broadband ISDN" IEEE Communications Magazine, Vol. 25, No. 11, pp. 8-19, Nov. 1987. See also Daniel J. Harold and Robert D. Strock, "The Broadband Universal Telecommunications Network" IEEE Communications Magazine, Vol. 25, No. 1, pp. 69-79, January 1987; United Telecom Technology Planning, "Fiber in the Subscriber Loop" pp. 47, February 1988; Egan and Taylor, 1989a, supra, and National Cable Television Association, Research and Policy Analysis Department, The Cost of Telephone Company Installation of Fiber to the Home, Washington, D.C., July 1989.

technologies and existing analog/metallic ones, providing for an initial infrastructure investment capable of supporting two-way residential broadband service. From the consumer's point of view, there are two minimum qualifications for the future network: high-bandwidth capacity all the way to the customer premises and two-way communications capability.[4] Beyond this, there are other desireable, but not necessary, features such as digital signaling and switching. Our view is that future customer demand for communications functionality is basically satisfied with high-bandwidth two-way services. Initially, full-motion (entertainment) video service will be one-way (downstream) and the upstream communications capability will remain narrowband. Eventually, customers will also expect fast interactive (on-demand) video, however, this capability is only now under development and widespread deployment is at least 10, and more likely 20 to 30, years off.[5]

3.0 Investment and Financial Data

Tables 3.1 and 3.2 show recent investment and financial data for the telephone industry. Local telephone company data is separated from long distance carriers since the two generally do not coordinate investment activity. On the local level, long

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[4] "Two-way" in this case means allowing for addressable and point-to-point communications. Switching is not necessarily implied.

[5] This is the prediction of most engineering-oriented studies of broadband technology adoption. See for example Lawrence K. Vanston and Ralph C. Lenz, Technological Substitution in Transmission Facilities For Local Telecommunications, Austin: Technology Futures, Inc., 1988, at vii.

distance carriers usually target the market of large businesses while local companies have the task of building residential and small business networks. Tables 3.3 and 3.4 show similar data for the cable television industry. These data will be useful for evaluating two key facets of financing residential broadband networks. First, the data indicate the cost and cash flow of the embedded base of largely analog and copper technology, and second, they show the investment and capital turnover rates which, in turn, provide funds and stimulate spending for technology adoption.

Figures 3.5 and 3.6 give a breakdown of the telco and cable industry investment by broad category of plant. These illustrations will be useful for examining the possibilities for upgrading and replacing the current analog/metallic network facilities. As of 1988, as shown in pie charts 3.7, 3.8 and 3.9, a substantial portion of telco inter-office plant was already fibered. Conversely, to date the cable industry had installed fiber only sparsely, with nearly all distribution plant remaining coaxial cable. It is interesting to note that even with vastly different local network architectures, switched-star for telcos and passive-tree-and-branch for cable, the local distribution portion is almost 50% of the total investment in outside plant.[6] This seems curious since telcos have such a large investment in

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[6] Due to differences in cable and telco terminology it is difficult to make such comparisons. However, the customer drop portion of local distribution is clear in both cases. How one views the "feeder" portion of cable distribution plant which is all shared (non-dedicated) matters in such calculations. Assuming a cable architecture like the one shown in Figure 3.6, we estimate the sum of "feeder" and drop portions to be in the area of 50% of the total investment.

TABLE 3.1

LOCAL TELCO FINANCIAL DATA ($M)

	Annual Revenues	Operating Cash Flow	Net Income	Deprec. Expense	Capital Expends.	Debt Ratio (%)	Access Lines (M)
1986	87779	26980	10071	15396	21035	41.43	119360
1987	91593	26920	10085	17806	20311	41.73	123257
1988	96668	28039	10449	18767	20806	41.00	127624

Source: Company reports.

TABLE 3.2

LOCAL TELCO INVESTMENT ($M)

	GPIS	NPIS	DR(%)	DE(%)	RETS	ADDS
1986	213206	155658	26.99	7.22	7659	21035
1987	222402	159812	28.14	8.01	8538	20311
1988	232604	161197	30.70	8.00	8559	20806

GPIS: Gross Plant in Service
NPIS: Net Plant in Service
DR: Depreciation Reserve/GPIS
DE: Depreciation Expense/GPIS
RETS: Plant Retirements
ADDS: Plant Additions

Source: Company reports.

Table 3.3

CABLE FINANCIAL DATA ($M)

	Annual Revenues	Operating Cash Flow	Net Income	Deprec. Expense	Capital Expends.	Debt Ratio (%)	Subs (M)
1986	8528	3418	1046	1979	3439	72.33	41
1987	9847	4262	123	2202	3215	71.83	43
1988	12126	5491	172	2839	4046	72.45	47

Source: Company Reports, Paul Kagan Associates.

Table 3.4

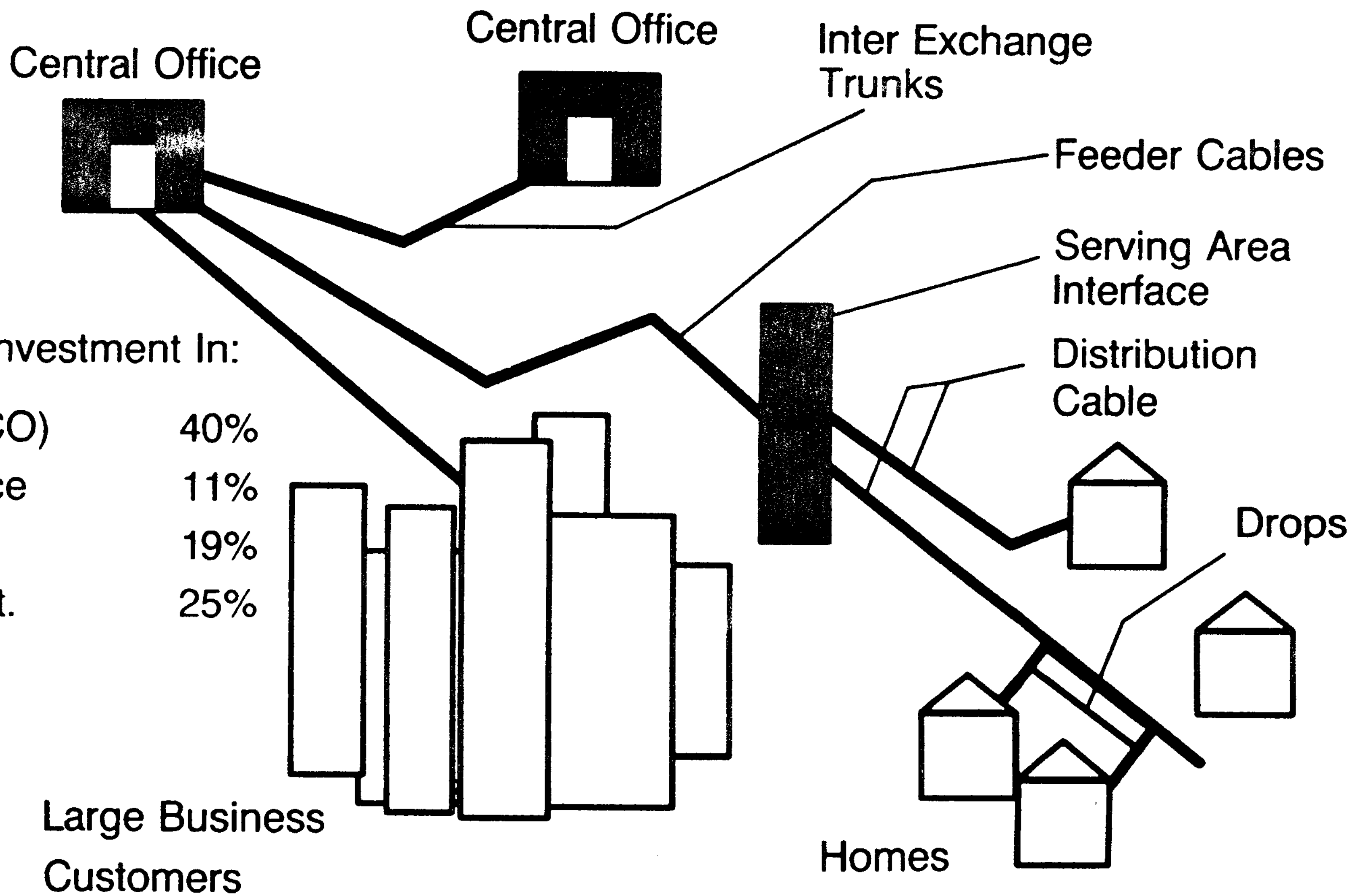
CABLE INVESTMENT ($M)

