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National Cable Television Association

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December 10, 1998

EX PARTE

#98-178

Ms. Magalie R. Salas
Secretary
Federal Communications Commission
445 12th Street, S.W.
TW-A325
Washington, DC 20554

RE: CC Docket No. 98-146

Dear Ms. Salas:

The National Cable Television Association ("NCTA") hereby submits the enclosed Report, "Cable Modems, Access and Investment Incentives," for inclusion in the docket in the above-captioned proceeding.

The Report was prepared by Bruce M. Owen, president of Economists Incorporated and visiting professor of economics at Stanford University, and Gregory L. Rosston, Lecturer in Economics and Public Policy at Stanford University and a Research Fellow at the Stanford Institute for Economic Policy Research.

In this Report, Mr. Owen and Mr. Rosston analyze the effects on investment incentives of the proposal that has been made by AOL, other ISPs and certain ILECs that cable operators be required to offer local cable modem transmission service as a separately priced component or option, rather than solely as part of a bundle of Internet access and content services. They conclude "*even the threat, much less the actuality, of government regulation, such as the mandatory unbundling proposed by AOL and others, will chill the appetites of investors and reduce the pace of telecommunications infrastructure construction.* This will produce the opposite of what Congress intended in enacting Section 706."

If you have any questions concerning this matter, please contact the undersigned.

Sincerely,

Daniel L. Brenner

No. of Copies rec'd_____
List A B C D E

cc: Chairman William E. Kennard
Commissioner Susan Ness
Commissioner Gloria Tristani
Commissioner Michael K. Powell
Commissioner Harold W. Furchtgott-Roth
Deborah Lathen, Esq., Chief, Cable Services Bureau
Dr. Robert Pepper, Chief, Office of Plans and Policy

CC 98-146 (1)

Cable Modems, Access and Investment Incentives

by

Bruce M. Owen

Gregory L. Rosston

December 1998

Bruce M. Owen is president of Economists Incorporated and visiting professor of economics at Stanford in Washington. He was formerly chief economist of the Antitrust Division of the U.S. Dept. of Justice and earlier of the White House Office of Telecommunications Policy. He is the author of The Internet Challenge to Television (Harvard Univ. Press, 1999) among other works on telecommunications.

Gregory L. Rosston is Lecturer in Economics and Public Policy at Stanford University and a Research Fellow at the Stanford Institute for Economic Policy Research. He served as Deputy Chief Economist of the Federal Communications Commission and is the author of several articles and co-editor of two books on telecommunications policy.

Executive Summary

This paper analyses the effects on investment incentives of the proposal that has been made by AOL, other ISPs and certain ILECs that cable operators be required to offer local cable modem transmission service as a separately priced component or option, rather than solely as part of a bundle of Internet access and content services. Such a limitation on the strategic business options reduces the risk-adjusted expected return on investment in cable infrastructure. As a result, other things equal, there will be less investment in cable infrastructure. Some investments will not be made and others will be postponed, delaying or denying the availability of broadband service to certain consumers. This is true whether or not cable systems have market power in the relevant market that includes cable modem services.

Having the sole right to capture the benefit of their investments in broadband transmission facilities is likely to provide cable operators with increased incentives to invest for the same reasons that motivate the patent system. The most effective way to take advantage of such rights may be to offer an attractive bundled package of services, without which there would be less, or no, demand for cable modems. This is especially likely to be true during the initial or startup phase of the diffusion of cable modems. Given that cable operators offer such bundled services, an obligation to offer components at presumably lower (and, inevitably, regulated) prices creates incentives on the part of others to free ride and reduces the return that the cable operator can earn on its considerable investment in a modern digital cable system.

The business strategies described here are commonplace. They have untoward consequences only when market power is present, and not always then. It is unreasonable to suppose that cable operators have market power with respect to a service that so far has hardly any customers, and for which telephone companies and others offer competing services. Here, the chief business strategy designed to deal with the risk that extremely expensive investments in local HFC networks will go unused is the offering of an exclusive bundle of services designed to be more attractive to consumers than analog modems, ISDN, xDSL, DirecPC, Teledesic and so on. Forced unbundling works to block this strategy.

High speed local transmission service is expensive, risky and may require significant complementary investments. @Home and Road Runner provide Internet access and other services tailored to the cable modem environment. There is significant risk for both cable operators and ISPs dedicated to the cable environment. As a result, both benefit from an integrated, bundled offering that allows them to invest in their service with the knowledge that the necessary complementary assets will be available to consumers.

At the end of the day, what our analysis comes down to is the simple and not very controversial proposition that *even the threat, much the less the actuality, of government regulation, such as the mandatory unbundling proposed by AOL and others, will chill the appetites of investors and reduce the pace of telecommunications infrastructure construction.* This will produce the opposite of what Congress intended in enacting Section 706. At the same time it will, of course, advance the economic interests of those who compete with the cable firms to be regulated, in this case the integrated Internet services such as AOL whose business strategies most closely resemble the characteristics of

integrated cable modem services, as well as other ISPs and ILECs who are beginning to offer broadband local transmission services of their own.

In brief summary, our major points are these:

- Exclusivity is, generally, an important component of the value of property. The incentive to invest in new capital assets is reduced if their owners are denied this right.

- At this very early stage of the development of broadband local transmission systems, capital investment is very risky, especially with respect to consumer acceptance. Successful consumer marketing is key.

- An exclusive, integrated package of broadband transmission and access that is attractive to consumers is one way for cable operators to reduce the risk that consumers may not accept this new service in sufficient numbers to ensure its viability.

- Exclusivity and bundling of components are common, effective, and pro-competitive business strategies. Such strategies raise competition policy concerns only in the presence of market power, and not always then. It is absurd to argue that cable operators have market power in this brand new service with competitive alternatives.

- For regulators to require cable investors to give up their exclusive property rights through forced unbundling is a remedy appropriate only in the most extreme instances of essential facilities or bottleneck monopolies. Even there, it has long been recognized that requiring access to essential facilities can create perverse incentives, including the incentive to invest less than optimally in the bottleneck facilities.

- If cable operators are foreclosed from the option of offering an exclusive, integrated package of cable modem-related services, the following adverse effects become more likely. Mere increased likelihood of such negative effects is sufficient to reduce the risk-adjusted rate of return to investment in broadband cable facilities and reduce investment.

  - Increased free riding and opportunistic behavior by others on the investment efforts of the cable operator—especially likely given the shared resource nature of HFC local cable networks.

  - Loss of economies of scale in local transmission service resulting from inadequate marketing efforts due to the high fixed cost nature of HFC plants.

  - Confusion of responsibility for service quality, leading both to free riding and to reduced consumer demand for service.

  - Adverse effects on the reputation of the cable operator's transmission service due to inadequate service quality offerings by ISPs and by Internet content suppliers.

  - A downward spiral into increasingly onerous regulation, as enforcement of an unbundling requirement leads inevitably to calls for rate regulation.

Introduction

We have been asked by the National Cable Television Association (NCTA) to examine the effect on incentives to invest in telecommunications infrastructure of the proposal by AOL and others to use regulation to force cable operators to "unbundle" high speed local Internet transmission service from upstream services such as those currently offered by Internet Service Providers (ISPs). The incentives question arises because Section 706(b) of the 1996 Telecommunications Act calls for the Commission to take actions to remove barriers to infrastructure investment.

Section 706(b) also calls for the Commission to promote competition. We strongly believe that it is absurd to claim, as AOL and others have done in support of regulatory intervention, that cable systems have market power today with respect to any element of the vertical chain of services associated with cable modems[1] by means of a transmission product that has been offered in a few cities for two years or less.[2] Even if cable operators did have

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[1] *Definitions:* The vertical chain of services at issue here starts at the user's residence, where a "cable modem" is installed. The cable modem is connected to the cable operator's local headend facility by a high speed or broadband "last mile" or "local" digital transmission plant, generally hybrid fiber/cable. This facility delivers both one-way video and two-way data (and in some cases, voice) services. We are concerned in this paper solely with data service. We refer to it herein as local or last mile *transmission*. Other services relevant here include the *access* services provided by [Internet] access providers [ISPs], which may (like AOL) also provide a user interface (like a browser) and special *content*, supplementing the content on the Internet. An ISP that supplies content is sometimes called an OSP; we do not use the term. [Internet] access service, content, specialized interfaces, and consumer marketing services are referred to herein as "vertical" or "complementary" services with respect to local cable transmission. "Bundling" refers to a combination of cable modems, last mile transmission service, access, interface and content, all packaged together for sale to consumers.