	GPIS	NPIS	DR(%)	DE(%)	RETS	ADDS
1986	17097	13735	19	11.6	971	3439
1987	19221	14759	23	11.5	510	3215
1988	21872	16408	25	13.0	485	4046

GPIS: Gross Plant in Service
NPIS: Net Plant in Service
DR: Depreciation Reserve/GPIS
DE: Depreciation Expense/GPIS
RETS: Plant Retirements
ADDS: Plant Additions

Source: Company Reports, Paul Kagan Associates.

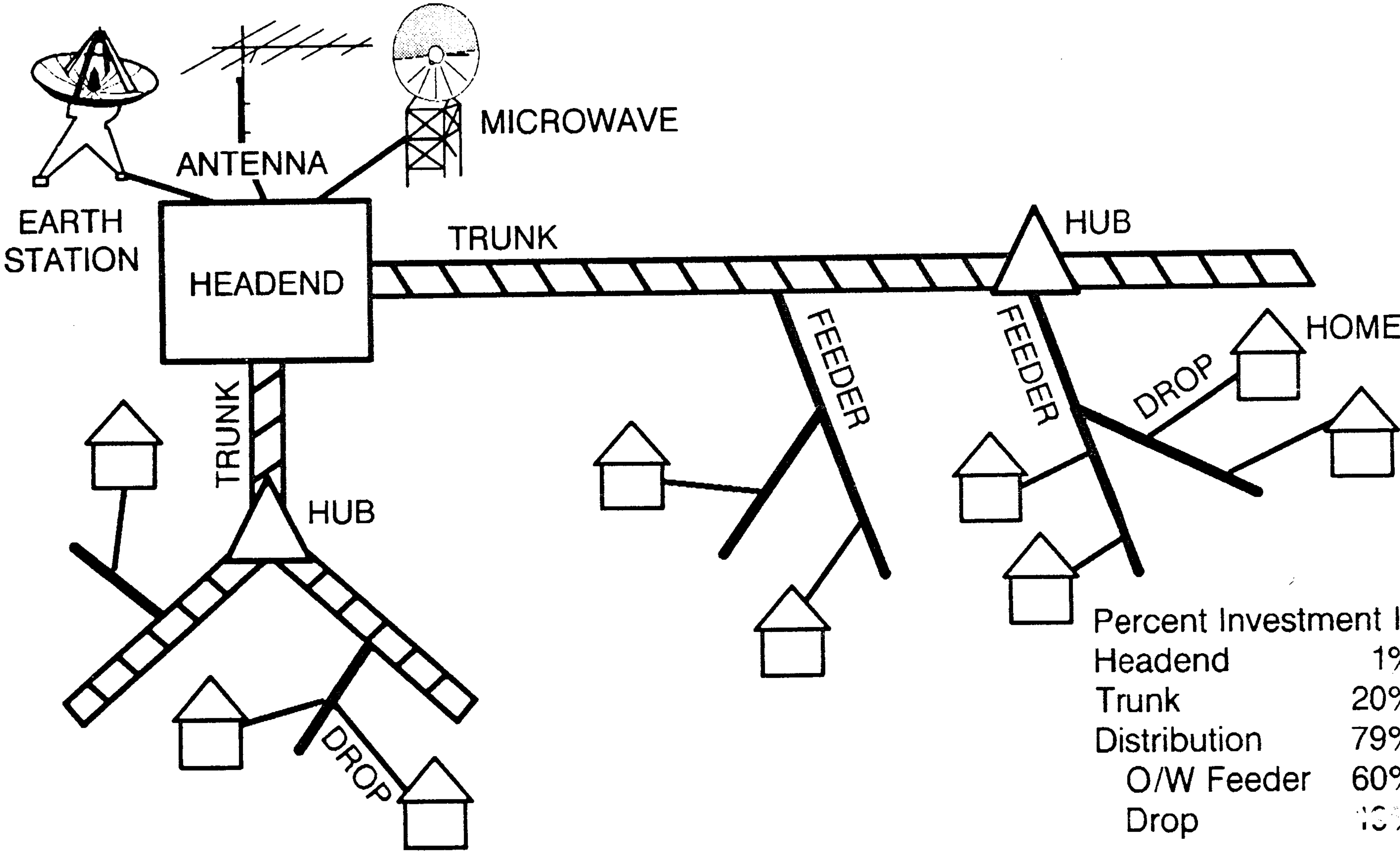
Telephone Network



Percent Investment In:

Switch (CO)	40%
Inter Office	11%
Feeder	19%
Local Dist.	25%

Cable Network System

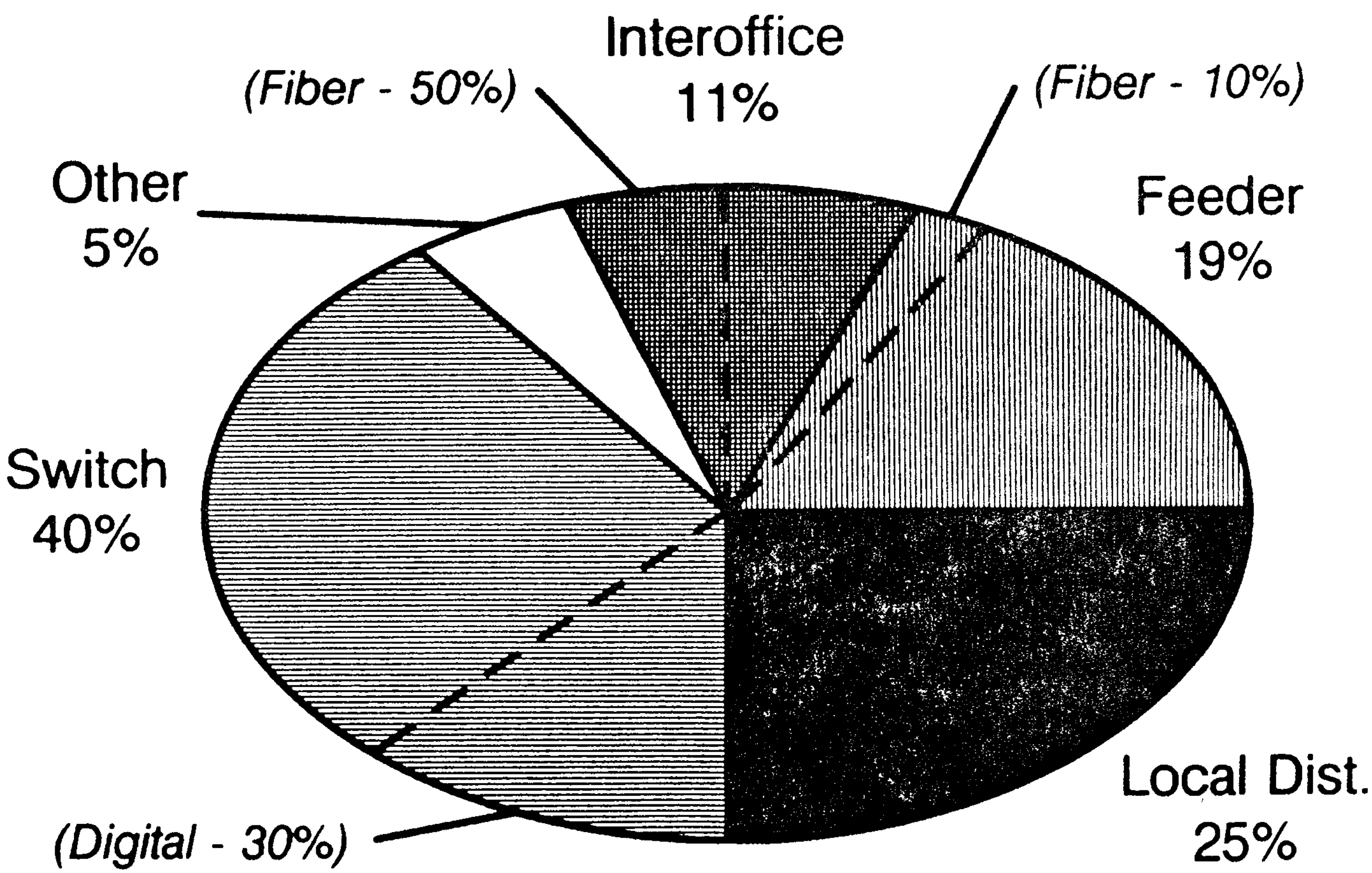


Percent Investment In:

Headend	1%
Trunk	20%
Distribution	79%
O/W Feeder	60%
Drop	1[illegible]%

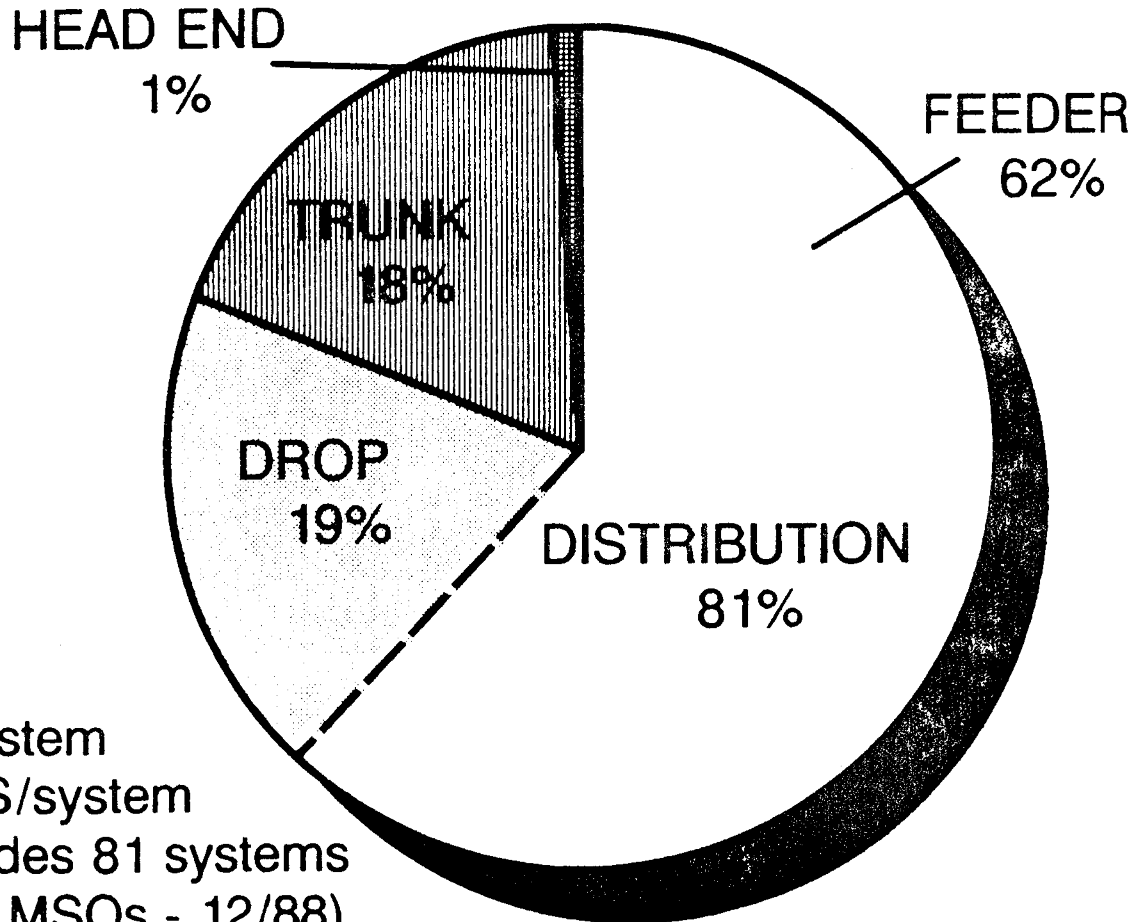
Telephone Investment

Total Telephone Plant In Service



Cable Plant In Service

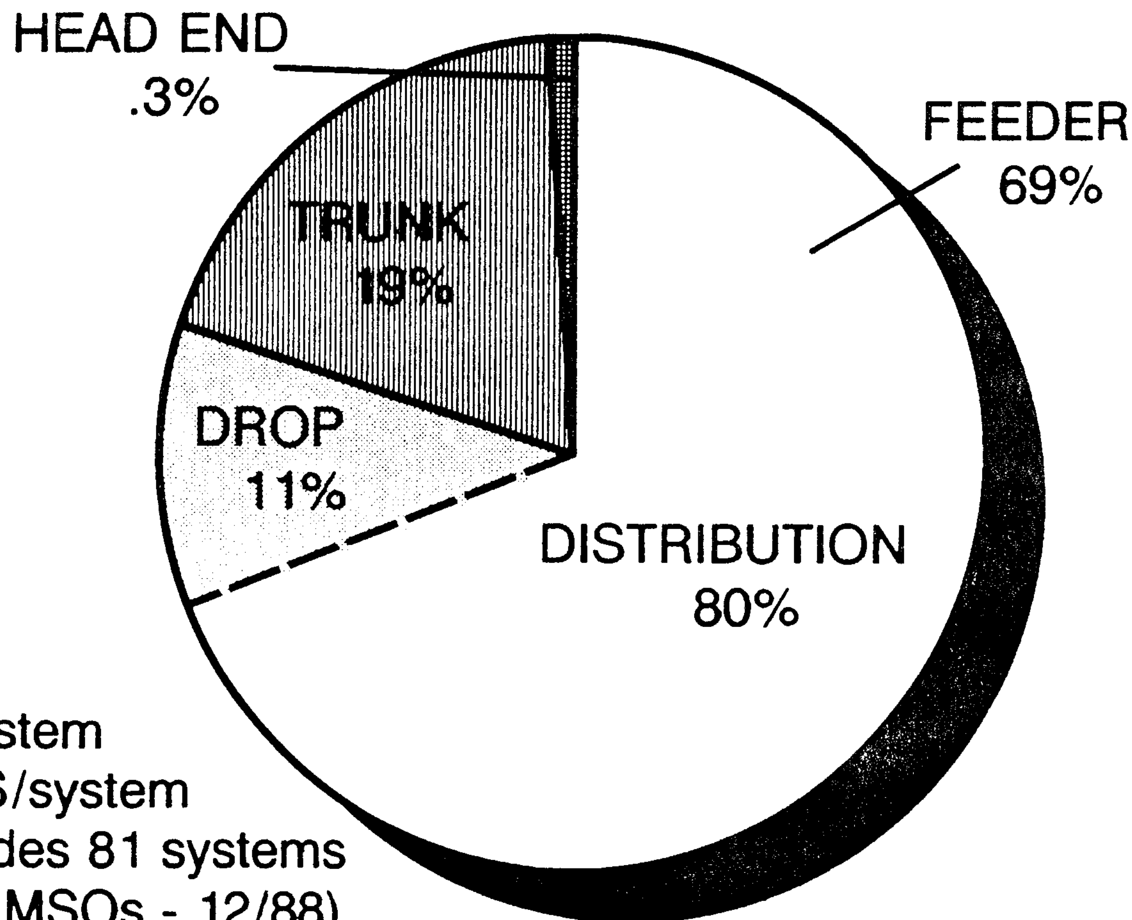
Aerial Plant



Notes:
* 1750 miles/system
* 107,020 SUBS/system
  (Sample includes 81 systems of 100 largest MSOs - 12/88)
* Labor costs included

Cable Plant In Service

Underground Plant



Notes:
* 1750 miles/system
* 107,020 SUBS/system
  (Sample includes 81 systems of 100 largest MSOs - 12/88)
* Labor costs included

switching and interoffice plant. However cable too has a relatively large investment in its shared trunk plant. It is significant, however, that telco embedded per/subscriber plant costs in 1989 were about four times that for cable ($1800 v. $450). If the shared interoffice and switching plant is excluded, telco subscriber loop costs are double that for cable ($900 v. $450).[7] Cable companies have no interoffice plant per se since intercity or intersystem links are not yet common.

Telco composite depreciation rates are about 8% with a depreciation reserve of 31% which gives a net plant cost of about $1,200 per subscriber line, or about $600 investment per local loop. Cable depreciation rates are about 10% with a depreciation reserve of 25% giving a net plant cost of about $350 per subscriber.

Even though cable industry revenues in 1988 were only $12B compared to $97B for telcos, cash flow ($5B) was about 45% of revenues, which was much higher than telcos at 30%. Thus, cable operating margins are much higher. This is partially reflected in the bidding-up of cable company values to three to four times book cost per subscriber and inflated stock prices, which directly result from high cash flow projections. Telcos are also valued high relative to book cost. However, while telcos are profitable in terms of net income, cable as a whole is marginal. Interestingly, the very high debt ratio of cable companies (about

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[7] The feeder portion of modern telco loop plant is shared among many subscribers just as it always has been for cable.

72% on average) is nearly twice that of telcos (about 41% on average). Such ratios are misleading, in fact; cable debt per subscriber, at $630, is almost double its net book investment, $349. This is in stark contrast to telco per subscriber debt which is only about 40% of net book investment.

All of these financial data have important implications for fiber technology adoption. First and foremost is that the cable industry certainly seems in a position to cost effectively adopt new technology to enhance existing one-way broadband networks. However, their highly leveraged capital structure is not at all conducive to this. During the 1980s, it became fashionable for financiers to take cable firms private and then siphon off available cash flow to pay the large increases in debt which reflect market value, not book cost. But it is not the high debt ratio alone which causes this; the absence of real competitive pressure from telcos or others is also to blame. Of course, whenever significant profit opportunities exist in an industry, capital for technology deployment will flow into it, regardless of the financial structure of incumbent firms. In the cable industry, the local monopoly position of the incumbent and various entry barriers act as investment disincentives for potential entrants who cannot garner a significant share of existing monopoly profits.[8]

Even though telcos also have high cash flow, they do not

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[8] For a discussion of how the monopoly position of incumbent firms comes about and is maintained see Thomas Hazlett, "Duopolistic Competition In CATV: Implications for Public Policy," Yale Journal Of Regulation, Vol.7 No.1, Winter, 1990.

face the threat of leveraging by outsiders and therefore have a capital structure and regulatory situation much more conducive to technology adoption, even when short-run revenue opportunities are not present. This is largely due to rate-base regulations which allow telcos a reasonable return on capital investments.[9]

Of course, the current financial picture is only part of the story; the prospective cost of deploying residential broadband networks is equally important.[10]

4.0 Cost of Technology Adoption

There are two convenient categories for describing residential broadband network costs; fiber-to-the-home and hybrid fiber/metallic configurations. The most advanced broadband networks feature two-way, on-demand, fiber-to-the-home communications with high deployment costs of $2,500-$15,000 per subscriber.[11] Even though telcos have a significant switching capacity problem relative to cable, technology is moving forward to reduce network switching node costs significantly. Cable

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[9] See Egan and Taylor, 1989a, supra. Even though there is no law against telco leveraged buyouts, so far no outsider has been willing to test these waters. For an amusing example of what one raider may have to do to complete an LBO, see "Which RBOC will Donald Trump Buy?" Teleconnect, December 1988, pp. 30-31.