[2] There were estimated to be around 300,000 cable modem subscribers in October 1998, out of approximately 50 million homes with PCs and approximately 67 million cable subscribers. As noted below, broadband last mile connections are just now being introduced by telephone companies, cable operators, wireless licensees and geosynchronous satellites, and will

such power, the proposed remedy would harm rather than promote competition.[3] However, our assignment here is to focus on the question of investment incentives. Our analysis of investment incentives is not changed by the assumption that cable operators have market power in the relevant market.

Cable operators have increased incentives to invest in Internet-capable system upgrades precisely because of their integration with and ability to offer exclusively[4] services like @Home and Road Runner, the most prominent of several cable-oriented Internet access and content suppliers. Integration helps nascent technology develop the necessary complementary services to stimulate demand and ensure quality. The @Home and Road Runner networks for example provide cable operators the necessary assurances that there will be high quality complementary services and that it will be worthwhile to spend the billions of dollars to upgrade their systems. Without integration and accompanying exclusivity, risk may increase and returns may

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in the future be offered by LEO satellite systems. Each of these new services must find ways to compete successfully with the slower but much less expensive analog modem and the subsidized conventional residential loop. In addition, broadband providers must compete with compression and storage technologies that substitute for bandwidth. Thus, it makes no sense to define a relevant market that includes just last mile transmission service offered by cable operators.

[3] See "Declaration of Professors J. A. Ordover and R. D. Willig," attached to "AT&T's and TCI's Joint Reply to Comments and Joint Opposition to Petitions to Deny or to Impose Conditions, CS Docket No. 98-178, November 13, 1998.

[4] The terms "unbundle" and "exclusive" are used herein somewhat more narrowly than is usual because they are directed at analysis of the particular proposal made by AOL and others. As we understand it, AOL does not object to cable operators' offering a bundle of services associated with cable modems. But AOL does ask the FCC to impose the condition that such cable operators offer pure local transmission service as a separate component, much as local ILECs are now required to do. As with ILECs, of course, such unbundling logically implies rate regulation. The term exclusivity arises because cable operators would lose the ability to control use of the transmission facilities in which they have invested, and would retain only nonexclusive rights to those assets. No one contends, however, that end users of cable modems would not in any case have access to the Internet or to content suppliers such as AOL.

be lower, leading to a reduction in the willingness to invest. We show that, because of the complexity of network arrangements, the argument that unbundling or nonexclusivity would have no effect on investment incentives, quality and consumer welfare is simply wrong. Investment would be lower with a rule that lowers returns and consumers would suffer from a reduction in quality or fewer options.

Background

In its seminal 1996 communications legislation, Congress sought among other things to encourage investment in telecommunications and information infrastructure. Many new telecommunications and information technologies are now being deployed by telephone companies, satellite systems, wireless operators and cable operators, among others, to supply high speed or broadband residential last-mile Internet transmission.[5]

Each of the new transmission products or services is in some respects unique, and most, such as cable modems, have been available to only a limited number of consumers, and only to them for about a year. During their short life spans, these services have gone through numerous changes required by developments in consumer demand and competitive offerings. In short, each of these offerings, including cable modems, is a highly risky investment whose ultimate success is very much in doubt. None comes near to qualifying as an "essential facility" or "bottleneck" (see pp. 14-15, *infra*.)The fu-

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[5] Residential Internet transmission today typically is by means of dial up connection using modems with maximum speeds of around 33 kilobits per second. "High speed" and "broadband" as used herein means anything significantly faster than current practice. The most common high speed residential connections available today are telco ISDN lines, which offer speeds up to 128 kilobits per second. Other high speed services are offered on an experimental or introductory basis by some cable operators, by at least one LMDS operator, and by the Hughes DirecPC satellite service. Bell Atlantic and other RBOCs are in the process of introducing ADSL service in certain areas. So-called "mega-LEOs" such as Teledesic plan to offer such service in future years.

ture may hold additional significant shifts or shortfalls in demand, technological alternatives or both. The risks from these possible future changes are real factors that firms consider in making their investment decisions because adverse changes reduce the return to investments, or are themselves the risks for which investors require compensation. Regulations that exacerbate these risks by limiting the upside potential returns to investments in upgraded cable plant will artificially reduce the incentive to invest.[6]

Cable Modem Business Strategies

It is worth looking in some detail at the "bundled" last mile transmission and access services at issue in this proceeding, and at the industry that supplies these services. Today, residential Internet local transmission service is provided by telcos, almost entirely with analog facilities. ISDN and xDSL services are also telco products. There are more than 4,000 ISPs who intermediate between telco facilities and the Internet backbones. Some ISPs are themselves integrated into backbone facilities, and others (such as AOL) operate or lease private networks or proprietary backbones that also interconnect with the Internet. Finally, some ISPs offer proprietary user interfaces and proprietary content. AOL is again an example.

There can be little doubt that the ISP Internet access industry is competitive in its structure, as are the industries that offer Internet backbone facilities and content. What is it that explains why, in spite of this ready competitive supply of services, some companies such as AOL offer "bundles" of content,

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[6] This paper is concerned solely with the issue of forced unbundling of cable operators' last mile transmission service for use with cable modems. However, as noted in footnote 1 *supra*, the same HFC cable plant also supplies other services whose economic success is no less important to cable investment incentives. We hold these other services and their circumstances constant for purposes of our analysis. Thus, a reduction in the expected return from cable modem-related services will reduce the incentive to invest in the common cable plant, holding constant the expected return from the remaining services.

interfaces, and transmission service, and why do they maintain exclusive control of these components? That is, why do we not require AOL, for example, to provide access to its proprietary content services to any content vendor that wishes to take advantage of the consequent ease of reaching AOL's 13,000,000 subscribers? (There is a nearly exact parallel between the issue of access to AOL's content and that of access to a cable operator's transport facility.) One answer is that offering such exclusive bundles was seen, particularly in the early days (five years ago!), as a competitive advantage because it permitted companies such as AOL to offer a more attractive and easy-to-use product. Further, integration into transmission and content permitted AOL to reduce the risks that it faced with respect to the availability and reliability of critical inputs.[7] Exclusivity, as with AOL's original proprietary network, permitted AOL to control its level of service quality without relying on the shared resources of the Internet. In the recent past, AOL at least has placed somewhat less emphasis on vertical integration. For example, it sold its proprietary backbone network to WorldCom, although it still leases proprietary (private, exclusive) facilities rather than relying on Internet transmission. This reinforces the point that vertical integration or "bundling" and associated exclusivity may be a critical feature of startup or early stage market development, when risk and uncertainty is at its peak, and when complementary sources of supply are least likely to be available. Of course, cable modem service is now at this stage of development.

Cable television operators are just beginning, after some false starts, to upgrade their cable plant to be able to offer such digital services as cable modems. At least until recently there has been too much uncertainty over stan-

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[7] AOL's integrated transmission is not the same as the "local transmission" defined above. AOL does not own the last-mile links to residences. It does control the links from local modem banks to and among its servers.

dards and demand for this work even to begin. This is hardly the picture of an "essential facility" as that term is used in antitrust analysis (see pp. 14-15, *infra*.) Indeed one might reasonably infer from the delays in implementing digital cable that it has been, and may still be, a submarginal investment opportunity whose viability depends critically on maintaining at least the current minimum critical constellation of risk and return factors. The work is very expensive and very capital intensive, involving expenditures of as much as $1,000 per home passed, generally for sophisticated hybrid fiber/cable (HFC) networks. Obviously, the cost per actual cable modem subscriber will be astronomical if not many subscribers materialize. No one knows how many subscribers will materialize because no one in the past has offered a high speed access service to residential customers. ISDN, the earliest high speed residential service, has not been wildly successful.

In short, cable operators find themselves in the position of having to decide whether to invest billions in a new transmission technology for which there is no proven demand and no ready complementary access and content services. (While some ISPs offer dedicated access at T1 or even T3 speeds to corporate users, no ISP is prepared to offer service to hundreds of thousands of residential users at such speeds.)

Faced with the task of marketing this transmission service effectively (in order to reduce the risk or to increase the return of the huge investment), cable operators have various strategic options. One option is to offer cable modem service the way the telcos offered ISDN service—providing only transmission and leaving it up to the market to supply the various vertical or complementary access and content services. (The telcos, for example, have largely relied on ISPs such as AOL to come up with access facilities, interfaces, and content that take advantage of ISDN's unique attributes and to market these to consumers. The ISPs seem to have dropped that ball.)

Another strategic option is for the cable operator to enhance the demand for its expensive local transmission facilities by putting together a package of Internet access and content services not currently available in the market, complementary to high speed local transmission, and to market the package to consumers as a practical easy-to-use and exclusive bundle. Consumers benefit by not having to invest in the search and information costs associated with putting together their own package, a daunting task at the outset of any new technology, when standards and services are not yet well-defined or well-known. It is this second option-for the cable operator to offer an *exclusive* bundle of services that will be attractive to consumers and whose reputation will be under the control of the cable operator-that forced unbundling seeks to foreclose, a foreclosure that its economist says will not reduce the cable operator's incentive to invest in transmission infrastructure.

The @Home Network service and Road Runner are probably the most developed of the various new cable access services. @Home, which is owned by a group of large cable MSOs, operates by offering consumers a bundled cable modem, a user interface, cable digital transmission service, equipment at the cable headend to cache popular Web content, a proprietary national high speed backbone network, and ports to the other backbones (i.e., to the Internet). Road Runner apparently has similar attributes. (Descriptions of both services, excerpted from their web sites, appear in the Appendix.)

Road Runner and @Home offer features not presently available (at least at prices accessible to consumers) from any conventional ISP. These features include content and interfaces designed specifically to take advantage of high speed local transmission, physical access facilities (including national backbone networks and local caches) aimed at dealing with the issues posed by simultaneous high speed local transmission, and a marketing program aimed specifically at cable subscribers. In addition, they provide billing and

customer support service, not only for the Internet access service, but for the entire package. This integrated approach leads to a solution for the customer, who knows where to call and who to blame in the case of problems with the service. Customers are saved the risks and search and information costs of assembling their packages of services.

Internet service quality is not solely a function of "last mile" bandwidth, but depends also on servers, routers, backbone networks, and content. Absent an integrated approach, one that specifically creates and markets Internet access and content services that complement the special characteristics and capabilities of an HFC cable plant and cable modems, the interstate highway bandwidth of a cable modem could well terminate at the country lane of a typical Internet access provider, leaving cable modem subscribers to wonder what they were paying for, and shortly thereafter, to stop paying.

Economic Principles and Issues Underlying Investment Incentives

Rules that increase risk or reduce returns reduce the incentive to invest

Even a freshman economics student knows that investors' willingness to commit money to any given project depends on the expected return and risk of that project compared with other uses of the investment funds. Anything that reduces expected return or that increases risk will reduce the amount of capital that investors will be willing to commit. Thus, one sure way to frustrate Congress' purpose in enacting section 706 is to use regulation to reduce

the expected return or to increase the expected riskiness of investments in new communication technologies.[8]

The concept of exclusivity is key to the effects of the patent system, or indeed any system of property rights, on the incentive to innovate and to invest. Exclusivity prevents others from free riding on the efforts of the investor, and permits the investor to retain a greater portion of the social benefits of his or her investment. Exclusivity is not the same as monopoly; a patent for example is almost never an economic monopoly. Generally, a patent holder can and from a social welfare point of view *should* undertake whatever business strategies maximize return on investment. Examples of such strategies may include vertical integration, tying, exclusive dealing, and bundling. It is only in the unusual case where market power is present that any of these activities raises competition policy issues, and even then must be judged under a "rule of reason." Otherwise, these practices are regarded as pro-competitive.

AOL and its economist, Professor Hausman, have proposed that high speed last mile transmission service offered by cable operators be unbundled from cable modem Internet access and content services, such as those offered by @Home and Road Runner, and made available to users or competitors as a separate component, presumably at a lower price than the operator's bundle of transmission and access services. Professor Hausman puts forth the standard "Chicago School" argument that cable systems can extract monopoly profits from their market power over the transmission elements of the service, and therefore would derive no additional benefit or investment incentive from controlling the content or access elements or other related services.

[8] The U.S. Constitution invokes the same general principle in Article I, Section 8, giving Congress the power to promote innovation by granting *exclusive* rights to intellectual property and thereby enhancing the expected return on investment in innovative activity.

Assuming for the moment that cable operators do have monopoly power in whatever relevant market includes broadband local transmission, Hausman's assertion lacks merit. At the most general and theoretical level, it simply is not true that the rents from a vertically integrated monopoly can always be fully captured at the monopoly stage.[9] The Chicago school argument holds under certain restrictive conditions not applicable here. Uncertainty, technological change, variable proportions, and the possibility of input substitution all violate the assumptions underlying the claim that the unbundling rule would have no effect on the investment incentives of a hypothetical monopolist. Professor Michael Katz provides a summary of reasons why a firm facing these conditions would want to enter into a tying (bundling) arrangement to increase the returns from its investments.[10]

As we do not share Hausman's assumption that last mile cable modem transmission service is an economic monopoly, it is even more useful to look at the bundling question in a competitive context. Competition from other suppliers, integrated or not, may make bundled offerings even more socially useful than in a monopoly context. Bundling in the competitive environment is generally in both consumers' and firms' interests.[11] For example, auto makers routinely bundle all of the parts necessary to make a car run—engine, tires, steering wheel, etc., even though it is possible to purchase many of these components individually. With the bundle, customers have a

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[9] Leaving vertical integration or bundling aside, the mere assumption that cable operators have market power in local broadband transmission has no clear cut implication for investment incentives. Monopolists are more profitable than competitors, and this increases the return on investment, implying more investment. But monopolists' profits come from restricting output, and that implies less investment.

[10] M. Katz, "Vertical Contractual Relations," in R. Schmalensee and R. Willig (eds), The Handbook of Industrial Organization, North-Holland: Amsterdam, 1989. *See also*, J. Tirole, The Theory of Industrial Organization, Chapter 4, MIT Press: Cambridge, 1989.

[11] C. Shapiro, "Aftermarkets and Consumer Welfare: Making Sense of *Kodak*," Antitrust Law Journal, vol. 63, pp. 483-511.

of these components individually. With the bundle, customers have a quality automobile, are not required to assemble the package themselves, and car sales increase. In the same way, cable operators bundle @Home with the high speed local transmission to ensure that their customers get a high quality service, but only provide a miniscule percentage of the Internet content available to their subscribers. Cable operators offering services such as @Home and Road Runner also leave their subscribers free to access other Internet services, including AOL. By analogy, automobile owners are free to purchase aftermarket add-on products or to replace components of the OEM product if they wish. It is not uncommon to encounter automobiles that have been heavily customized in this way. We do not, however, force General Motors to sell naked chassis to accommodate customizers.

The arguments above show that (a) even if local cable transmission service is a monopoly, cable operators cannot in general extract the maximum return on their investments without bundling other services and (b) if local cable transmission service is *competitive*, bundling may be an essential competitive strategic option. A trespass on the cable operator's property right in its transmission investment would undermine investment incentives in either case.