[10] Future demand is also very important but is beyond the narrow scope of this paper. Other authors have examined demand and universally conclude that there is no significant new revenue streams available to cover the full costs of fiber-to-the-home. For some examples, see Egan and Taylor, 1989a, supra, and Allen Richard Frechter, Telecalc: A Telecommunications Demand Forecasting System with a Study of the Market for Residential Broadband ISDN, M.I.T., Sloan School of Management, Unpublished thesis, June 1987.

[11] Egan and Taylor, 1989a, supra. See also, National Cable Television Association, Research & Policy Analysis Department, The Cost of Telephone Company Installation of Fiber to the Home. Washington, D.C., July, 1989 and "Wiring U.S. with Fiber Optics May Cost Telcos $450B-$900B", NCTA, MultiChannel News. June 26, 1989, p. 1, 33. Also see Robert K. Yates, Nolwen Mahe and Jerome Masson, Fiber Optics in Cable Television: A Planning Guide, DTI Telecom, Inc., August 1989, at 3.3.

companies could continue to avoid local switching costs with the high capacity of fiber-to-the-home but the cost of electronics at or near the subscriber premises for real-time two-way addressable service remains very high.[12] At such high per-subscriber costs, the cable industry financial structure and cash flow could not support an aggressive fiber-to-the-home construction program. There is simply no business case for it in Net Present Value (NPV) terms until a very substantial increase in customer demand occurs for real-time two-way and interactive broadband services.

In contrast, telcos could support an aggressive fiber-to-the-home strategy due to their favorable capital structure and cash flow from regulated operations.[13] This raises some difficult public policy issues regarding the funding of digital and fiber optic technology adoption. For instance, in a rate-base regulated environment all existing subscribers must share the costs of network upgrades and improvements, but not all may use them.[14]

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[12] M.I. Eiger, H.L. Lemberg, K.W. Lu, S.S. Wagner, "Cost Analysis of Emerging Broadband Fiber Loop Architectures" IEEE 5.5.4, 1989. See also Marvin Sirbu, Frank Ferrante, and David Reed. "An Engineering and Policy Analysis of Fiber Introduction Into The Residential Subscriber Loop," Center for Telecommunications and Information Studies Working Paper #289, Graduate School of Business, Columbia University, 1988.

[13] See Egan and Taylor, 1989a, supra. and Egan, 1989b, supra.

[14] See Egan, 1989b, supra and David Gabel, "Technological Change, Contracting and the First Divestiture of AT&T," Center for Telecommunications and Information Studies Working Paper Series #329, Graduate School of Business, Columbia University, 1989.

4.1 Fiber Backbone Networks

The hybrid fiber/metallic network generally implies a fiber-optic backbone, or trunk, interconnected to telco twisted pair or coaxial cable for the last network segment. Both telcos and cable can deploy fiber backbones at a small fraction of the cost of fiber-to-the-home because fiber is exceptionally well suited for shared (non-dedicated) subscriber plant and will likely be preferred in trunk and feeder facilities based on cost savings alone.

Given the available data, either telcos or cable companies can upgrade the local distribution networks with a fiber optic backbone for about $100 per subscriber.[15] This, however, is where the good news ends for telcos. Even though cable or telco fiber backbone costs are about the same per residential subscriber, the difference in quality, reliability, and future functionality leaves no comparison between cable and telephone companies -- cable companies win hands down. A telco fiber backbone, while perhaps more reliable and of higher quality from a network engineering and maintenance perspective, holds virtually no service advantage for customers; subscribers still only get two-way narrowband telecommunications due to the limitation of the existing copper loops. Cable subscribers, on the other hand, realize substantial benefits as fiber backbones can enhance

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[15] See Yates, Mahe, and Masson, 1989, supra.; Claude T. Baggett, "Cost Factors Relative To The Fiberoptic Backbone System," NCTA '88 Technical Papers, National Cable Television Association, Washington, D.C., 1988; Scott Esty, "Fiber Beats Copper in the Feeder Plant," Telephony, November 16, 1987.

picture quality, system reliability, overall system bandwidth (more available channels), and with minor added expense, system redundancy (alternate routing) and two-way narrowband possibilities.

In fact, many cable fiber backbone architectures effectively constitute a hub-and-spoke or star network configuration as opposed to a tree-and-branch, which is the weakest inherent feature of traditional cable networks. The standard cable architecture incorporates long cascades of amplifiers on coaxial cable which cause degradation of signal quality. Fiber effectively vitiates this problem and allows for future upgrades to two-way addressable and on-demand communications at a relatively low cost, though CPE may be quite expensive (but this is also the case for telcos).

Table 4.11 provides a survey of cable hybrid system costs featuring fiber backbones. Figure 4.12 provides an example of the hybrid cable network. Notice that a cable fiber backbone can fundamentally alter the traditional coaxial cable network architecture, making possible, for the first time, headend signal variation, redundancy, and back-up. This occurs primarily through the use of multiple lasers at the headend and dedicated fiber trunk-to-hub circuits with possibilities for fiber hub interconnection. Figure 4.13 shows two possibilities for laser signal transmission from cable headends through the use of multiple lasers or optical splitters. These are two possibilities for providing multiple originating signals for programming rather

Table 4.11

Fiber Optic Cost Estimates
for Cable Television *

Study & Yr	Cost/ Sub ($)	Cost/ mile ($)	Trunk/ mile ($)	E/mile ($)	Trunk/ Total (%)	E/Total (%)	Trunk/ Sub ($)	E/Sub ($)
ATC-88	36	7080	3566	3514	50.3	49.6	18.1	17.9
Jones-89	250	11838	NA	NA	NA	NA	NA	NA
Rogers Toronto -90	160	63303	19747	43557	31	69	NA	NA
Reed & Sirbu-89	886	88600	8200	80400	9	91	82	804

E = Electronics

Notes:

1. Baggett, Claude T. "Cost Factors Relative to the Fiberoptic Backbone System" NCTA '88 Technical Papers, National Cable Television Association, Washington, D.C., 1988.
   ATC considers several system configurations: 2 amp cascades; 3 amp cascades; and 4 amp cascades. The 4 amp cascade was chosen as the most cost efficient for a fiber backbone scenario. This system covers 375 miles of plant with 10,000 subs. 51 miles of fiber are to be installed as backbone.

2. Swasey, Laurence "Jones Switches on First Leg of Augusta Fiber Plant" Multichannel News, at 32 and 34, June 26, 1989.
   The Jones system uses a fiber backbone to serve 59,879 subs over 1267 total miles of plant. The coax system is left operational to serve as a redundant network.