However, the problems with the proposal to require unbundling are even greater. It is not necessary to assume that the sale of exclusive bundles of Internet access and content services along with cable modems and local transmission is essential to the survival of cable operators in the Internet business to conclude that foreclosing this strategy as an option will deter investors. Even in the case where high speed cable transmission is an *ex post* success without such bundling or exclusivity, forced unbundling will reduce *ex ante* expected return and increase *ex ante* risk. By eliminating one of several available business strategies in advance of developments showing which

is superior, it necessarily follows that the *ex ante* expected value of such an investment project falls and risk rises. Cutting off an option seldom makes one better off. Here, of course, we know that many cable operators are actually choosing the exclusive bundle option (i.e., @Home or Road Runner), suggesting that it is far from an irrelevant alternative.

If there are three fire exits in your home, for example, it does not follow that blocking one of them has no effect of the probability that you will escape a fire. In general, cutting off one of three options lowers by one-third your chance of survival. It is even worse when the fire exit blocked is the one most likely to be chosen. Professor Hausman's position, essentially, is that blocking every fire escape except the one in the basement is okay. Few fire marshals would agree. As with fire exits, so with potential business strategies. At the time of an initial investment, the only information available to the investor may consist of descriptions of various risks and possible strategies to cope with risks. Having the government eliminate a strategy by fiat necessarily decreases the attractiveness of the investment, and on the margin the investment is less likely to be made. Here, the chief business strategy designed to deal with the risk that extremely expensive investments in local HFC networks will go unused is the offering of an exclusive bundle of services designed to be more attractive to consumers than analog modems, ISDN, xDSL, DirecPC, Teledesic and so on. Forced unbundling works to block this strategy.

Exclusivity enhances investment incentives

We have explained at some length why a cable operator seeking to attract consumers to use local transmission capacity might want to bundle vertical services as part of the marketing strategy. And we have explained why an investor would care about the availability of this and other strategic options. But what does exclusivity mean in this context, and why does it matter?

Exclusivity in the present circumstances means that the cable operator owns the right to decide the minimum set of services that will be offered to its local transmission customers by means of the local transmission facilities in which it has invested millions of dollars. Exclusivity matters because, in its absence, there are likely to be opportunities for others to free ride on the investments and marketing efforts of the cable operator and detrimentally affect the reputation of the service. The negative factors reduce the expected return the cable investor can earn on its investment, making the investment less likely to take place.

Opportunities for free riding are likely to be especially important in the early days of a service when penetration is low, and there are fixed costs of various kinds. For example, virtually all of the costs of building user interfaces and of developing content are invariant with respect to the number of users--they are public goods. Hence, for low penetration rates, costs per user are high. Customers lost for whatever reason drive unit costs higher still. Similarly, initial development and investment costs in the national network are likely to have a substantial fixed cost component, which will loom large relative to low penetration rates in the early stages of development of local cable transmission service.

Exclusivity also encourages investment in marketing cable modems. Without the exclusivity, each access or content provider would invest in marketing its own internet access brand and have little incentive to market the cable system's local transmission technology. An ISP cares very much about customers choosing its access service and has much less interest in whether the customers choose standard dial-up, ISDN, xDSL, DirecPC or other transmission technologies. This indifference to transmission would leave the marketing of cable transmission to the cable systems themselves, who, without exclusivity, would be unable to guarantee a quality end-to-end product.

As a result, investment in promotion of the technology may decline significantly. Once again, the ability to capture fully the spill-over effects through exclusivity will increase the expected returns from the investment and ultimately make the investment more likely.

Further, without exclusivity, other vendors can adversely affect the reputation of a new service. Cable modems and high speed local transmission compete with other current and future local transmission products. Cable operators have determined that high quality is an important feature of their competitive package and have invested heavily in the development of quality end-to-end service specifically designed for their transmission architecture. If instead various ISPs simply connect their services, designed for the vast majority of dial-up users with low speed modems, the quality of the experience may give cable modems a bad reputation since users will not know if cable service or their ISP is to blame for the poor quality.

Forced unbundling is applicable only to bottlenecks and will reduce investment incentives

The proposed unbundling of transmission and access services, viewed as a remedy in the competition policy context, is equivalent to depriving cable operators of one dimension of their property rights in their business, as noted above. The incentive effects of this are equivalent (in reverse) to those of the exclusivity that the framers of the Constitution thought would promote investment in the "useful arts." In a nutshell, more complete property rights promote efficiency, increase output and enhance incentives to invest. It is precisely for this reason that the antitrust remedy of requiring access to monopoly "essential" facilities is confined in its application to the most extreme and intractable circumstances, such as the local exchange facilities of

telephone companies.[12] Application of the remedy clearly reduces the incentive to invest in the facilities deemed essential, whether or not they are essential, and whether or not their current owner has market power, and *before* their owner has market power, if an evolutionary process is underway. Only when forced access would produce some benefit to consumers at least as great and as certain as the loss from the destruction of supply-side incentives can the remedy be justified.

The brief period that has passed since the first experimental introduction of cable modems is one reason why forcing unbundling is not appropriate. Similarly, a rule that penalized @Home or Road Runner for being successful in the future could cause significant perverse incentives that might lead them to compete less vigorously than otherwise. As a result, if cable modems prove successful in their competition with other high and low speed local transmission technologies, the threat of an unbundling rule may lead cable companies to increase prices now and slow their investment plans so they do not trigger a rule change in the future. Clearly this would harm consumers.

Moreover, even if one assumes that the provision of local broadband Internet transmission service is a monopoly of the cable industry, it makes no sense to assert that barring cable operators from offering integrated vertical services would have no effect on their investment incentives. Professor Hausman himself has been a vigorous advocate in pointing out the potential

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[12] See D. W. Carlton and J. M. Perloff, Modern Industrial Organization, 2nd Edition, 1994, Chapter 20; D. Reiffen and A. N. Kleit, "Terminal Railroad Revisited: Foreclosure of Essential Facilities or Simple Horizontal Monopoly?" Journal of Law and Economics, 1990; J. E. Lopatka and A. N. Kleit, "The Mystery of Lorain Journal and the Quest for Foreclosure in Antitrust," Texas Law Review, 1995; and, R. A. Posner, Antitrust Law: An Economic Perspective, 1976, Chapter 8.

effects of FCC rules on incumbent LEC investment decisions.[13] Professor Hausman's simple argument on behalf of the LECs is no less applicable here–if a regulation lowers the return to an investment, the investment is less likely to be made.

Bundling reduces the risk of investing in cable modem infrastructure

How is it that a cable operator is to justify investing the millions of dollars required to upgrade its systems so as to offer broadband local transmission services with no assurance that the Internet access and content industries will offer the specific products and marketing services that might make such a venture profitable? As we have noted repeatedly, Internet-capable cable is a new and expensive service, very dependent on gaining a degree of penetration that may not turn out to be achievable. The plant upgrade is a heavy fixed cost, and unless a substantial number of subscribers are found, the cost per subscriber will exceed revenue per subscriber. The demands for the transmission service and for the access and content services are obviously interdependent, and as far as we know there is no agreed upon technical interface beyond the standard IP conventions. (Higher speed backbone arrangements, such as Internet 2 or Mbone, are still experimental.)

From the traditional ISPs' perspective, cable modem users, like ISDN users, are a tiny and possibly ephemeral part of the market. The ISPs have little incentive to create and aggressively market products and services designed to take advantage of the high speeds that cable transmission can offer. Indeed, when so-called 56k modems were introduced many ISPs were slow to introduce compatible modem banks, partly because of disputes concerning standards and no doubt partly because their Internet links and servers could not

[13] J. Hausman, "Valuation and the Effect of Regulation on New Services in Telecommunications," *Brookings Papers on Economic Activity: Microeconomics*, 1997.

support the extra volume of traffic. Even today, many ISPs do not offer ISDN connections, do so only at prohibitive prices, or offer access service quality that makes the extra ISDN bandwidth largely redundant.

Bundling may alleviate a "Tragedy of the Commons"

As discussed earlier, high speed cable transmission plant is designed very differently than telephony solutions. The cable modem solution involves significant sharing of bandwidth, just like an office local area network (LAN). The more bandwidth that is used by one user or group of users, the less is available to other subscribers. Unless usage is priced, this can lead to a "tragedy of the commons" where each user has an incentive to overuse the common resource. Further, some of the burden of that cost falls on suppliers of content, who find themselves unable to control the quality of service perceived by their customers.[14]

It is apparently difficult, and possibly inefficient, to monitor individual usage on the shared network. In addition, there are difficult peak load issues. As a result, each competing ISP would have an incentive to use more bandwidth and not invest in bandwidth-conserving technologies because the benefits of such investments would accrue in large part to other ISPs with customers on the system. A single ISP, especially one coordinated with the cable system, can better internalize the impacts of these decisions and will lead to more efficient investment in infrastructure.[15] As discussed above, Road Runner and the @Home service have been designed specifically to ad-

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[14] According to a page one story in the San Francisco Chronicle on December 1, 1998, @Home has recently experienced problems of exactly this sort, resulting in temporary measures to ration high bandwidth usage such as streaming video.

[15] For a technical description of the difficulty of coordinating externalities, see "Affidavit of Milo Medin," attached to "AT&T's and TCI's Joint Reply to Comments and Joint Opposition to Petitions to Deny or to Impose Conditions, CS Docket No. 98-178, November 13, 1998.

dress these problems through sophisticated network management systems, integrated end-to-end solutions and coordination with cable system operators.

Application of the economic principles shows that forced unbundling will lower risk-adjusted returns and thus discourage investment

The synergies and required coordination between high speed cable transmission and ISP service to alleviate the "tragedy of the commons" and provide competitive service to consumers is not merely hypothetical or one-sided. Other "high-speed" transmission technologies, such as ISDN, may require different access solutions to bring the best service to consumers and ultimately to make the technology successful in a competitive marketplace. For example, high speed cable transmission makes use of shared bandwidth whereas telephone company provision of digital subscriber line (xDSL) technology makes use of dedicated paths between the subscriber and the first point of switching. The shared bandwidth on cable systems means that there may be significant coordination needs between the transmission provider and the ISP to minimize degradation when peak demands are placed on the system.

In addition, the @Home service "caches" high traffic Internet sites at the cable head-end to reduce off-net traffic and to improve the speed of service to the cable modem subscribers. While caching might still be possible with multiple ISPs, the cost of caching for each ISP would be spread across fewer subscribers and therefore be less attractive for providers. (Caching means, in essence, investing in storage capacity. Since customer demands are stochastic, the cost of storage is not linear with number of customers for a given quality of service.) This in turn would reduce the quality and speed of cable Internet service in general and particularly with respect to the competitive alternatives, such as conventional analog, ISDN and xDSL. As a result, the

number of subscribers to even the high speed cable access would decrease. At this point, it is entirely plausible an ISP can only internalize this tradeoff through ownership links or equivalent complex contracts, possibly including some form of exclusivity. If so, only in this way can the efficient amount of investment in maintaining high quality be achieved.

As the material in the Appendix shows, there is significant coordination between the @Home and Road Runner services respectively and the operation of the local cable plant to ensure quality high speed access. The use of caching as well as the regional data centers and the end-to-end management of the systems are clearly designed to maximize the overall quality of the cable-modem experience. Without joint incentives to ensure quality, there might be significant finger-pointing about which party is to blame for problems with the service. In the early stages of a technology with competitive alternatives, reputation may be a critical feature of marketing. Therefore integrated service leading to high quality, customer service and ultimately customer satisfaction may be very procompetitive.

Joint marketing of transmission service and access and content services tailored to cable consumers makes a great deal of common sense, because it permits the cable operator to internalize some of the interdependencies and reduce the risks of both services. @Home, for example, takes advantage of these efficiencies in at least two ways. First, it has invested in a national brand name associated with cable modem service. @Home advertising is directly tied to cable modem experience in contrast to AOL and other non-integrated ISPs who advertise, market and sell the ISP service for a wide variety of local transmission services. In this way they offer service on the cable systems of their cable system owners, and also offer the @Home quality to other cable systems on a more turnkey basis.

In addition, @Home is pushing forward to understand the benefits of broadband access on advertising revenues. It has sponsored research on the effectiveness of broadband advertising.[16] If the research increases the demand by advertisers for broadband "eyeballs" it can lead to lower prices for consumers. An ISP that is not primarily a broadband provider would have less incentive to pursue activities intended to promote broadband demand.

Although cable plant in certain areas might be attractive to upgrade even with an unbundling rule, there are very likely other systems, in less densely populated areas, where telephony competition is likely to develop more slowly, that would be detrimentally impacted by such a rule. Artificially reducing the incentive to invest in such areas and to provide advanced services is antithetical to good telecommunications policy, good competition policy and the intent of the Telecommunications Act.

Nonexclusivity will compel rate regulation

Forced unbundling would impose additional regulatory costs. Specifically, it is likely to lead to rate regulation. The objective of those who favor unbundling can hardly be met if the cable operator remains free to set any prices it chooses for the components. In California, to take an analogous situation, not only were cellular carriers required to make airtime available to resellers, but the state required a wholesale margin. Professor Hausman himself has argued that the resale requirement for cellular in general has harmed compe-

[16] "@Home Network Unveils New Broadband Advertising Models and Top-Line Research Findings From Rich Media Study," October 26, 1998. http://www.home.com/corp/news/pr_981026_01.html.

tition and that the extension to rate regulation in California in particular was extremely detrimental to consumer welfare.[17]

In cable, a simple unbundling strategy without any regulatory oversight might be that cable operators would offer @Home or Road Runner service for free with the purchase of local high speed transmission. In essence, this would be the same as the situation today. Clearly, ISPs would not like this and would complain to relevant regulatory agencies.[18] This would require regulatory hearings and a determination of appropriate rates for the two different services. Such an effort would not be a one shot deal, but would much more likely require continuing oversight as costs changed and various parties petitioned for rate changes. In other words, as the Commission's history amply demonstrates, forced unbundling likely would not be an event, it would be a process, in which various parties would enjoy property rights in the status quo, and would seek to build further rights.[19] Because this downward spiral into regulation is a foreseeable process, and because it has foreseeable negative effects on the returns and risks of infrastructure investment,

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[17] Ex parte presentation of Prof. Jerry Hausman for AirTouch, PR Docket 94-105 (Mar. 9, 1995), "The Cost of Cellular Telephone Regulation," January 3, 1995. "My findings are that cellular regulation has a very high cost among two dimensions. First, cellular service prices are about 17% higher in states which regulate cellular. However, beyond the price effect, cellular penetration is lower in states that regulate cellular because state regulatory commissions limit the terms on which cellular companies can offer service and provide equipment. This limitation or prohibition on customer specific terms and pricing typically arises from prohibitions on 'price discrimination' by regulatory commissions. The negative effect on consumer welfare is quite large and has not been discussed in previous investigation of the effect of regulation..." pp. 2-3.

[18] See Ex parte presentation of Prof. Jerry Hausman for AirTouch, PR Docket 94-105 (Mar. 9, 1995), "The Cost of Cellular Telephone Regulation," January 3, 1995. Page 13 discusses the effects of protests by competitors to regulators about prices and reseller margins, which are analytically identical to the protection of ISP margins in this case.

[19] See R. G. Noll and B. M. Owen, The Political Economy of Deregulation: Interest Groups in the Regulatory Process, 1983, chapter 1; see also B. M. Owen and R. Braeutigam, The Regulation Game: Strategic Use of the Administrative Process, 1978.

it is not surprising to see investment bankers pointing out these down sides to the Commission.[20] The Commission's own experience with cable rate regulation and its effects on other dimensions of service, such as the number and quality of networks, illustrates the point that regulatory interventions can seldom be limited in scope or duration.[21]

The effect of forced unbundling and nonexclusivity would then be, not merely to reduce investment incentives by cutting off one, and perhaps the only effective, marketing strategy for cable operators, but to further reduce the incentive to invest by imposing the substantial risk of future regulation of rates and of services.