3. Rogers Engineering, Don Mills, Ontario, Canada. Company data, 1990.
   Rogers system uses a primary and secondary hub configuration with optical bridgers connecting to coaxial drops. 89 miles of fiber are to be installed over a system incorporating a total of 1,444 miles. The system serves 394,712 subscribers at a rate of 273 subscribers per mile in this urban system. The average cost per subscriber is estimated in Gary Kim, "Rogers Architecture: A Step into the Future," MultiChannel News, June 26, 1989, p. 32.

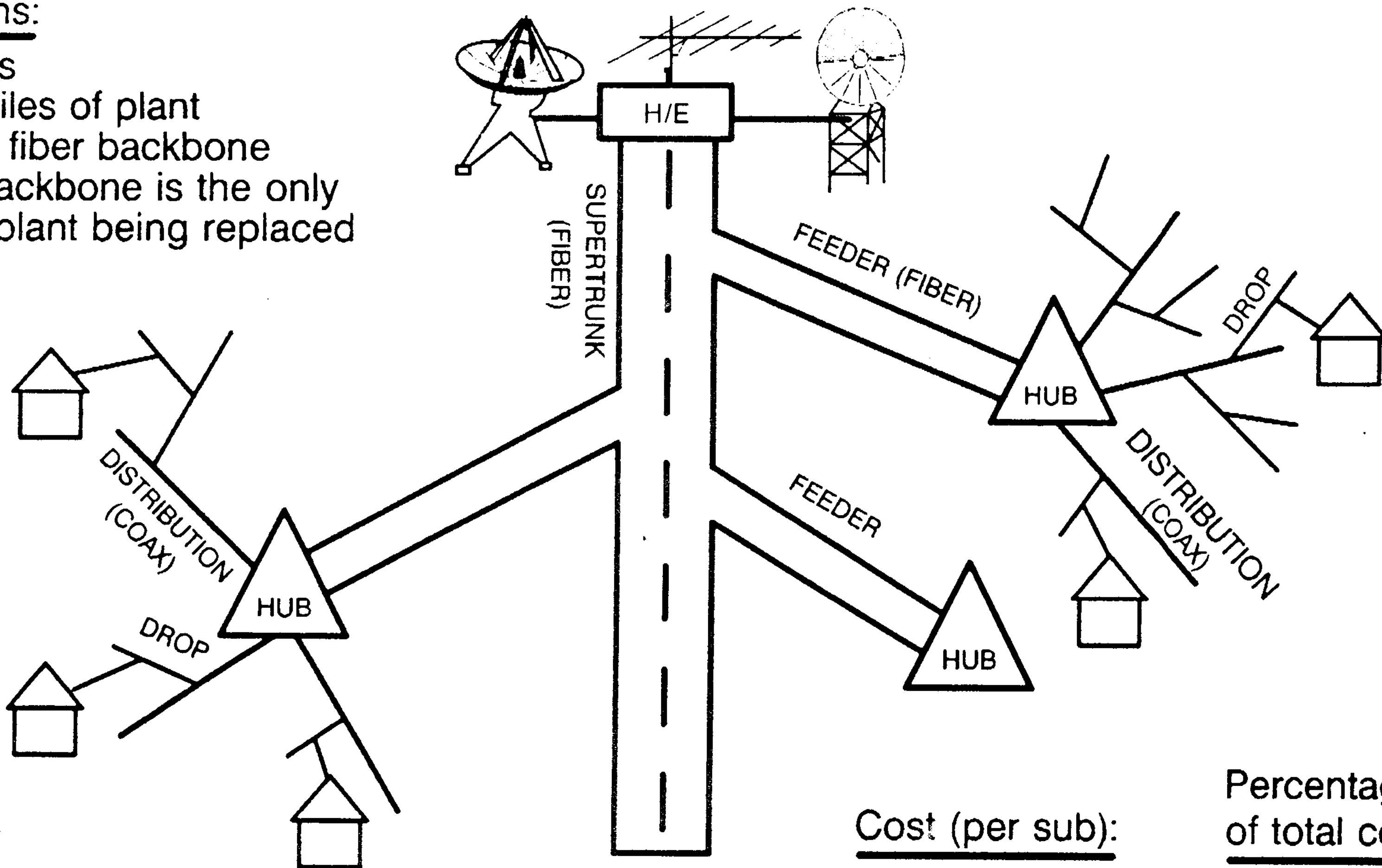
4. Reed, David p. and Sirbu, Marvin A. "A Cost Analysis Of A Fiber Upgrade For A Coaxial Network to Support On-Demand Video" Department of Engineering and Public Policy, Carnegie Mellon University, January 1989.
   The Reed/Sirbu study focuses on an On-Demand Video (ODV) system. Several systems are considered: SCM; PCM/TDM STS-12; and PCM/TDM STS-48. The authors conclude that the STS-48 configuration is superior. The trunk is the only part of the system to be upgraded. The authors assume 734 total miles of cable, 100 homes per mile, 25,600 subs and 60% penetration.

* Many of these estimates are not directly comparable due to differing assumptions in each study, especially regarding subscriber density. For example, the Jones Cable system cost would be substantially less per subscriber assuming densities used in the other systems.

*Hybrid Coax/Fiber System**

Assumptions:

10,000 subs
375 total miles of plant
51 miles of fiber backbone
The fiber backbone is the only part of the plant being replaced