The risk of "opportunistic behavior" will reduce investment incentives

Because of the significant fixed and sunk cost of upgrading cable systems to provide high speed transmission, cable operators may be subject to significant ex post opportunism on the part of ISPs. Since there are competing technologies available, and many others on the horizon, ISPs will be able to change service providers unilaterally. Since under the unbundling proposal ISPs will be the primary contact for subscribers, and consumers may be less likely to switch ISPs than transmission providers, cable companies will be at risk of having a large amount of stranded investments.

If customers are more likely to retain their cable modem service under the @Home service than with an independent ISP, cable operators may be will-

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[20] See letters to Chairman Kennard from Dennis H Leibowitz, Senior Vice President, Donaldson Lufkin and Jenrette (October 7, 1998), William S. Boothby III, Managing Director, J.P. Morgan (October 9, 1998), Phyllis B. Riggins, Senior Managing Director, NationsBanc Montgomery Securities (October 7, 1998).

[21] See generally, R. Crandall and H. Furchtgott-Roth, Cable TV: Regulation or Competition, Brookings 1996.

ing to invest more in the network and offer lower prices for long term commitments. Even though individual subscribers might switch access and therefore transmission providers, the leverage from a single large decision maker such as AOL switching platforms changes the leverage considerably. Without a long term commitment to the platform and the incentive to invest in the complementary assets and marketing, the incentive to undertake the risky sunk investments diminishes.[22]

Bundled cable modem service is marketed and priced directly by the cable companies and they remain the point of contact for the customer. As a result, they are more likely to retain the customer on the cable transmission network than if the point of customer contact is through an independent ISP, especially an ISP that is not contractually committed to supporting the cable platform.

Conclusion

Those who favor unbundling would have the Commission impose an access obligation on cable operators who offer cable modem service, the effect of which would be to impair the ability of the cable operator to capture the economic gains from investing in the facilities needed to provide the service. The inevitable result will be a reduction in return or an increase in risk. Consequently, cable investors will have less incentive to invest and will invest less in the telecommunications infrastructure necessary to support broadband last mile links to the Internet. This will produce the opposite of what Congress had in mind in enacting Section 706.

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[22] J. Hausman, "Valuation and the Effect of Regulation on New Services in Telecommunications," *Brookings Papers on Economic Activity: Microeconomics*, 1997.

At the end of the day, what our analysis comes down to is the simple, and not very controversial proposition that even the threat, much the less the actuality, of government regulation will chill the appetites of investors and reduce the pace of telecommunications infrastructure construction. At the same time it will, of course, advance the economic interests of those who compete with the firms to be regulated.

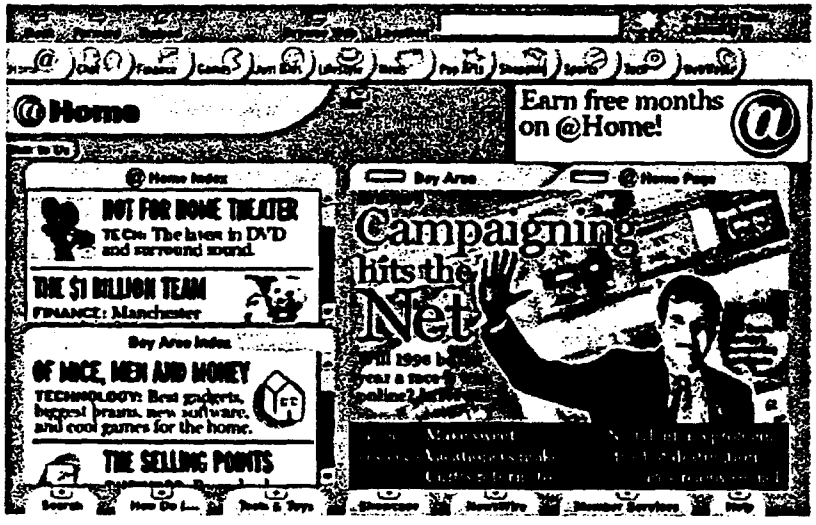
APPENDIX

EXCERPTS FROM @HOME AND ROAD RUNNER WEB SITES

@Home

What is @Home™? The Cable Internet RevolutionSM

Sign Up Now ... Feel the rush of a great Internet experience. One day, you order @Home. Suddenly, you're master of the Internet. Your eyes and ears are thoroughly entertained. Your mind is stimulated with new knowledge. You're producing some of your best work. You're in close contact with friends, family, colleagues, and Webheads from here to Lake Granatoo.



The @Home Service includes everything you need to enjoy the World Wide Web for one low monthly price.

It doesn't take long to realize something is different about @Home. Maybe it's the fact that it's up to 100 times faster than pokey telephone modem connections. Or that @Home's sophisticated network architecture delivers the best performance, the best reliability, and the best ease-of-use of any online service. Whatever it is, it feels good. Very good. With a connection that's up to 100 times faster, @Home opens the door to a much more gratifying Internet experience. Graphics, sound, video, mail, and lots more are screaming in and out of your home computer at blistering speeds. How is this possible? @Home uses cable modem technology to connect your PC to the Internet. At last, the Internet becomes your faithful servant, delivering vibrant multimedia and rich interactivity to your desktop. Sign Up Now and the World Wide Wait is a thing of the past. The Facts on Downloading 28.8 Dial-up

(28.8 Kbps) (1,500-3,000 Kbps) 1,500 KB file 6 min 56 sec 0 min 7 sec 10 MB file 46 min 16 sec 0 min 52 sec

The @Home Service includes everything you need to enjoy the World Wide Web for one low monthly price.

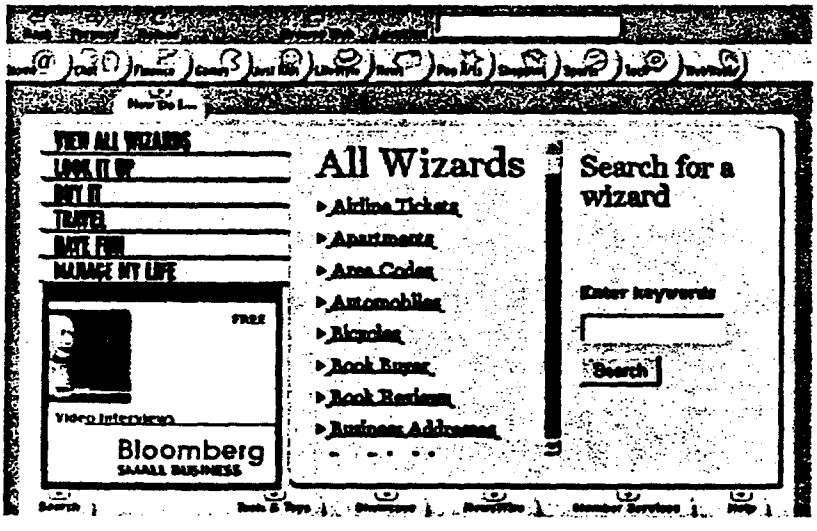
Unlimited Access - 24 hours a day, 7 days a week Reliable Service - No need to dial-up and no busy signals ever! Rich, interactive, multimedia content from the world's leading content providers Customized Browsers - the latest Netscape Communicator or Internet Explorer browser 3 private e-mail addresses 15 MB of Web space for personal home pages Remote email access from any Internet connection Access to news and chat groups

Reliable Service and Unlimited Access With @Home, busy signals are a thing of the past. When your computer is on, so is the Internet. Launching the @Home service is only a double-click away. The @Home icon resides on the desktop just like your word processor icon. Just double-click and launch the @Home Experience. No more dialing, no more slow modems and, most importantly, no more busy signals! @Home gives you Unlimited Internet use - 24 hours a day, 7 days a week all for one low monthly price. @Home's New Interface makes Navigation Easy Sign Up Now for @Home and you'll reap all the rewards of using our new, redesigned interface. It's even better than the interface that won us the #1 rating for Ease of Use and Navigation. Our clean, elegant browser is your window to a world of Internet riches that would take hours to access via another service. Plus, you'll experience exclusive @Home content created to take maximum advantage of our ultra-high-speed environment. Use @Home to learn, work, play, explore, email, and more with grace, agility, and speed.

@Home Channels make finding information quick and easy. Whether you're looking for the latest news, stock quotes, sports scores, or technology breakthrough, @Home delivers the most compelling, noteworthy sites in one neat package.

Visit @Home's "How Do I . . ." section and learn how to use the Internet to accomplish daily tasks quickly and easily. Take advantage of @Home's round-the-clock connection to purchase airline tickets, search an encyclopedia, buy a CD, find an apartment, and more.

Put the Internet to work for you today! Sign Up Now.



Only on @Home Finally, honest-to-goodness multimedia on the Internet

Groove, swing, rock and twist with TuneIn, @Home's near-CD-quality audio service - one of the many things you won't find on any other Internet service. TuneIn also delivers headline news, pumped-up sportstalk, and Webcast concerts. Surf our new Channels for a rich and interactive multimedia experience. They'll point you to vast online areas featuring news, sports, entertainment, games, finance, kids, lifestyle, shopping, and technology. Battle opponents from around the globe at the most popular computer games. With 100 times the speed, you can expect 100 times the intensity on the world's lowest latency gaming network.

Customer Comments "p.s. When my old Internet service provider asked me why I was canceling my account I told him I had two words for him ... CABLE MODEM ... he laughed ..." Dave Weltman

Local Content: Think Globally, Surf Locally By partnering with the best local content providers, @Home brings you local news, events, and information in an exciting multimedia

rich format. You will always be up to date on what's going on in your hometown with @Home. Installation Package Other services may shoot you a disk in the mail, or direct you to a Web site to download some software. Now take note of everything @Home does to transport you into the future of the Internet.

Highly-skilled technicians arrive at your home. They split your cable wire and bring it to your personal computer. They configure your computer to use @Home. They install your networking interface card. They install your cable modem. They set up your customized Netscape or Internet Explorer browser. They make sure your @Home connection is ready for action. And they answer every one of your questions in detail.

Then they leave you alone to plunge into the most exhilarating Internet experience the planet has to offer. If problems arise, we'll provide quick solutions at our top-rated online service area. And of course we're always available to take your phone call, too.

If you think you're paying $19.95 a month for Internet access...

Most Internet providers charge $19.95-$29.95 per month, but the real cost is much more. By the time you add up all the hidden costs of a second telephone line, service, and toll charges, etc., the price becomes a lot more than $19.95 a month.

For a comparable price, @Home provides unlimited Internet access at speeds up to 100 times faster than a conventional dial-up modem. The @Home service is also easy to use and rated Number 1 by Internet users. We are so certain that you will love @Home's speed, reliability, content, and ease of use that we offer a 30 day Money Back Guarantee - No Questions Asked. Sign up Now for the best value on the Web.

"@Home is the best thing to happen to my computer since electricity. All of the Internet hype is finally realized..." George Papaioannou

Value Comparison When your local cable company teams up with @Home to bring you the cable Internet revolution(sm), you receive an excellent value. With slow dial-up service, you're saddled with monthly fees and service charges, not to mention the cost of an additional phone line. For about the same price, you can experience breathtaking cable Internet speeds without a single busy signal. This is why @Home is the best buy on the Internet. Imagine never having to dial-up again. Sign Up Now for the best value on the Web.

MONTHLY COSTS

	@Home	Dial-up	ISDN
Dial-up ISDN ISP/ Monthly Fee	$29.95 - $49.95	$19.95 - $24.95	$19.95 - $24.95
Monthly Phone/ ISDN Line Charges	$0 (not needed)	$15.00	$20.00 $49.95 (ISDN Line)
Monthly Toll Charges	$0 (not needed)	Plan Dependent	Plan Dependent
Total Monthly Charges	$29.95 - $49.95	$34.95 - $44.95	$69.90 - $74.90

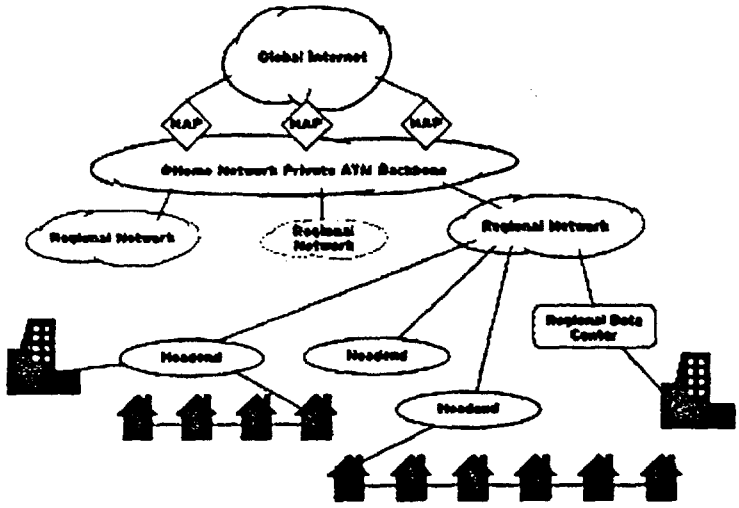
Typical monthly subscription prices are $29.95 - $49.95. Specific pricing details may vary by local market.

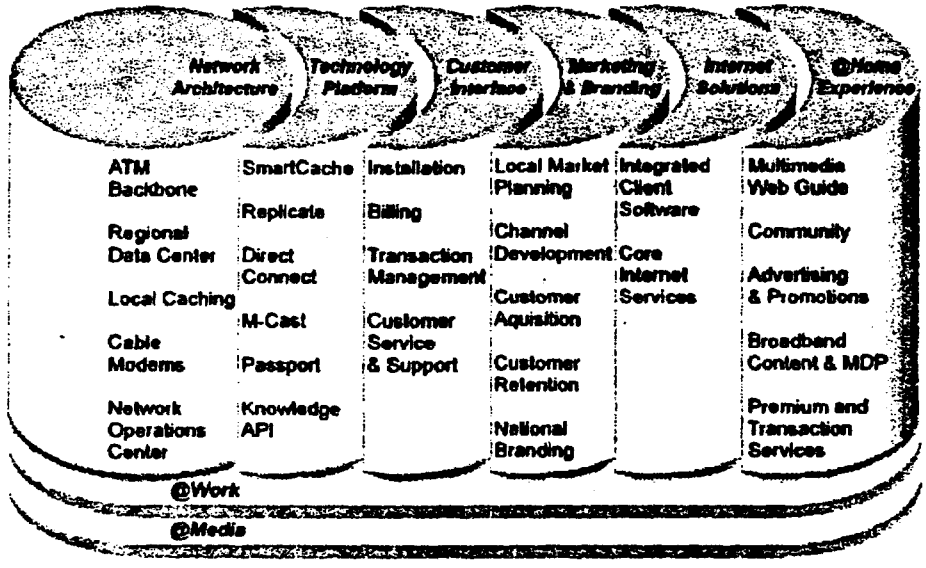
Note: Installation charges for dial-up services, ISDN services, and second telephone lines vary by provider, and typically range between $75 and $250. @Home charges a one time installation fee of $99 - $175. Some markets offering @Home service may have cable modem purchase options or requirements.

The installation fee covers: cost and installation of a networking interface card (NIC card) in your home computer, splitting and running the cable wire to your home computer anywhere in your home, installation and configuration of @Home's customized Netscape or Internet Explorer browser, and a personalized overview of the service.

If you are not fully satisfied with the @ Home service, we will refund your money in full at any time within the first 30 days.

Network Architecture To overcome the performance limitations of the Internet, @Home Network™ has developed a high-performance "parallel Internet." While it uses the same underlying protocols to ensure compatibility and seamless access to everything on the Internet, @Home™'s network architecture is markedly different.