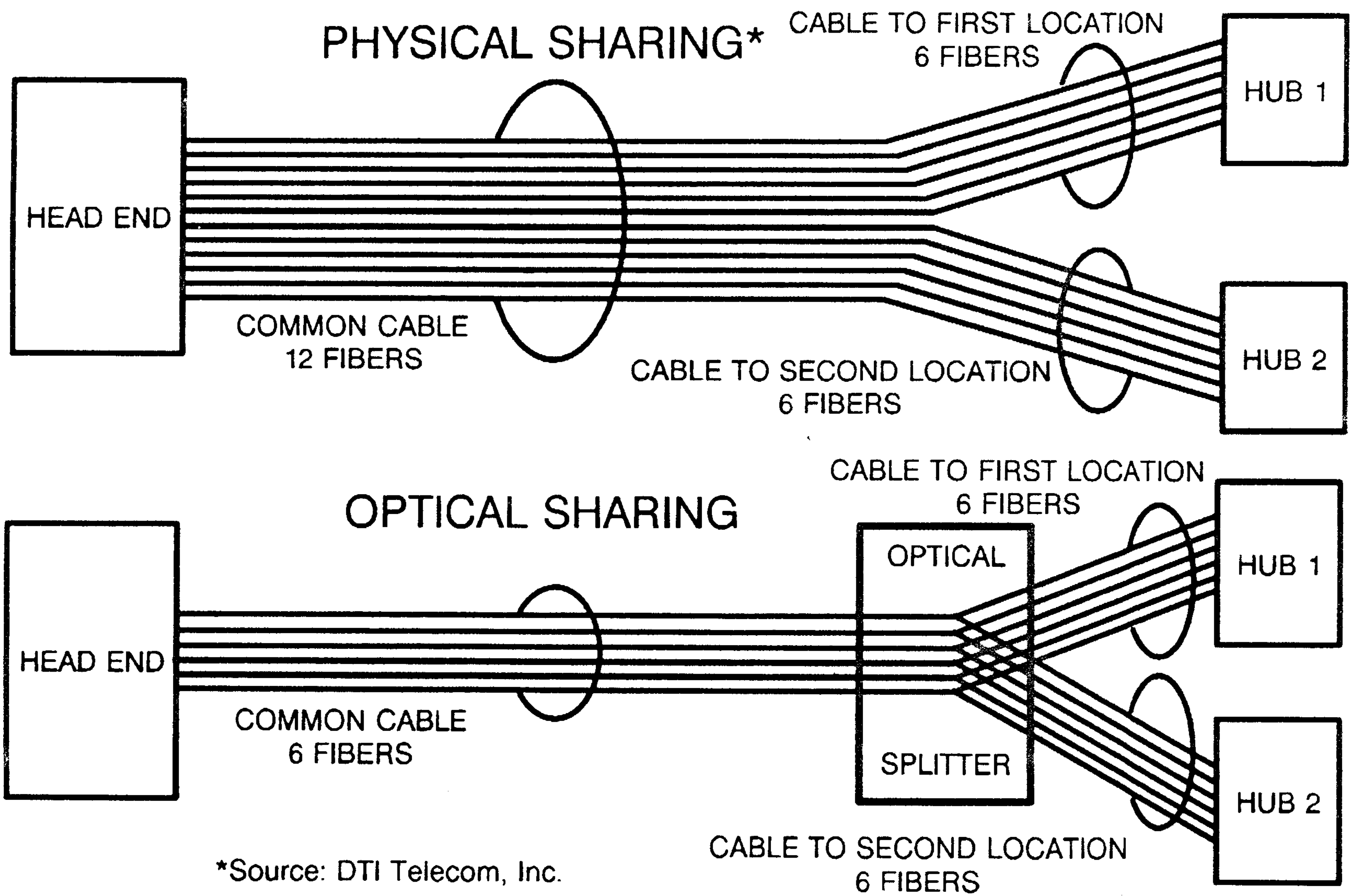


*Based on ATC

Cost (per sub):	
Electronics	$17.9
Fiber Trunk	$18.1
Total	$36

Percentages of total cost:	
Electrontics	49.6%
Fiber Trunk	50.3%

Fiber In The Cable Trunk Network



*Source: DTI Telecom, Inc.

than only one as in traditional configurations. Thus, a major advantage of a fiber upgrade is the reduction in the number of amplifiers in cascade, thereby increasing channel capacity, enhancing signal quality and reducing maintenance costs; additional benefits include system redundancy, improved reliability, increased bandwidth channeling for future upstream signaling, and the potential for private (addressable) and two-way point-to-point communications.

Telco fiber backbones are less interesting from a customer perspective since the service capabilities of copper loops are not perceptibly enhanced for residential customers. Thus, the primary motivation for telco fiber backbone deployment is the cost efficiency of high density, shared plant. Basically, telco fiber backbones replace non-fiber trunk and feeder plant (see Figure 3.5).[16]

Perhaps the most significant result of telco deployment of fiber backbones is that cable may be able to efficiently interconnect to it from head-end or fiber-hub points in order to achieve intercity 2-way switched and point-to-point service. This situation is intuitively appealing since the relative strengths of both telcos, with high bandwidth interoffice and intercity facilities, and cable, with high bandwidth local distribution facilities, may be combined for the benefit of residential subscribers. Perhaps new Open Network Architecture (ONA) rules at the state and federal levels will stimulate this development.

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[16] See Esty, 1987, supra.

5.0 The Canadian Cable Industry

On most counts, the development of cable television in Canada has had many similarities to that of the U.S. However, recent developments by Rogers Communications, an integrated communications company with assets totalling nearly two billion dollars[17], have seemingly pushed the development of Canadian cable broadband communications beyond that of the United States -- a position that may be maintained well to the end of this century. Rogers' vision is to interconnect local broadband cable communications with other narrowband telecommunications on both the local and national levels.

In addition to cable television, other divisions of Rogers Communications provide cellular and long distance telecommunications services. Currently, their cable operations serve some 1.5 million subscribers. Cantel, Rogers' mobile communications division, provides 157,000 subscribers with services ranging from cellular telephone service to paging and voice mail. Roger's system is quite advanced, providing "seamless" cellular telephone service anywhere across Canada, as long as customers are in an area served by cellular. Rogers also holds a major interest in CNCP, a national telecommunications provider. Currently CNCP only provides for data and private line voice networks, however in 1989, CNCP applied for permission to enter the long-distance telephone market, and it is anticipated

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[17] Source: Rogers Communication, 1989 Annual Report.

that permission will be granted.[18]

The integration of these three major enterprises provides an extraordinary potential for bypass of traditional telecommunications service providers. For instance, the fiber supertrunk which interconnects cable hubs also contains fiber circuits which support cellular telephone system interconnection. In addition to the obvious efficiencies from shared cable facilities, the potential integration of all these services raises possibilities for the provision of new broadband services.[19]

A closer look at the Rogers advanced cable system installed in Toronto and elsewhere provides an interesting example of a fiber/coax hybrid network. As shown in Figure 5.1, the structure has three levels. The first, consisting of a fiber backbone feed, carries downstream video signals from the cable headend to primary hub sites.

At the second level, each primary hub is connected, via a fiber supertrunk, to secondary hubs. These hubs are interconnected, providing redundancy in the event of node failure.

The third tier of this system consists of a hybrid fiber/coax network which is divided into areas serving about 10,000 homes with cascades requiring 10 or fewer amplifiers. This

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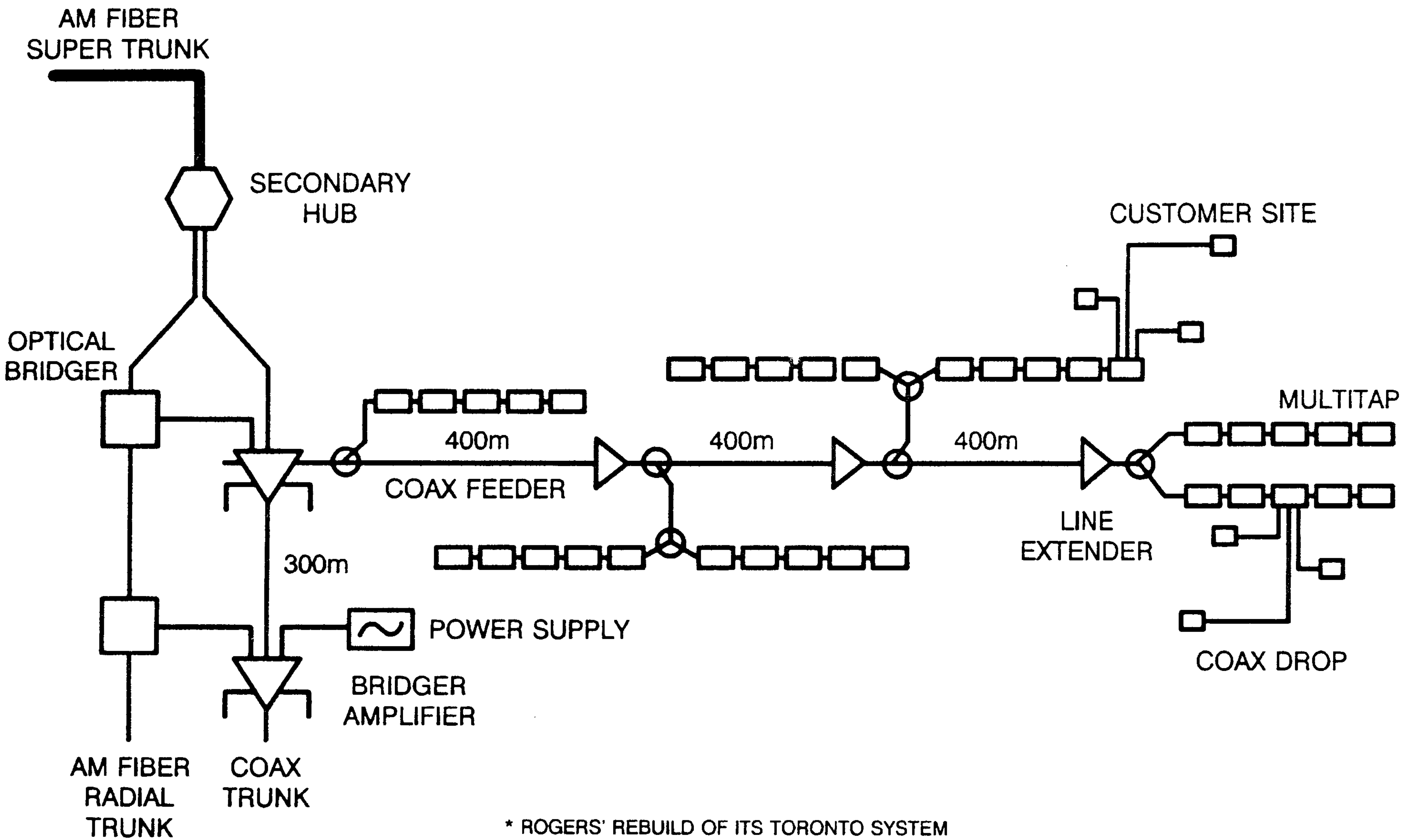
[18] Fleming Meeks, "This Will Be a Very Political Issue," Forbes Magazine, February 19, 1990, pp. 80-86.

[19] George Hart and Nick Hamilton-Piercy, A Broadband Urban Hybrid Coaxial Fiber Telecommunications Network, Rogers Engineering, March, 1989.

Hybrid Fiber/Coax Topology*



* ROGERS' REBUILD OF ITS TORONTO SYSTEM

distribution system, which accounts for 70% of total plant miles, is capable of transmitting at 1000MHz. Although transmission will initially be at 550MHz, installing capacity for 1000MHz will avoid the cost of rebuilding when transmission capability expands. Optical bridgers, interfacing fiber and coax, will extend the fiber network past the secondary hubs to the coaxial cable network which feeds about 200 homes.

Though Rogers' system in Canada provides but one example of an advanced architecture for the cable industry, the other systems surveyed in Table 4.11 possess similar attributes. Opportunities for the use of such hybrid networks to support new bypass services by interconnecting with local cellular and toll carriers are just beginning to be explored.

Due to the institutional environment, U.S. cable MSOs have not invested very much in telecommunications services and facilities relative to Rogers in Canada. Because of this, the synergies between video distribution and telecommunications services over upgraded cable broadband networks are not obvious in the US; but as changes occur in the US legal and regulatory environment, the Rogers example may be indicative of future trends.

6.0 Financing Residential Broadband Networks

In the final analysis, the critical business and public policy issue is how to finance the adoption of fiber technology to enhance the value of public communications networks in the

U.S. Since near-term possibilities for iber-to-the-home are financially infeasible based on a NPV analysis, should we: 1) wait for technology and revenue opportunities to develop sufficiently for private sector deployment; or 2) proactively push the technology through investment incentives such as tax breaks or credits; or 3) finance it from rate-base regulated telco operations?[20]

Or is the alternative examined herein reasonable? The deployment of cable fiber backbones, which seem to meet the NPV test, may provide the "right" amount of residential broadband communications services, especially if it is interconnected to the fiber backbone telco network. This scenario is the case of fiber-near-the-home. There are other possibilities as well.[21]

Based on the available data and barring government subsidy, it appears that the most timely and cost-efficient means of delivering interactive broadband communications to residential subscribers lies in cable hybrid networks with telco interconnection. Even though there has been little planning on how to efficiently interconnect the telco and cable facilities, this scenario certainly seems to incorporate the best of both worlds. It minimizes the incremental investment required to achieve advanced functionality for current residential broadband networks while setting the stage for futuristic, full-scale,

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[20] An extensive policy discussion of this issue is in Egan, 1989b, supra.

[21] See, for example, David Large, "The Star-bus Network: Fiber Optics to the Home," CED Magazine, January, 1989, pp. 64 - 73, and Dean Bogert, "AM Lightwave Transmission," CED Magazine, September, 1989, pp. 38-41.

real-time, two-way interactive communications. It is important to note, from a public policy perspective, that this interconnection does not necessarily imply merging two local monopolies into one.[22]

Unfortunately, the cable industry is not likely to aggressively pursue fiber backbones or telco interconnection for provision of 2-way residential communications as long as they remain effective local monopolies. The imperative to innovate and adopt technology is simply not present without a serious competitive threat, especially when their financial structure is heavily leveraged and cash flows are capitalized as monopoly rents for current shareholders as opposed to being invested in the cable network.

Even though fiber-to-the-home is a very expensive proposition, one recent study has shown that if telcos were willing and allowed to change their capital structure to become leveraged to the extent of the cable industry, they could finance widespread deployment of basic fiber-to-the-home without significant increases in subscriber rates.[23] This reveals the stark contrast between the use of leverage to pay inflated short-run shareholder values versus long-term innovation and investment.

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[22] See Egan, 1988, supra, pp. 70-71. Egan points out that rather than create a monopoly, this situation should result in "cooperative competition," in Egan, 1989b, supra.

[23] Egan and Taylor, 1989a, supra.

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Bruce L. Egan

and

Douglas A. Conn *

* Bruce L. Egan is Special Consultant and Affiliated Research Fellow and Douglas A. Conn is Associate Director, Center for Telecommunications and Information Studies, Graduate School of Business, Columbia University. Research Assistance was provided by Richard E. Nohe, Pierrette Pillone and Yong C. Liu. The views expressed herein are solely those of the authors.