Two key themes in @Home's network strategy are "pushing data closer" and "end-to-end management." To embody the first theme, @Home Network uses a hierarchical, distributed network architecture with proprietary caching and replication technologies to ensure that the information a user wants is always "as close as possible" within the network. "End-to-end management" describes @Home's proactive network quality, service, and performance management systems. Because the network is centrally managed, @Home can avoid the "finger pointing" that plagues the general Internet, and dynamically identify and address network quality, service, and performance issues before they ever affect users.

The primary components of @Home's network infrastructure include the ATM backbone, Regional Data Centers (RDCs), Local Caching Servers, Cable Modems, and the Network Operations Center.

ATM Backbone @Home Network operates its own national infrastructure, which connects to the global Internet at multiple Network Access Points (NAPs). The network also has Tier 1 peering with other national and regional Internet Service Providers. A high-speed Asynchronous Transfer Mode (ATM), fiber optic backbone connects these access and peering interchange points to @Home Network's RDCs. @Home Network's ATM backbone provides a high performance, cost-effective, scalable transport mechanism, as well as the capability to extend service to new markets without having to constantly reconfigure the network as it expands. The backbone operates at OC3 (155Mbps) speeds and can be upgraded to higher speeds.

Regional Data Centers (RDCs) @Home Network's RDCs act as service hubs for defined geographic areas, such as major metropolitan areas. Key activities at the RDCs include:

Delivering @Home Network's online multimedia content and services (including World Wide Web, email, newsgroups and chat) to subscribers Monitoring and proactively managing network performance Multicasting multimedia content and other data streams efficiently throughout the region Replicating and caching media partners' content and applications Providing infrastructure to economically house cable operators' local content and subscribers' web pages

Local Caching Servers At the next level of the distributed network, local neighborhood points of presence, called headends, are connected to each RDC. Consistent with the goal of pushing data as close to the customer as possible, these headends deploy enhanced proxy servers for caching content. Benefits of using local caching servers to keep data close to the user include:

Major performance improvements since the cache acts as a "dedicated" local server, even for data that originated in the broader Internet Reduction in the amount of data movement in higher layers of the network Far more comprehensive usage statistics than normally attainable on the Internet; these statistics can be used for tuning performance, tailoring the service, and targeting promotions and advertising.

Cable Modems In the home, a cable modem connects to the cable television coaxial wiring and also attaches to the user's Windows or Macintosh computer via a standard Ethernet

connection. In the near future, "Internet appliances" and similar devices may provide access. Cable modems are sold by several vendors, including Motorola, Hewlett-Packard, Bay Networks, and a number of smaller manufacturers. The speed of the modem depends on the specific model, but generally varies between 10 Mbps and 30 Mbps downstream to the home, and between 768 Kbps and 10 Mbps upstream from the home.

Network Operations Center (NOC) @Home Network provides end-to-end network management through the NOC. Acting as "mission control," the NOC uses proprietary network management tools and systems to monitor the network 24-hours-a-day, seven-days-a-week; identify and resolve potential issues before they affect the network; and manage performance along the entire path from the content provider to the home computer. From the centralized NOC, @Home can manage multiple RDC locations, local caching servers, and other network infrastructure. @Home's carefully designed, consistent system configuration and management also enable the NOC to provide a high level of overall system security and reliability.

Multiple Delivery Systems While two-way HFC continues to provide the best medium for broadband service, @Home Network provides multiple solutions to reach customers not serviced by two-way delivery systems. Telco-return systems deliver data via high-speed cable lines while upstream data travel over conventional phone lines. As the vast majority of traffic is downstream, the performance for telco-return users is more than 100 times faster than conventional dial-up services, while the information they send, such as key strokes and mouse clicks, travel at analog speeds. In addition, telco-return provides a smooth migration path to a two-way delivery system for cable operators.

@Home's MDU solution enables cable operators to extend the @Home service to large residential complexes without the added expense of providing cable modems for each apartment or unit. Similar in design to a business LAN, information from the @Home Network flows through a regional data center (RDC) to a housing complex via a two-way digital line, at T1 speeds or higher depending upon traffic loads. Information is then disseminated through a central high-speed router stored at the complex. From the router, information is carried to secure Ethernet 10Base-T hubs in each building. The hubs are connected to single apartments or units by Ethernet wiring and within each apartment or unit. Data ports are installed in convenient locations, such as the den, living room, or bedroom, for easy personal computer hook-ups.

Road Runner

Road Runner is a high-speed online service delivered to the PC over the cable television infrastructure. By utilizing the latest advances in web technology and leveraging the blazing speed made possible by cable's hybrid fiber-coaxial network, Road Runner integrates compelling multimedia programming with the latest communication tools and personalized services such as mail, chat listings and personal home pages - all within a broadband environment. Developed to appeal to a wide audience, it combines simple navigation features, top-of-brand programming and easy to use Help and Member Services. The flexible design enables the seamless integration of an impressive breadth of national and local programming, news and entertainment. Road Runner offers customers a unique online experience that enables them to enjoy the full potential of the broadband environment.

"...five partners, recognized as world leaders in media, broadband communications, computer software and hardware, and publishing."

Road Runner is provided by ServiceCo LLC, a joint venture among affiliates of Time Warner Inc., MediaOne Group, Inc., Microsoft Corp., Compaq Corp., and Advance/Newhouse. This strategic partnership, formed in June of 1998, combines the resources and world class talent of five entrepreneurial companies united in their commitment to make the delivery of broadband online services over cable the preferred worldwide distribution system. These five partners are recognized as world leaders in media, broadband communications, computer software and hardware, and publishing.

ServiceCo provisions the Road Runner service to its affiliates as a comprehensive package that includes both the broadband programming and the technical infrastructure over which it is deployed, or as a broadband programming package only. Affiliate systems include Time Warner Cable systems, MediaOne cable systems and a growing number of third party cable operations. Time Warner Cable and MediaOne project that, by the year 2000, all of their cable plant will be upgraded and capable of delivering Road Runner to their 27 million homes passed.

ServiceCo is privately held and is headquartered in Reston, Virginia with regional offices in New York City and Denver.

"Increases delivery of data to the PC at speeds up to 100 times greater than that of a residential telephone line!"

The Road Runner IP infrastructure is an end-to-end client-server-enabling network. It transports rich multimedia applications to the personal computer based on TCP/IP and related technologies. The foundation of this infrastructure lies in the existing cable television network, which has been upgraded with fiber optics. It combines the enhanced reliability and capacity of fiber optics with the existing broadband coaxial network, resulting in an increase in delivery of data to the PC at speeds up to 100 times greater than that of a residential telephone line. A server complex interconnects several cable headends over a regional network.

The networking model assigns significant operating and technical responsibilities to the ServiceCo technical staff. The company owns, operates and maintains the regional network and all of the IP infrastructure beyond the distribution hub, while the cable operator maintains and operates the HFC plant and the cable modem. This structure creates a hierarchy that separates functions and keeps protocols isolated, providing a manageable architecture that will facilitate the integration of ever-evolving new technologies into Road Runner affiliates.

ServiceCo also provisions 2nd and 3rd level customer care. Subscribers can directly access a National Help Desk online or through an 800 number. A Network Operations Center (NOC) is staffed 24 hours a day, seven days a week.

In September 1996, the first commercial broadband online service was delivered to customers through a broadband fiber-coaxial cable network linked to the end user's personal computer by a high-speed cable modem. Among the first cable operators to cross into this new business frontier, Time Warner and MediaOne (at the time called Continental Cablevision) led the way by aggressively launching their respective services to cable operations across the nation.

Just 15 months after these initial launches, Time Warner Inc. and MediaOne announced their intention to merge their services to create the nation's largest broadband online business. When the new joint venture was finalized on June 15th 1998, both Microsoft Corp. and Compaq Corp. had joined the partnership as strategic partners and investors. Advance/Newhouse, through its ownership in Time Warner Entertainment, also became an active partner.